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Mortality estimates for WHO SEAR countries: problems and prospects

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ABSTRACT

Cause-specific mortality estimates for 11 countries located in the WHO's South East Asia Region (WHO SEAR) are generated periodically by the Global Burden of Disease (GBD) and the WHO Global Health Estimates (GHE) analyses. A comparison of GBD and GHE estimates for 2019 for 11 specific causes of epidemiological importance to South East Asia was undertaken. An index of relative difference (RD) between the estimated numbers of deaths by sex for each cause from the two sources for each country was calculated, and categorised as marginal (RD=±0%–9%), moderate (RD=±10%–19%), high (RD=±20%–39%) and extreme (RD>±40%). The comparison identified that the RD was >10% in two-thirds of all instances. The RD was 'high' or 'extreme' for deaths from tuberculosis, diarrhoea, road injuries and suicide for most SEAR countries, and for deaths from most of the 11 causes in Bangladesh, DPR Korea, Myanmar, Nepal and Sri Lanka. For all WHO SEAR countries, mortality estimates from both sources are based on statistical models developed from an international historical cause-specific mortality data series that included very limited empirical data from the region. Also, there is no scientific rationale available to justify the reliability of one set of estimates over the other. The characteristics of national mortality statistics systems for each WHO SEAR country were analysed, to understand the reasons for weaknesses in empirical data. The systems analysis identified specific limitations in structure, organisation and implementation that affect data completeness, validity of causes of death and vital statistics production, which vary across countries. Therefore, customised national strategies are required to strengthen mortality statistics systems to meet immediate and long-term data needs for health policy and research, and reduce dependence on current unreliable modelled estimates.

Summary box

- In the absence of empirical data, mortality indicators for WHO South East Asia Region (SEAR) countries are estimated by international agencies and research groups using statistical models.
- Comparison of mortality measures from different estimation exercises demonstrate large variations at country level for specific causes of death.
- As a result, such modelled estimates are not reliable evidence for population health assessment, health policy or research.
- An evaluation of national mortality statistics systems in WHO SEAR countries identified specific challenges related to structure and organisation, operations and technical capacity that influence data availability and quality.
- The analysis offers recommendations for a strategic approach to design and implement mortality statistics system strengthening programmes that will generate routine and reliable empirical data in SEAR countries.

INTRODUCTION

Timely and reliable mortality statistics by age, sex and cause are primary empirical evidence for population health development strategies; and are required to inform progress against many indicators of the United Nations Sustainable Development Goals (UNSDGs) for 2030.[1] National Civil Registration and Vital Statistics (CRVS) systems are the optimal source for mortality statistics to monitor progress towards the UNSDGs.[2] However, inadequacies in national CRVS systems have limited the availability of reliable information on deaths by age, sex and cause for over two-thirds of all countries.[3] In particular, there is a critical need for good quality mortality statistics for the 11 countries located in the WHO South East Asia Region (WHO SEAR) given that the region contains more than a quarter (26.1%) of the global population, and which is currently experiencing profound demographic and epidemiological transitions.[4]

The WHO SEAR countries comprise three with large populations (more than 150 million) which are India, Indonesia and Bangladesh; five with medium sized populations (20–70 million) which are Thailand, Myanmar, Nepal, DPR Korea and Sri Lanka and three with small populations (<1 million) namely Bhutan, Maldives and Timor Leste. In addition to these variations in population size, there is considerable diversity in terms of geographical spread, environment and climate patterns, economic profile, culture

and language across the region, which highlights the need for health actions that are based on local epidemiological evidence. However, in the absence of reliable nationally representative empirical data, current mortality estimates for these countries in the SEAR are derived from international demographic and epidemiological statistical models.[5] Given the limited local data inputs, there is considerable uncertainty in these modelled estimates.[6 7]

Over the past three decades, there have been several iterations of global, regional and national population health estimations as part of the Global Burden of Disease (GBD) study framework.[8] Currently, the Institute of Health Metrics and Evaluation (IHME), University of Washington is the lead institution for the annual GBD estimation series, and the estimates for 2019 were released in October 2020.[9 10] In parallel, the WHO also conducts an alternate analysis to derive Global Health Estimates (GHE), which essentially comprise the same set of mortality and morbidity statistics for each country, as the GBD estimates.[11] The WHO GHE estimates for 2019 were released in December 2020.[12] This article compares the two separate GBD and GHE cause-specific mortality estimates for 11 WHO SEAR countries in 2019, along with a discussion of the variations between these estimates, and their implications. This analysis also reviews the current status of the mortality statistics systems in these countries, and proposes a strategic approach to strengthen the availability of routine and reliable empirical data on mortality and causes of death on a timely basis.

REVIEW OF CURRENT MORTALITY ESTIMATES

A general description of the approaches employed by the WHO GHE and IHME GBD study teams for mortality estimation helps place the comparative analysis into context. As part of its annual appraisal of the global, regional and national landscape of population health status and trends, the WHO publishes an annual statistics report which includes detailed estimates of deaths by age, sex and cause of death for each country.[13] To develop these estimates, all Member States are required to submit annual reports of primary mortality statistics to the WHO, which are then used as the basis for the annual World Health Statistics Report. However, only 70 of the 194 countries in the world submit annual CRVS data on cause-specific mortality of adequate quality for WHO direct use in global mortality assessments.[14] The WHO GHE data analysis team applies several data corrections and adjustments based on international epidemiological models to derive mortality estimates by age, sex and cause for these 70 countries.[11] Several other countries submit data which are either incomplete or with poor cause attribution, owing to limitations in national mortality statistics systems. Hence, for these countries with partial data which is not of good quality, and all other countries without national data, the WHO GHE employs a modelling approach to derive mortality estimates, as discussed later.

The IHME GBD study also implements an annual activity to develop cause-specific mortality estimates for all countries. In brief, estimation for each country is based on a two-step process, the first being an estimation of the total national deaths by age and sex. This is achieved by modelling age-specific death rates (ASDRs) by sex for each WHO SEAR country, and then applying these ASDRs to respective national age-sex population estimates developed by the IHME GBD team, to derive the national age-sex estimates of deaths from all causes. In the second step, a modelled cause of death distribution is fitted to the estimated total numbers of deaths in each age-sex category, to derive the complete set of national mortality estimates by age, sex and cause. The GBD modelled national cause of death distributions are derived from a historical international database of mortality data from all countries, with specific criteria applied when considering each country-year of data for inclusion in the database. For each country, the GBD models use national data on a range of covariates associated with mortality as inputs, along with input values on cause of death distributions from the international mortality database. The choice of cause of death input values in the modelling process varies for each country, according to the quality of national data[i] included in the GBD historical mortality database. For countries with good quality national data, the GBD modelled cause of death distributions are only based on national covariates and the cause of death data from all countries assigned good quality data scores. For each of the remaining countries, the GBD modelled distributions are based on national covariates and the entire international mortality database. Further details on the GBD estimation methodology are available elsewhere.[5 15] As a result, the GBD generates estimates of deaths by age, sex and cause for all countries.

