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Integrating verbal autopsy and medical certification of cause of death data to strengthen local health evidence

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Abstract

Introduction

Measurement of progress towards many Sustainable Development Goals (SDGs) and other health goals requires accurate cause of death (COD) data. Seven of the 17 SDGs, and 17 of their corresponding indicators, require COD data from a Civil Registration and Vital Statistics (CRVS) system. Increasingly, routine COD data are available from a) medical certification of cause of death (MCCOD) for hospital deaths, and b) verbal autopsy (VA) for community (i.e., non-hospital) deaths. However, integration of these data sources is not straightforward because of incomplete death registration, a need to estimate total deaths (by age and sex) in the community and in hospitals, and different cause lists for MCCOD and VA data.

Objectives

This presentation will present a method to integrate VA and MCCOD data that enables the estimation of key cause of death indicators. It will demonstrate its application to estimate premature mortality from non-communicable diseases in Myanmar, discuss the challenges in its implementation and elaborate on implications for application of the method in other countries.

Methods

The process to integrate VA and MCCOD data firstly relies on assessment of characteristics, strengths, and weaknesses of each set of COD data to determine if the full integration can proceed. The integration itself relies on estimation of total deaths that occur in the community and in hospitals by sex and age group – this should be estimated using established methods (e.g., empirical completeness method) if death reporting is incomplete. MCCOD and VA COD data also need to be mapped from different cause lists. The number of deaths by cause is then estimated by multiplying the proportion of deaths (by sex and age group) from each cause by estimated all-cause deaths – this is done separately for community deaths (using VA) and hospital deaths (using MCCOD) before summing the results to produce estimates for the whole population.

Results

Application of the integration method to data from Myanmar in 2019 (from a nationally-representative sample of 42 townships) to estimate SDG Indicator 23 - the probability of dying between ages 30 and 70 years from either cardiovascular diseases, cancers, chronic respiratory diseases, or diabetes – showed that 70% of community deaths were estimated to have a VA (81% males, 63% females). Overall, 89% of deaths in Myanmar were estimated to have occurred in the community. The resultant probability of dying from any of the four causes was 270 per 1,000 for males and 210 per 1,000 for females – similar to WHO estimates that were based on more limited data. Challenges in implementing the method include the quality of COD data and completeness of both community and hospital death reporting. The method however can be readily implemented by country analysts with modifications for local data and the VA tool employed.

Conclusions

Accurate COD estimates for the whole population rely on use of both VA and MCCOD data. As COD data for community and hospital deaths becomes more available, there will be increasing opportunities for countries to fully utilise their potential for as a source of local health evidence.

Introduction

Measurement of progress towards many Sustainable Development Goals (SDG) and other health goals requires accurate and timely all-cause and cause of death (COD) data. Seven of the 17 SDGs, and 17 of their corresponding indicators, require COD data from a Civil Registration and Vital Statistics (CRVS) system; for example, SDG 3.4 aims, by 2030, to reduce premature mortality from NCDs by one-third.[1,2] Increasingly in many countries, two sets of routine COD data are available for policy and planning purposes:

1. data from medical certificates of cause of death (MCCOD) by physicians for hospital deaths, and;
2. data from verbal autopsy (VA) for community (i.e., non-hospital) deaths.

Estimating population-level COD indicators from these data however is not straightforward where death registration is incomplete because it is challenging to estimate total deaths (by age and sex) in the community and in hospitals that can facilitate the integration of these data sources. This presentation describes a method to integrate COD data from MCCODs and VAs where death registration is incomplete to enable estimation of national and subnational cause-specific mortality rates (and hence many such indicators). It demonstrates its application to estimate premature mortality from non-communicable diseases in Myanmar, discusses the challenges in its implementation and elaborates on implications for application of the method in other countries.