To complete its estimation for the remaining countries without good quality national data, (which includes the 11 SEAR countries) the WHO GHE methods use these GBD national estimates as a starting point. First, the GHE analysis takes the GBD modelled ASDRs by sex for each country and applies them to the United Nations Statistics Division (UNSD) age-sex population estimates developed under the World Population Prospects 2019 revision,[16] to derive the GHE estimate of total deaths by sex and age for each country. Then, the GHE process adjusts the GBD estimated cause of death distribution patterns using evidence from several international disease-specific epidemiological models developed by the WHO, to derive the national GHE estimated cause of death distributions. In the final step, these GHE cause of death distributions are

[i]The IHME mortality database assigns a score of 'well-certified' deaths, in a national dataset according to the completeness of recorded deaths and specificity of assigned causes of death. A score of ≥85%=good quality.

applied to the GHE estimates of total deaths, to derive the final GHE estimates of cause-specific mortality.

In summary, these processes result in two separate sets of mortality estimates by age, sex and cause for each country. The most recent estimates from GBD 2019 were released in October 2020; and the GHE estimates were subsequently released in December 2020,[10 12] and their respective publicly available databases were accessed to extract the required mortality estimates for comparison.[9 10 17]

COMPARISON OF ESTIMATES

For each WHO SEAR country, GBD and GHE estimates of total deaths in 2019 from 11 causes of death of epidemiological significance in South East Asia were extracted. These causes included a selection of common infectious diseases, neonatal conditions, major non-communicable diseases and selected forms of injury. For each cause, the variations between GBD and GHE estimates were analysed by computing the relative difference (RD) between the estimates from each source at national level, as follows:

$$\%\ \text{relative difference (RD)} = \frac{\text{GBD estimate} - \text{GHE estimate}}{\text{GHE estimate}} \times 100$$

Estimates for total deaths for each sex from each cause were used as the base numbers for calculating the RD. We propose four levels of RD as follows:

a. Marginal: RD=±0% to 9%.
b. Moderate: RD=±10% to19%
c. High: RD=±20% to 39%.
d. Extreme: RD>±40%.

A broad comparative assessment of the results for the 11 Member States of WHO SEAR is presented in table 1. Out of a total of 242 instances presented in table 1, about one-third had marginal RD (±10%), about half had moderate to high RD (11%–40%) and 17% had extreme RD (>±40%).

Specifically, the RD is above 20% in almost all countries for tuberculosis, diarrhoeal diseases, road injuries and suicide. For India and Indonesia, although the RD is of lesser degree for most causes, these translate into considerable differences in terms of number of deaths, due to their larger populations. On the other hand, the magnitude of RDs for most of the 11 causes of interest in Bangladesh, DPR Korea, Myanmar, Nepal and Sri Lanka are a cause for policy concern, in the absence of any explanation for one estimate being more accurate than the other. Variations in ranks for these causes from each source (online supplemental appendix 1) also limit the use of these mortality estimates for health sector priority setting. It must be borne in mind that even where both estimates are similar, there is potential for both being equally incorrect, due to the absence of any reliable empirical local data inputs for the verification of the modelling outcomes.[5] Under these circumstances, these differences between the estimates, without any rational basis to evaluate the veracity of one estimate as compared with the other, renders neither estimate to be reliable evidence for monitoring population health status and evaluation of health policy and interventions.

These findings underscore the urgent need for reliable local data for cause-specific mortality statistics in SEAR countries, or at least to serve as viable inputs into an estimation process that clearly tracks the adjustments to local data, in deriving final population level estimates. An analysis of gaps in current CRVS system design and/or implementation in SEAR countries is presented in the following sections. The findings and recommendations from this gap analysis serve as essential starting points for a strategic approach to system strengthening activities, with a goal to establish a robust CRVS system which registers all deaths and generates accurate cause-specific mortality statistics on a timely basis.

REVIEW OF NATIONAL MORTALITY STATISTICS SYSTEMS

Unavailability of reliable mortality statistics for SEAR countries has been a protracted challenge for several decades.[18–20] To address this situation, the WHO SEAR Office has conducted several developmental activities over the past 15 years, starting with a Regional Consultation on this subject in 2007.[21] Subsequently, a series of national level CRVS assessments were conducted during 2011–2013, the findings from which were used to inform development of a regional strategic plan to strengthen CRVS systems over the decade of 2015–2024.[22] The WHO SEARO strategic plan was aligned with the United Nations Economic and Social Commission for Asia Pacific (UNESCAP) Regional Action Framework under their CRVS Decade 2015–2024 initiative.[23] As part of the CRVS Decade programme, all countries undertook initiatives to strengthen CRVS systems, either with international technical and funding support or through national programmes focusing on birth and death registration. However, a mid-term review of the UNESCAP initiative in 2019–2020 found that only three countries (India, Sri Lanka and Thailand) had reported over 90% completeness of death registration, as estimated by their national statistical agencies. Moreover, the ascertainment of causes of death was a persistent problem for all WHO SEAR countries.[24] For India, it should be noted at subnational levels, that there were several states with relatively lower levels of reported completeness of death registration, indicating the need for a continued effort to record all deaths.[25]

In recognition of these persistent critical gaps in mortality data availability, the WHO SEAR Office commissioned a regional situational assessment of CRVS systems in 2019–2020, with a focus on mortality statistics.[26] For each country, national CRVS laws and regulations, field operating procedures, vital event registration forms, data management tools and processes, and statistical reports were reviewed according to a framework for CRVS

Table 1 Relative difference* between GHE and GBD estimates of total deaths for selected causes by sex in WHO SEAR countries, 2019

Cause of death	Sex	Bangladesh	Bhutan	DPR Korea	India	Indonesia	Maldives	Myanmar	Nepal	Sri Lanka	Thailand	Timor Leste
Tuberculosis	M	−9%	−19%	−81%	1%	−3%	29%	−22%	−54%	21%	−30%	−74%
	F	−38%	−25%	−82%	−10%	−30%	11%	−32%	−57%	−1%	9%	−74%
Diarrhoea	M	−7%	−34%	−24%	−12%	−7%	−22%	−4%	−14%	64%	−9%	−13%
	F	−9%	−24%	−22%	−1%	−6%	−31%	−12%	−4%	72%	−10%	−23%
Neonatal conditions	M	−6%	30%	−28%	3%	−10%	194%	−5%	−5%	6%	−37%	−9%
	F	−17%	37%	−26%	−1%	−24%	198%	−8%	−7%	7%	−37%	−22%
Ischaemic heart diseases	M	27%	−9%	13%	−2%	−4%	15%	17%	25%	−9%	3%	37%
	F	12%	0%	16%	3%	−7%	2%	16%	13%	−8%	−3%	12%
Stroke	M	29%	−11%	9%	−2%	−6%	12%	17%	23%	104%	4%	35%
	F	8%	0%	13%	2%	−8%	2%	14%	12%	119%	−2%	12%
COPD	M	30%	−16%	9%	0%	−8%	3%	19%	21%	−44%	−1%	36%
	F	9%	−5%	15%	5%	−9%	−1%	16%	12%	−51%	−4%	11%
Diabetes	M	27%	−11%	11%	−1%	−3%	15%	16%	23%	7%	5%	35%
	F	5%	1%	11%	3%	−4%	6%	11%	14%	6%	4%	15%
Road injury	M	−66%	−49%	36%	−1%	21%	160%	−48%	−40%	−23%	−12%	4%
	F	−64%	−46%	31%	2%	18%	113%	−48%	−44%	−13%	−15%	1%
Suicide	M	22%	16%	25%	9%	18%	42%	25%	40%	52%	13%	33%
	F	24%	19%	19%	18%	12%	2%	24%	25%	38%	27%	30%
Falls	M	24%	−12%	23%	2%	2%	30%	26%	22%	111%	9%	19%
	F	1%	−6%	18%	5%	−8%	4%	23%	10%	191%	0%	−4%
Drowning	M	13%	5%	21%	12%	14%	44%	40%	8%	28%	14%	−9%
	F	−6%	5%	19%	8%	4%	31%	32%	−21%	25%	15%	−32%
All causes	M	11%	−10%	4%	0%	−5%	15%	8%	14%	−8%	2%	6%
	F	3%	0%	7%	5%	−7%	10%	11%	5%	−5%	−2%	−2%

±0%–9%; ±10%–19%; ±20%–39%; ±>40%.

*Relative difference: positive value indicates higher estimate from GBD study, negative value indicates lower estimate from GBD study.

GBD, Global Burden of Disease; GHE, Global Health Estimates; SEAR, South East Asia Region.

evaluation developed by the United Nations Statistics Division (UNSD).[27] Broadly, the UNSD CRVS evaluation framework examines the legal basis and institutional procedures for CRVS, the operational characteristics of implementation, the availability of resources and the vital statistics practices. The review covered eight countries of the region, excluding DPR Korea, Thailand and Sri Lanka. For Sri Lanka and Thailand, similar information was obtained through direct contact with national researchers. This manuscript reports the salient aspects of the organisation, design and operations of national systems that are relevant to the compilation of mortality statistics.

DESIGN CHARACTERISTICS OF CRVS SYSTEMS

Table 2 describes the major features of current CRVS systems in the 11 countries under consideration. Eight countries have specific laws pertaining to CRVS. For Bhutan, the requirement for birth registration is stated under the Citizenship Act of 1977, while for death registration, a form with necessary instructions is documented in the Census Handbook of 1993. For Myanmar, there are nine separate laws that mention various provisions for registration of births and deaths, the most recent being the Ward and Village Tract Administration Law of 2012.[28] In Timor Leste, vital registration is conducted according to a regulation (3/2001) formulated by the United Nations Transitional Administration in East Timor. For India, the legal framework facilitates decentralised implementation with each state enacting its specific operational rules and regulations, while the central government issues periodic updates to the general principles for civil registration, along with revisions to processes for compilation and reporting of vital statistics. The most recent vital statistics updates included a general instruction in 2014 that mandated the coverage of all health facilities under the Medical Certification of Cause of Death (MCCD) scheme, and a circular in 2017 instructing all districts to compile, monitor and report vital statistics on births and deaths on a monthly basis.[29 30] Similarly, in 2019, the government of Indonesia has published a Regulation on the National Strategy for the Acceleration of Population Administration for the Development of Vital Statistics, which includes instructions and targets for CRVS development.[31] Several other countries (Bangladesh, Sri Lanka and Nepal) are also undertaking updates to their CRVS legal and administrative mechanisms, all of which indicate a renewed and positive focus towards strengthening CRVS systems in the region.

For implementation, all WHO SEAR countries have established extensive networks of registration centres in urban and rural areas. As the largest country in the region, India operates over 280 000 centres, with a high reporting coverage and completeness of birth and death registration.[25] In Indonesia, the government has instituted a process for decentralising the functions of registration from the existing offices in districts and cities to all the 7246 subdistricts in its 34 provinces. This will ensure direct accessibility of registration services, especially to the rural citizens residing in over 75 000 villages across the country.[31] Similarly, Nepal, given its challenging geographical terrain, has established registration centres in all its villages and urban wards through expanding online registration. Bangladesh and Bhutan have established infrastructure throughout the country for online birth and death registration services.[26] Sri Lanka, Maldives and Thailand have already achieved total national coverage and completeness of CRVS.

Despite these developments in administration and infrastructure for CRVS systems, there are several constraints from the perspectives of system design, operational procedures, and institutional/human capacity that hinder efficient implementation. For instance, only three countries have death reporting periods of less than a week. Such periods should be reduced for the other countries, since it is readily understood that longer durations can increase the likelihood for events to remain unregistered. From an operational perspective, nearly all SEAR countries legally mandate the WHO International Form for MCCD for events that occur in all health facilities within the country.[32] Although, routine implementation is practiced only in Maldives, Sri Lanka and Thailand. As mentioned previously, MCCD coverage is currently being expanded in India. In Bangladesh, Indonesia and Nepal, initiatives have been launched to officially introduce the MCCD form in some health facilities.[26] The SEA regional CRVS review noted that there was a widespread need to strengthen operational procedures for cause of death ascertainment for both institutional and domiciliary events in all countries. On a more positive note, it was observed that the reporting of stillbirths is legally or procedurally mandated in all SEAR countries except Thailand and Timor Leste. Even in Thailand, although stillbirths are not mandated under existing vital statistics practices, information on such events in health facilities is captured by the routine health information systems.

Finally, the SEA regional review evaluated the status of countries in regard to compliance with international mandates for reporting vital statistics, which are implemented under the United Nations Annual Demographic Yearbook System, and the WHO Mortality Database System.[11 33] It was found that during the period from 2015 to 2018, only Maldives and Thailand had reported mortality statistics to both systems, and none of the remaining SEAR countries were fully compliant with such international reporting mandates. In regard to data quality, the WHO Mortality Database System assigns scores to data from countries that take into account data completeness, timeliness and quality of registered causes of death, and assigned 'low quality' scores to both Maldives and Thailand.[11] Although Sri Lanka also reports data on causes of death to the WHO, such data has not been submitted since 2014.