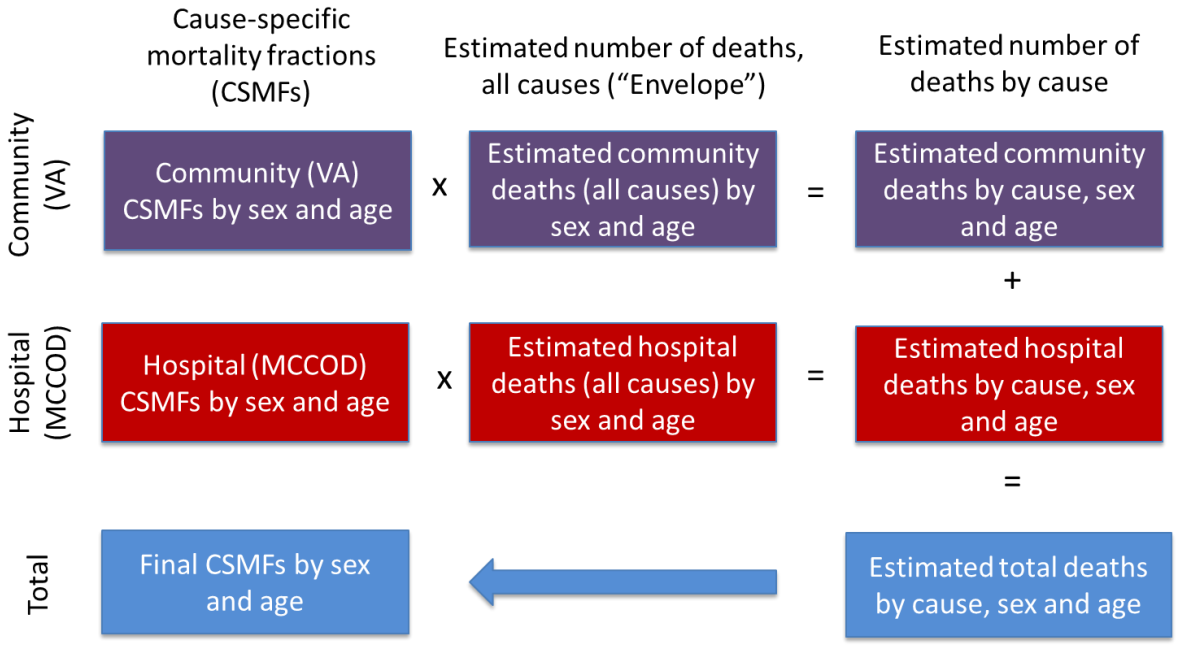
Methods

To estimate cause-specific mortality rates, it is necessary to estimate the number of deaths, by sex and age group, from each cause by combining:

- cause of death data from VAs (community deaths)
- cause of death data from MCCODs (hospital deaths)
- the estimated number of deaths from all causes that occur in the community
- the estimated number of deaths from all causes that occur in hospitals.

From this data, cause-specific mortality fractions (CSMF) can be calculated, which is the percentage of all deaths that are due to a specific cause. A summary of the process is presented in Figure 1.

Figure 1 Summary of process to integrate VA and MCCOD data[3]