Table 2 Design characteristics of CRVS systems in WHO SEAR Countries in 2019

Country	Population (million)	CRVS laws/ most recent update	Major subnational entities	Registration network	Death reporting practices			International data reporting compliance
					Time limit	Stillbirths	MCCD*	
Bangladesh	168.1	2004/2006	Division[8]	► Rural: 4571 ► Urban: 458	30 days	Yes	Yes	No
Bhutan	0.83	1977/1993	District[20]	► Rural: 205 ► Urban: 30	One year	No	No	No
DPR Korea	26	NA	Province/city/SAR (9/2/3)	NA	NA	NA	NA	No
India	1368	1969/2018	State/territory (28/8)	► Rural: 272 724 ► Urban: 7451	21 days	Yes	Yes	No
Indonesia	270	2006/2019	Province[34]	► Rural: 416 (districts) ► Urban: 98 (cities)	30 days	Yes	Yes	No
Maldives	0.45	1993	Atoll/city (17/4)	► Health facilities ► Atoll/city councils	1 day	Yes	Yes	Yes
Myanmar	54	1907/2012	State/region (7/7)	► Rural: 287 townships ► Urban: 321 towns	3 days	Yes	Yes	No
Nepal	30	1977	Province[7]	► Rural: 3157 villages ► Urban: 3082 wards	35 days	Yes	No	No
Sri Lanka	21	1951/2008	Province[9]	► Rural: 863 registrars ► Urban: 332 districts	30 days	Yes	Yes	No
Thailand	69	1908/2019	Province/SAR (76/1)	2634 local civil registration points	24 hours	No	Yes	Yes
Timor Leste	1.4	NA	Municipality[13]	13 municipalities	28 days	No	No	No

*International form for Medical Certification of Cause of Death (MCCD).
SAR, Special Autonomous Region.

Table 3 Current availability of mortality and cause of death statistics for WHO South East Asia Region countries, 2017–2019

Country	Data year	Data source	Reported CRVS deaths	National estimate of completeness (%)	Reported deaths with MCCD (%)	MCCD with ill-defined causes* (%)	CRVS committee established
Bangladesh	2018	UNESCAP questionnaire†	196 910	24	12.5	3	2017
Bhutan	2018	UNESCAP questionnaire	3914	74	Nil	Not applicable	No
DPR Korea	NA‡	NA	NA	NA	NA	NA	NA
India	2019	Vital Statistics Report 2019[25]	7 641 076	92	21	13	2012
Indonesia	2018	UNESCAP questionnaire	407 518 §	25	50	35	2019
Maldives	2019	Maldives Health Profile 2019 [37]	1054	100	100	28	2017
Myanmar	2017	Statistical Yearbook 2019[36]	231 210	59	19	NA	2014
Nepal	2017	UNESCAP questionnaire	Not specified¶	54	Nil	Not applicable	No
Sri Lanka	2019	Census and Statistics website[38]	146 053	98	NA	NA	2019
Thailand	2018	Public Health Statistics 2018[34]	475 793	96	45	24	2010/2021**
Timor Leste	2018	UNESCAP questionnaire	2187	23	Nil	Not applicable	2017

*Coded to the International Classification of Diseases and Related Health Problems 10th Revision (ICD-10) chapter for 'Symptoms, signs and ill-defined conditions'.
†Questionnaire canvassed by UNESCAP to all regional countries to report progress towards the CRVS Decade 2015–2024 targets and goals.[24]
‡NA=data not available.
§Indonesian data are from the health sector recording system.
¶The actual numbers of deaths are not mentioned, and only the per cent of data completeness is provided in the questionnaire.
**Thailand has reconstituted the National CRVS committee in 2021.
CVRS, Civil Registration and Vital Statistics; MCCD, Medical Certification of Cause of Death; UNESCAP, United Nations Economic and Social Commission for Asia Pacific.

VITAL STATISTICS DATA AVAILABLE FROM NATIONAL SOURCES

To gain a more realistic understanding of the status of mortality data availability, the SEA regional CRVS review also examined national data sources and reports on vital statistics. Table 3 shows that five SEAR countries—India, Maldives, Myanmar, Sri Lanka and Thailand have established national practices for production and dissemination of mortality statistics from CRVS systems. Of these, only Thailand had an established practice for publishing a complete annual vital statistics report based on CRVS data. The Thai vital statistics report is comprehensive in content, including statistics on births, age-specific fertility rates, age-sex specific mortality rates, life expectancies and summary tabulations of deaths by age, sex and cause of death.[34] Several key vital statistics indicators are also available for major regions and provinces of Thailand. For India, annual vital statistics reports provide data on registered births by sex, stillbirths, crude birth and death rates, and numbers of deaths by age and sex for all major subnational states and territories.[25] The report also provides subnational estimates of birth and death registration completeness, as well as summary data on registered births and deaths for all 718 districts. The civil registration data reports do not publish age-specific fertility or mortality rates. A separate annual report provides data on medically certified causes of death, the most recent of which included information on underlying causes of death for 1 571 540 deaths (20.7% of registered deaths) in 2019.[35]

Myanmar publishes several mortality indicators in a section within the annual national statistics report. The most recent report with data for 2017 includes information on total numbers of registered deaths, ASDRs, and cause-specific death rates for leading causes of death in urban areas.[36] Maldives publishes an Annual Health profile which is comprehensive in content.[37] Sri Lanka publishes data on registered births, deaths and causes of death in tabular format on the Department of Census and Statistics website, but there is no accompanying descriptive or analytical text report.[38] Although the

remaining countries do not have any official processes for dissemination of vital statistics from civil registration, they have reported data on registered deaths and proportion with medically certified causes under the UNESCAP CRVS decade midterm reporting system.[24] However, the reported data for Indonesia are only for deaths recorded by the health sector, and not from the CRVS system. Table 3 shows that although national capacity for mortality statistics compilation exists across the SEAR, the data are incomplete for most countries, and there is a critical gap in reliable data on causes of death for all SEAR countries. Even where MCCD is implemented, there are relatively high proportions of deaths that are assigned to ill-defined causes, up to 35% in Indonesia, and this is a key limitation in the quality of available death registration data.

From a development perspective though, it is encouraging to note that except for Bhutan, Nepal and DPR Korea, all the remaining countries have established national CRVS coordination committees, with a mandate to design and implement system strengthening activities towards improving the availability and utility of mortality statistics for monitoring progress towards the UN SDGs. For India, there are state level coordination committees that function under the guidance of the national Office of the Registrar General of India. In Bangladesh, the CRVS coordination committee has a high degree of political support from the National Cabinet Division. The recently constituted national CRVS committee in Indonesia has officially launched its CRVS acceleration strategy, while Thailand is in the process of re-establishing the national CRVS committee, with some revisions to its structure and functions. In general though, the establishment of these coordinating bodies in most countries is relatively recent, which suggests that it could take some time before their impact on the availability, completeness and quality of mortality data is seen at national level.

SUMMARY OF FINDINGS

This situational analysis of current mortality statistics for WHO SEAR countries has identified several key findings. First, major international statistical modelling exercises undertaken by the WHO GHE and IHME GBD study teams generate national mortality estimates that vary considerably for specific causes of death, with no rationale to justify the veracity of one as compared with the other. At another level, there are also separate estimates of all-cause mortality and life expectancy at birth that are generated by the United Nations World Population Prospects (see online supplemental appendix 2), which also add another layer of uncertainty to the general understanding of mortality patterns for WHO SEAR countries.[16] As explained in the Methods section, there are differences in the background population exposures that are used in the GBD and GHE analytical processes to estimate all-cause mortality patterns, as well as additional adjustment procedures used by the GHE for estimating specific causes of death. These two aspects of differences in methodology are the main reasons for the differences in the estimates from the two sources. Consequently, these variations in mortality estimates from different sources as well as their limited precision (see online supplemental appendix 1) have major implications for countries attempting to use such information for assessments of disease and risk factors on national population health. For instance, Nepal has attempted to use the IHME GBD estimates for 2017 to evaluate its national burden from various forms of cardiovascular disease, but as can be seen from table 1, there are moderate to high levels of variation for mortality from stroke and ischaemic heart disease, when compared with GHE estimates.[39] Similarly, India has used the GBD estimates to evaluate the impact of air pollution, although there are substantial differences in the estimated numbers of adult deaths as well as their causes which are related to exposure to air pollutants, from different sources.[40 41] The GBD estimates for Indonesia have been cited as evidence for its national road map towards universal health coverage, without taking into consideration the underlying uncertainty in these estimates for all causes of death.[42] Our findings clearly demonstrate that using such unreliable evidence for policy analysis is not desirable, and there is a need for accurate empirical mortality data for all SEAR countries, which will eliminate the current reliance on such uncertain model-based mortality estimates.

The second key finding is that all WHO SEAR countries have some degree of functional death registration systems with laws, structure and organisation, which results in death recording but with varying levels of completeness and accuracy. There are certain gaps in national CRVS system design in several countries, which will need attention on a case-by-case basis. For instance, several countries need to shorten death reporting periods, which is particularly relevant to strengthen the recording of neonatal deaths. Otherwise, since both birth and death for neonatal events take place before the expiry of the currently longer reporting period, this results in neither event being reported, and hence bias in measurement of neonatal mortality rates from CRVS data. Accurate measurement of neonatal mortality is especially relevant for WHO SEAR countries, since substantial reductions in under-five mortality has compressed early age mortality to the neonatal period, which is now the focus under the UN SDG programme. Shorter death reporting periods are also important for complete and timely recording of adult deaths, for which early follow-up activities are required for accurate ascertainment of causes of death.[43] In other instances, there is a need to undertake programmes for decentralisation or to increase the provision of infrastructure. An overarching requirement is the need to build institutional and human capacity for ascertainment of causes for both hospital and domiciliary deaths in all countries. Nevertheless, all countries have demonstrated commitment towards system improvement through establishment of national CRVS coordination

and technical committees, which is a positive step towards improving system performance.

The third key finding from the review is the critical gap in the production and dissemination of vital statistics in most countries. Although the CRVS systems review indicates that there is a fair degree of death reporting and registration at the local level, the challenges in vital statistics production potentially arise from weak processes for data compilation. The in-depth country case studies conducted during the regional review identified that several countries operate separate vital event reporting systems in parallel, one through the official CRVS programme by the administrative sector, and the second through the health sector information systems. This results in incompleteness of data from either source, and can be resolved by improved local coordination, data sharing and integration mechanisms. For India, the reported completeness of 92% at national level needs to be confirmed through applying alternate estimation techniques, which would also be useful in evaluating subnational variations in completeness by location, sex and age categories, where feasible.[44] At another level, there are clear gaps in the availability of data on causes of death, for which separate technical resources are needed for cause of death ascertainment, data processing and coding, and statistical analysis. The relatively high proportions of ill-defined causes for medically certified deaths in several countries as shown in table 3 calls for close attention to training physicians for this function at all levels of national health systems.[45] Since a considerable proportion of deaths in all SEAR countries occur at home in the absence of medical attention, there is a need to use verbal autopsy (VA) methods for cause of death ascertainment, as recommended by the WHO.[43 46] Overall, the findings from table 3 are indicative of the critical gaps in these functions across the region. In summary, a comprehensive strategy is required to address the challenges in vital statistics compilation and production, which is customised to the specific national needs and circumstances for each WHO SEAR country.

WAY FORWARD

The challenges in dealing with variations in available estimates including those derived by expert analysis of national data have been well recognised in Thailand, emphasising the need for reliable empirical data.[47] To achieve this goal, a strategy has been devised that focusses on strengthening data on causes of death, as the Thai death registration system has already achieved very high levels of completeness. Since 2020, initiatives have been launched to strengthen MCCD through quality audit protocols at hospitals, implementation research to test the feasibility of using VA methods to strengthen cause of death attribution for domiciliary deaths, and a trial in using automated programmes for selection and coding of underlying causes of death. These activities are targeted towards the reduction in the proportion of deaths that are coded to ill-defined causes (currently 24%), and to improve efficiency and timeliness in data compilation and analysis.

In other countries too, activities over the past 5 years generally indicate a definite increase in death reporting and registration at the local level, although these have not yet translated into improvements in the overall availability of statistics.[48] The findings in table 3 indicate that all countries have some established processes for data compilation, although with varying levels of completeness. For instance, Bangladesh has undertaken steps to augment the role of the health sector in death notification and implementation of VA methods, through a successful small project that is currently being scaled up to increase coverage.[49] Indonesia too has launched a CRVS strengthening initiative involving health sector institutions, with pilot studies demonstrating completeness levels of over 80% in two field sites (CR, personal communication). Overall, the COVID-19 pandemic has also raised awareness in most countries about the importance of mortality data, and several countries have initiated steps to augment death recording and data compilation.[50] However, careful attention is required in planning scale up of these activities.

In principle, the three main focal areas for improving data availability are the completeness of death registration, the quality of recorded causes of death, and mortality statistics production. There are specific elements of national CRVS systems that influence these three focal areas in different countries, in terms of their structure and organisation, their operational framework and the nature of technical support required for efficient system performance. Table 4 provides a sample of these elements, which could serve as a general guide for each country as to which of these would need attention, when developing mortality statistics strategic development plans according to national system characteristics. The regional review in 2020 provides recommendations on the specific elements from table 4 that should be the focus for system strengthening priority actions for each country.[26] For instance, improvements in death registration completeness in Bangladesh would occur through a reduction in the reporting period as well as through improving local intersectoral coordination, while Myanmar would need to strengthen and harmonise various legal frameworks as well as undertake decentralisation protocols for implementation. With relatively high levels of death registration completeness in many states, India would need to focus attention on strengthening the methodology for cause of death ascertainment, for both hospital and domiciliary deaths. These are merely a snapshot of the likely priorities for these countries, to illustrate the parameters that would need to be considered in developing the national strategic approach.