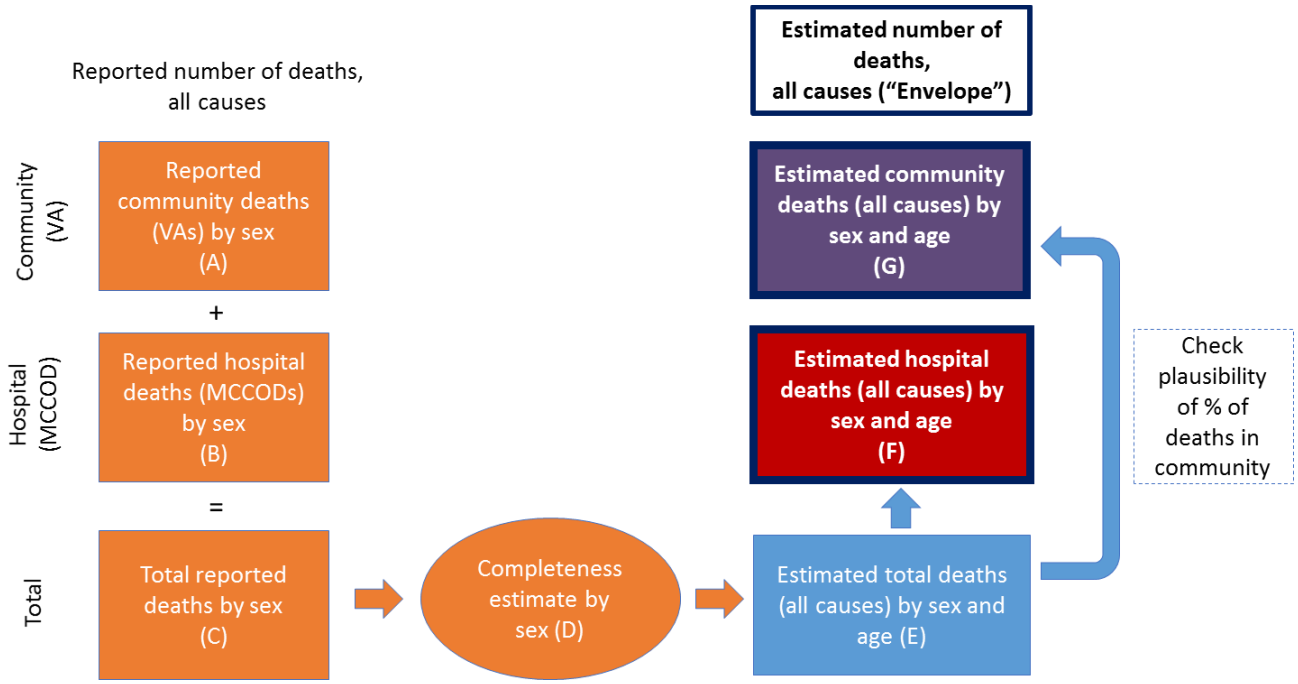


Before proceeding with this integration, it is necessary to assess the characteristics, strengths and weaknesses of VA and MCCOD data.[3] Assessment of the characteristics of VA and MCCOD data includes examination of the age and cause distribution of each data source, which will impact the final CSMFs: it would be expected that hospital deaths have a younger age distribution than community deaths because they are more likely to be acute rather than chronic conditions; any departure from this expected pattern would require closer examination of the data for quality or to ascertain if there is a plausible reason for such differences. There should also be assessment of the quality of VA data, in terms of the percentage of deaths for which there is a VA and the percentage of deaths which are undetermined, and MCCOD data, in terms of the percentage of deaths that are unusable or "garbage". VIPER (for VA using SmartVA) and ANACONDA (for MCCOD) tools can be used to assess data quality. If the data are of insufficient quality, then the integration cannot proceed.[4,5] For example, where VAs comprise less than of 50 per cent of community deaths, there will likely be a significant bias in the cause pattern of community deaths and so the integration should not proceed.

The next step is to estimate completeness of death registration (or reporting) (Figure 2).[3] Completeness can be calculated by using the empirical completeness method or dividing registered deaths by either United Nations World Population Prospects (UNWPP) or Global Burden of Disease (GBD) estimates of deaths (although these may not be available for a subnational area).[6-8] Completeness should be calculated separately for each sex and by age group (broad age groups may be better to use to provide a more reliable estimate of completeness – note that completeness of death reporting is commonly lower at younger ages).[9]

Estimated total deaths is then calculated as the reported deaths divided by completeness reported as a fraction. Community deaths can then be calculated as the total number of estimated deaths minus the number of reported hospital deaths, however the resultant percentage of estimated deaths that occur in the community should be assessed and, if necessary, estimated hospital deaths may need to be assumed to be higher than reported hospital deaths (i.e., hospital deaths are incomplete), and the calculation of estimated community deaths adjusted.

Figure 2 Summary of process to integrate VA and MCCOD data[3]



The next step is to ensure that there is a consistent cause list for both VA and MCCOD deaths. This requires the hundreds of ICD-10 causes in MCCOD data to be mapped to the VA cause list that is used. For example, the SmartVA cause list for adults comprises 33 causes. A cause mapping table can be used to this step.

Once this is completed, the calculation of CSMFs for both VA and MCCOD deaths by sex and age can proceed (as shown in Figure 1). From here, the number of deaths by cause is then estimated by multiplying the CSMFs for each cause (by sex and age group[i]) by estimated all-cause deaths separately for community deaths (using VA) and hospital deaths (using MCCOD) (Figure 1). Then, estimated total deaths by cause, sex and age group is calculated by summing total deaths for VA and MCCOD. Finally, final CSMFs by sex and age

[i] The age groups used may depend on the age groups for causes used in VA – e.g. if 12+ years is used for adult deaths.

group can be calculated. Cause-specific death rates can be calculated using population data. A more detailed description of this process can be found in Adair et al (2020).[3]

Results

This integration method was used to estimate SDG Indicator 23 - the probability of dying between ages 30 and 70 years from either cardiovascular diseases, cancers, chronic respiratory diseases, or diabetes - in Myanmar in 2019 using local data (a full description of the study is described in Adair et al., BMJ Global Health (2021)).[10] VA data were collected in a nationally-representative sample of 42 townships using the SmartVA tool and MCCOD data were available in hospitals for these same townships.