Given the diversity among SEAR countries, national strategic approaches would need to be customised to meet the long-term requirements of universal coverage and completeness of death registration, as well as immediate

Table 4 Selected topics to be considered in national strategic plans for mortality statistics strengthening in South East Asia Region countries

Domain	Completeness	Causes of death (COD)	Vital statistics
Structure and organisation	► Reduce birth and death reporting period ► Strengthen infrastructure/ decentralisation ► Develop intersectoral coordination mechanisms at national/local levels	► Strengthen legislation for reporting COD ► Identify health agency to lead implementation ► Issue regulations for health sector roles and responsibilities	► Enact vital statistics law (including COD statistics) ► Nominate national statistical authority ► Define relationship between statistical authority, civil registration and health
Operations	► Conduct business process improvement analysis ► Document procedures for active event notification[49] ► Implement protocols for field supervision	► Design forms/guidelines for MCCD/VA ► Integrate COD reporting with death registration ► Monitor health facility reporting compliance	► Document SOPs for data compilation and submission ► Establish ICT infrastructure with interoperability ► Monitoring of data timeliness, completeness and accuracy
Technical support	► Capacity building for civil registration staff ► Local level vital record computerisation ► Completeness monitoring at local level	► Capacity building of physicians/ VA staff ► Mortality coding and data quality audit ► Periodic validation research	► Institutional capacity for vital statistics dissemination ► Analysis of integrated MCCD and VA data[55–57] ► Compliance with international vital statistics mandates

ICT, Information and Communication Technology; MCCD, Medical Certification of Cause of Death; SOP, Standard Operating Procedures; UNESCAP, United Nations Economic and Social Commission for Asia Pacific; VA, verbal autopsy.

and interim needs for reliable mortality statistics by age, sex and cause. It is self-evident that for all SEAR countries, except Bhutan, Maldives and Timor Leste, the large populations will necessarily require a long lead time to achieve high levels of national data quality, particularly in regard to data on causes of death through either MCCD or VA. This lead time could be up to a few years in medium sized countries (Sri Lanka, Thailand, DPR Korea and Nepal), but even up to 1–2 decades for the larger countries (India, Indonesia, Bangladesh and Myanmar). Therefore, the development plans for these countries would need to include a strategy to target selected locations with technical support for strengthening cause of death attribution as well as for data processing and analysis, to enable the generation of interim population referenced mortality statistics for monitoring, evaluation and policy action.

Depending on national population size and existing status of system design and performance, these defined populations could be in the form of sentinel clusters, nationally representative samples of districts or specific urban/rural locations with currently better system performance. In all instances, the selected clusters should meet defined criteria on population sample size for reliable mortality measurement.[51] These sites could be the focus of implementation and operations research activities to design improved business processes, test tools and methods for causes of death, and measure interim population referenced mortality indicators. The strategic plan must clearly mention the protocols for periodic data quality assessment, particularly to monitor completeness of death registration and quality of causes of death from MCCD and VA.[52] The programme schedule must articulate specific interim time-bound targets and deliverables for production of mortality statistics in the selected populations preferably within 2–3 years of commencement of the system development programme, which will demonstrate success in implementation. Once a 'proof of concept' is established, the lessons learnt from such strategies would be the foundation for incremental scale up over the next decade, to increase national coverage of these system strengthening interventions.[3]

At the regional level, there are several common areas in which coordination and support could be provided to SEAR countries, particularly around strengthening attribution of cause of death as well as in production of useable statistics. Such broader needs could be addressed through regional level stewardship for setting priorities for targets and goals, harnessing technical support from regional and global institutions, and for resource mobilisation. Regional and national academic institutions are also required to participate in capacity building strategies for personnel from different sectors and institutions with specified roles and responsibilities in data capture and processing, as an essential element to ensure sustainability.[53]

CONCLUSIONS

The onset of the COVID-19 pandemic has brought to the fore the urgent need for reliable mortality statistics for WHO SEAR countries. Available mortality estimates from statistical models are clearly inadequate for the purposes for which such data are required, whether to

identify geographical areas and population subgroups that are most affected, or to understand the overall impact of the pandemic on population health.[54] Reliable empirical mortality data are also required for quantifying disease burden from other infectious diseases, non-communicable diseases and injuries. A realistic understanding of these shortcomings, along with knowledge of the current operational characteristics of mortality statistics programmes in SEAR countries, as presented in this article, is essential to plan improvements in data availability. Customised national strategic development plans that focus on system design, capacity building and mortality statistics production, sustained over the next 1–2 decades, are necessary to realise the immediate and long-term goals for mortality statistics in South East Asian countries.

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Appendix 1: Estimated rank order & magnitude of selected causes of death by sex for WHO SEAR Countries from GBD and GHE data sources for 2019

	Male						Female					
Bangladesh	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	6	21000	5	19026	15168	23553	7	16200	8	10061	5769	18222
Diarrhea	9	14100	10	13132	6667	44058	3	22000	3	19796	6426	51800
Neonatal conditions	4	24800	4	23319	17695	29572	4	20400	7	16856	12334	22173
Ischemic heart dis	2	61900	2	78924	60710	98788	2	46600	2	52086	39835	64468
Stroke	1	68400	1	87986	61920	109201	1	65800	1	70820	54984	87350
COPD	3	28100	3	36553	27449	63883	5	17600	4	19095	11784	39555
Diabetes	11	12300	8	15692	12274	19623	6	16600	6	17403	13049	21551
Road injury	5	21400	15	7286	5005	9199	21	3600	42	1326	1040	1680
Suicide	23	4700	16	5714	4373	7561	39	1300	33	1651	1255	2138
Falls	29	2500	28	3136	1246	4488	55	800	55	800	498	1025
Drowning	20	4800	18	5441	4017	8509	27	2300	26	2141	1608	3029
All causes	-	433100	-	480199	401484	569241	-	360128	-	369362	311432	436287

	Male						Female					
Bhutan	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	12	68	11	55	32	101	8	70	9	52	25	118
Diarrhea	7	94	9	62	21	115	7	75	8	57	20	149
Neonatal conditions	5	99	5	128	91	177	5	78	4	106	76	148
Ischemic heart dis	1	440	1	401	302	522	1	263	1	262	201	321
Stroke	3	199	3	177	129	232	3	161	3	160	114	202
COPD	2	274	2	231	150	385	2	251	2	237	169	299
Diabetes	9	87	7	77	53	105	6	77	6	78	58	106
Road injury	8	89	12	46	30	64	16	34	22	18	13	26
Suicide	25	26	17	30	19	44	34	10	33	11	8	16
Falls	13	64	10	57	26	105	12	47	12	44	18	68
Drowning	34	15	35	16	11	22	48	5	47	6	4	8
All causes	-	2596	-	2329	1893	2803	-	1933	-	1924	1610	2215

Appendix 1: Estimated rank order & magnitude of selected causes of death by sex for WHO SEAR Countries from GBD and GHE data sources for 2019

Bangladesh	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	6	21000	5	19026	15168	23553	7	16200	8	10061	5769	18222
Diarrhea	9	14100	10	13132	6667	44058	3	22000	3	19796	6426	51800
Neonatal conditions	4	24800	4	23319	17695	29572	4	20400	7	16856	12334	22173
Ischemic heart dis	2	61900	2	78924	60710	98788	2	46600	2	52086	39835	64468
Stroke	1	68400	1	87986	61920	109201	1	65800	1	70820	54984	87350
COPD	3	28100	3	36553	27449	63883	5	17600	4	19095	11784	39555
Diabetes	11	12300	8	15692	12274	19623	6	16600	6	17403	13049	21551
Road injury	5	21400	15	7286	5005	9199	21	3600	42	1326	1040	1680
Suicide	23	4700	16	5714	4373	7561	39	1300	33	1651	1255	2138
Falls	29	2500	28	3136	1246	4488	55	800	55	800	498	1025
Drowning	20	4800	18	5441	4017	8509	27	2300	26	2141	1608	3029
All causes	-	433100	-	480199	401484	569241	-	360128	-	369362	311432	436287

Bhutan	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	12	68	11	55	32	101	8	70	9	52	25	118
Diarrhea	7	94	9	62	21	115	7	75	8	57	20	149
Neonatal conditions	5	99	5	128	91	177	5	78	4	106	76	148
Ischemic heart dis	1	440	1	401	302	522	1	263	1	262	201	321
Stroke	3	199	3	177	129	232	3	161	3	160	114	202
COPD	2	274	2	231	150	385	2	251	2	237	169	299
Diabetes	9	87	7	77	53	105	6	77	6	78	58	106
Road injury	8	89	12	46	30	64	16	34	22	18	13	26
Suicide	25	26	17	30	19	44	34	10	33	11	8	16
Falls	13	64	10	57	26	105	12	47	12	44	18	68
Drowning	34	15	35	16	11	22	48	5	47	6	4	8
All causes	-	2596	-	2329	1893	2803	-	1933	-	1924	1610	2215

DPR Korea	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	4	11137	11	2106	1539	2837	4	6280	18	1135	506	1580
Diarrhea	45	203	56	154	70	285	48	172	56	134	56	260
Neonatal conditions	14	1447	20	1043	779	1378	18	1091	24	811	645	1048
Ischemic heart dis	2	14918	2	16820	14183	20018	2	16424	2	18978	15209	23512
Stroke	1	22888	1	25140	20920	29165	1	26760	1	30328	25120	37119
COPD	3	12337	3	13511	9976	16118	3	13841	3	15981	12353	20946
Diabetes	16	1381	16	1528	1206	1885	9	2290	9	2539	1983	3317
Road injury	6	4645	4	6327	4561	8844	14	1565	12	2055	1502	2686
Suicide	15	1405	15	1758	1212	2825	20	1002	17	1197	889	1627
Falls	18	1006	17	1238	828	1746	24	795	22	942	648	1214
Drowning	22	794	21	958	627	1416	36	332	33	394	263	536
All causes	-	111597	-	116303	101473	130982	-	113197	-	120754	105884	144635

India	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	12	269281	4	272901	218536	328389	7	166600	7	149733	114166	193345
Diarrhea	7	262711	6	230469	142738	482412	2	407604	3	401876	166196	793477
Neonatal conditions	5	227792	5	234329	191798	289764	5	206356	6	203675	165755	254767
Ischemic heart dis	1	925181	1	907913	738296	1091751	1	594853	1	611211	483945	737545
Stroke	3	369143	3	363240	294021	443439	4	327894	4	335838	264577	412800
COPD	2	494378	2	494418	384707	601238	3	385354	2	404026	271704	519237
Diabetes	9	142084	10	140278	115042	169376	8	129412	8	132810	106705	160980
Road injury	8	166421	9	164878	111162	201907	20	46175	18	47097	38005	57184
Suicide	25	100413	13	109469	77915	135328	14	72935	12	85867	68616	106283
Falls	13	110470	12	112422	89776	138254	9	115285	9	121244	88062	148331
Drowning	34	32093	26	35970	29075	44662	40	16680	40	18076	14867	21542
All causes	-	4979957	-	5002295	4240352	5861637	-	4191386	-	4389254	3782882	5059322

Indonesia	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	6	50680	5	48912	39392	60193	4	39397	6	27637	22289	34080
Diarrhea	7	33030	8	30568	16102	43335	6	30936	5	29021	13397	56326
Neonatal conditions	9	26050	13	23457	18203	29639	11	19385	14	14668	11512	18299
Ischemic heart dis	2	145045	2	139568	111323	170776	2	114251	2	105776	86283	124039
Stroke	1	171308	1	160939	127953	194174	1	185875	1	170410	138970	199354
COPD	4	52469	6	48297	38341	57985	8	25816	9	23434	18240	29010
Diabetes	3	53345	4	51499	41002	63491	3	57168	3	54834	43330	67508
Road injury	12	23949	9	29048	22785	40738	25	6718	20	7956	6486	9802
Suicide	34	5096	25	6035	4340	7974	47	1448	47	1622	1306	2034
Falls	21	9247	18	9392	7113	11835	19	9157	19	8386	5524	10088
Drowning	38	3150	34	3590	2811	4301	48	1368	51	1422	1199	1681
All causes	-	972754	-	925663	768137	1101576	-	843474	-	780232	647765	912462

Maldives	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	27	8	21	10	8	12	29	4	33	4	3	5
Diarrhea	24	9	29	7	4	10	21	6	30	4	2	8
Neonatal conditions	15	14	5	42	30	59	11	11	5	33	25	45
Ischemic heart dis	1	181	1	208	175	243	1	98	1	100	83	120
Stroke	2	90	2	101	84	121	2	53	2	54	44	66
COPD	3	45	4	46	37	56	3	46	3	46	36	57
Diabetes	6	26	6	30	25	36	8	21	7	22	17	27
Road injury	30	7	12	18	14	22	40	2	32	4	3	5
Suicide	16	13	10	18	14	24	43	2	51	2	1	2
Falls	17	13	13	17	13	23	20	6	20	6	5	8
Drowning	19	12	14	17	14	21	34	2	35	3	2	4
All causes	-	790	-	910	795	1039	-	538	-	592	516	675