The analysis of the quality of VA found that 12% of male and 10% of female VA deaths had a cause of "undetermined", while 22% of MCCODs were of very high, high or medium severity garbage (i.e. causes of less use for informing health policy). Overall, the data were assessed as being of reasonable quality. Next, it was estimated that 70% of community deaths in 2019 had a VA (81% males, 63% females) – this was calculated using the empirical completeness method and subtracting hospital deaths (assuming full completeness) from total deaths. This resulted in an estimated 89% of deaths occurring in the community, which was consistent with a separate model prediction of the percentage of home deaths in Myanmar.[11] The estimated number of deaths in these townships resulted in adult mortality probability (15-60 years) to be similar to GBD and UNWPP estimates for Myanmar.

The resultant estimate of SDG Indicator 23 – the probability of dying from any of the non-communicable diseases from ages 30 to 70 years – was 270 per 1,000 for males and 210 per 1,000 for females. Notably, this finding was similar to that made by the World Health Organization in 2016, using much more limited local data, of 270 for males and 210 for females, which supports the plausibility of the results.[12] Table 1 of Adair et al., BMJ Global Health (2021) shows the age-sex specific CSMFs for VAs and MCCODs and the percentage of deaths for each age-sex grouping that occurred in hospitals which are used in the calculation of the SDG Indicator 23.[10] Notably, for each of these four causes, the CSMF after the integration is higher than the CSMF from hospital data; that is, using hospital data alone would under-estimate mortality from these four causes. Further detail about the application of the methods in Myanmar can be found in Adair et al., BMJ Global Health (2021).[10]

Conclusion/Recommendations

Integration of MCCOD and VA data is valuable to understand COD patterns and trends in a population and to measure progress towards national and international targets, such as the SDGs. The method can be implemented by country analysts with modifications for local data and the VA tool employed. There are some challenges in implementing this method, in particular the quality of COD data and completeness of both community and hospital death reporting. A thorough assessment of the characteristics and quality of

the two datasets should be performed prior to integration and the integration should not proceed if the quality of data is too poor.

As COD data from VAs for community deaths becomes more available, there will be increasing opportunities for countries to apply methods to integrate VA and MCCOD data and fully utilise their potential for as a source of local health evidence.

References

1. Richards N, Sorchik R, Brolan C. *Why the Sustainable Development Goal agenda needs strong civil registration and vital statistics systems*. 2018. *CRVS Development Series*.
2. United Nations Department of Economic and Social Affairs. Sustainable Development Goals. United Nations Department of Economic and Social Affairs. Accessed 1 September, 2020. https://sdgs.un.org/goals/goal16
3. Adair T, Firth SM, Lopez AD. *Integration of data from medical certification of cause of death and verbal autopsy*. 2020. *CRVS best-practice and advocacy*. Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, University of Melbourne.
4. Mikkelsen L, Moesgaard K, Hegnauer M, Lopez AD. ANACONDA: a new tool to improve mortality and cause of death data. *BMC Med*. Mar 9 2020;18(1):61. doi:10.1186/s12916-020-01521-0
5. D4H Technical Working Group. *Guidelines for interpreting verbal autopsy data*. 2020. *CRVS Resources and Tools*.
6. Adair T, Lopez AD. Estimating the completeness of death registration: An empirical method. *PLoS One*. 2018;13(5):e0197047.
7. Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2019 (GBD 2019) Results. Accessed 3 February 2021. http://ghdx.healthdata.org/gbd-results-tool
8. United Nations Population Division. *World Population Prospects: The 2022 Revision*. 2022. *World Population Prospects*. https://population.un.org/wpp/
9. Adair T, Lopez AD. Generating age-specific mortality statistics from incomplete death registration data: two applications of the empirical completeness method. *Popul Health Metr*. Jun 7 2021;19(1):29. doi:10.1186/s12963-021-00262-3
10. Adair T, Firth S, Phyo TPP, Bo KS, Lopez AD. Monitoring progress with national and subnational health goals by integrating verbal autopsy and medically certified cause of death data. *BMJ Glob Health*. May 2021;6(5)doi:10.1136/bmjgh-2021-005387
11. Adair T. Who dies where? Estimating the percentage of deaths that occur at home. *BMJ Glob Health*. Sep 2021;6(9)doi:10.1136/bmjgh-2021-006766
12. World Health Organization. *Noncommunicable diseases country profiles 2018*. 2018.