Nepal	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	3	10918	5	5076	3870	6306	4	5616	10	2412	1661	3269
Diarrhea	9	2274	12	1965	1049	3623	7	3797	6	3662	1512	7642
Neonatal conditions	5	4994	6	4766	3809	5846	6	3902	7	3631	2888	4449
Ischemic heart dis	2	12700	2	15858	12118	19502	2	6976	2	7885	5679	10233
Stroke	4	7137	3	8744	6688	11209	3	5771	3	6445	4832	8460
COPD	1	13401	1	16253	11784	19756	1	13625	1	15244	9908	19325
Diabetes	15	1457	14	1796	1317	2302	15	1472	14	1678	1297	2109
Road injury	7	2947	15	1762	1093	2295	14	1707	20	959	749	1187
Suicide	10	2145	9	2995	1976	3920	36	427	32	533	389	702
Falls	13	1529	13	1870	1421	2420	13	1793	12	1980	1365	3772
Drowning	20	972	18	1053	651	1343	30	533	34	423	311	566
All causes	-	92858	-	105570	88743	118178	-	83605	-	87761	75896	98289

Myanmar	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	5	11970	7	9302	7034	11960	7	7329	10	5011	3284	7016
Diarrhea	14	3940	15	3802	2397	6488	15	3297	16	2898	1346	5668
Neonatal conditions	7	9717	8	9214	6174	12815	5	7471	6	6851	5426	8443
Ischemic heart dis	2	18139	2	21146	18013	25048	2	16732	2	19437	16604	22559
Stroke	1	34020	1	39741	34151	46505	1	37420	1	42658	36075	49540
COPD	3	16274	3	19330	15904	22650	3	10257	3	11900	6485	14585
Diabetes	6	9860	6	11393	9640	13631	4	10083	4	11226	9511	13259
Road injury	9	8312	13	4330	3169	5546	18	2692	24	1409	1062	1840
Suicide	30	1264	26	1585	1120	2081	54	301	49	372	273	491
Falls	15	3543	12	4457	3279	6896	22	2143	20	2642	2009	3249
Drowning	25	1730	20	2415	1646	3389	43	482	39	637	436	922
All causes	-	210527	-	228169	196005	271446	-	176243	-	192763	170116	223078

Sri Lanka	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	36	505	24	611	439	834	37	264	35	262	189	370
Diarrhea	40	256	31	420	236	815	32	348	19	600	211	1277
Neonatal conditions	30	563	25	597	390	865	26	445	23	476	321	672
Ischemic heart dis	1	14635	1	13259	9903	17198	1	11699	1	10709	7761	14050
Stroke	6	3512	2	7166	5315	9413	6	3293	2	7198	5388	9347
COPD	3	5610	7	3161	2137	4351	4	3845	9	1867	959	2694
Diabetes	2	5704	3	6098	4597	7949	2	6756	3	7175	4960	9369
Road injury	8	3320	10	2540	1757	3394	14	879	16	769	567	1013
Suicide	13	2285	5	3471	2528	4758	17	692	12	954	714	1260
Falls	26	651	14	1372	986	1875	35	313	13	911	628	1205
Drowning	31	563	17	718	523	954	45	168	41	210	157	283
All causes	-	80874	-	74009	56780	95180	-	65122	-	61624	48536	77468

Thailand	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	13	6826	15	4797	3526	6279	21	2725	18	2978	2222	3934
Diarrhea	21	3250	22	2960	1597	5869	19	3613	17	3251	1177	7098
Neonatal conditions	33	1518	44	957	713	1247	37	1161	48	734	548	934
Ischemic heart dis	1	27588	1	28549	21443	37043	2	23717	2	23046	17276	29645
Stroke	2	26212	2	27362	20278	36451	1	24062	1	23663	17665	30410
COPD	7	13212	8	13133	9697	16921	10	6263	11	6037	4217	8860
Diabetes	10	7970	11	8385	6038	11042	6	10806	6	11185	8558	14486
Road injury	3	17843	5	15622	11607	20852	16	4585	15	3919	2830	5214
Suicide	15	5102	13	5780	4154	7843	38	1045	32	1327	938	1787
Falls	19	3545	16	3866	2789	5181	27	1859	26	1864	1324	2899
Drowning	22	3241	17	3696	2796	4866	45	715	42	823	632	1064
All causes	-	275123	-	280223	216313	357677	-	221603	-	217279	172929	270365

Timor Leste	Male						Female					
	GHE		GBD				GHE		GBD			
Cause	Rank	Estimate	Rank	Estimate	LL	UL	Rank	Estimate	Rank	Estimate	LL	UL
Tuberculosis	1	707	6	184	110	271	2	432	6	114	64	167
Diarrhea	7	161	8	139	57	264	6	124	11	95	41	187
Neonatal conditions	4	346 #	4	313	243	392	5	272	4	212	169	263
Ischemic heart dis	3	426	2	585	395	774	3	388	2	436	338	538
Stroke	2	435	1	588	404	860	1	488	1	547	436	654
COPD	6	177	5	240	171	333	7	107	5	119	81	188
Diabetes	15	57	17	77	53	101	9	986	7	114	84	147
Road injury	8	110	12	115	65	151	15	44	21	44	25	56
Suicide	21	35	21	46	23	70	38	13	32	17	8	23
Falls	20	38	22	46	30	69	26	24	27	22	16	29
Drowning	17	53	18	48	26	69	18	31	28	21	10	29
All causes	-	4085	-	4344	3686	4828	-	3468	-	3412	2980	3791

Appendix 2: Estimated life expectancy at birth and total deaths by sex for 11 SEAR countries from the Global Health Estimates (GHE), Global Burden of Disease (GBD) study, and the United Nations World Population Prospects (WPP) for 2019

Country	Life Expectancy at birth (years)						Total estimated deaths (000's)			
	Males			Females			Males		Females	
	GHE	GBD	WPP	GHE	GBD	WPP	GHE	GBD	GHE	GBD
Bangladesh	73.0	73.4	70.5	75.6	75.9	74.1	433.1	480.2	360.0	369.4
Bhutan	72.0	72.2	71.0	74.4	74.3	71.6	2.6	2.3	1.9	1.9
DPR Korea	69.3	69.8	68.3	75.7	76.3	75.4	111.6	116.3	113.2	120.8
India	69.5	69.5	68.11	72.2	72.1	70.5	4980.0	5002.3	4191.4	4389.3
Indonesia	69.4	69.4	69.3	73.3	73.5	73.6	972.8	925.7	843.5	780.2
Maldives	78.6	78.0	77.1	80.8	80.5	80.4	0.8	0.9	0.5	0.6
Myanmar	65.9	66.2	63.7	72.2	72.6	69.8	210.5	228.2	176.2	192.8
Nepal	68.9	69.2	68.8	72.8	73.0	71.7	92.9	105.6	83.6	87.8
Sri Lanka	73.8	74.3	73.3	79.8	80.2	80.1	80.9	74.0	65.1	95.2
Thailand	74.4	74.9	73.1	81.0	82.0	80.6	275.1	280.2	221.6	217.3
Timor Leste	67.9	69.0	67.2	71.4	72.4	71.3	4.1	4.3	3.5	3.4