# A new method for estimating the completeness of death registration

This *CRVS summary* is edited from 'Estimating the completeness of death registration: An empirical method', ***an open access PLoS ONE*** article available at https://crvsgateway.info/library

## Why does death registration completeness matter?

In recent years, there have been major investments made by national governments and donors to address the poor state of much of the world's civil registration and vital statistics (CRVS) systems. A major focus of this interest has been to ensure that all, or at least the vast majority, of deaths are registered so that planning can proceed with confidence, based on the knowledge that vital registration data are not biased and incomplete.

Accounting for the bias that is likely to arise from incomplete death registration is important as it is likely that unregistered deaths will have a different cause of death profile than registered deaths. This is because of the different socioeconomic characteristics of people who are not covered by vital registration systems, and due to the different types of deaths that are more likely to be registered (such as those that occur in hospitals). Put simply, registered deaths may only provide a partial, or biased, representation of the true cause of death profile of a population.

Consequently, governments at the national and subnational level need to routinely measure the completeness of death registration (**Box 1**), not only to monitor performance of the CRVS system and target interventions accordingly, but also to know by how much to adjust death registration data to produce more reliable mortality statistics to serve the current needs of planners.

**Box 1: Death registration completeness**

The completeness of registration is defined as the percentage of actual deaths in a population that are registered. Put another way, it is the number of registered deaths divided by the actual number of deaths in a population.

$$\text{Completeness of death registration (\%)} = \frac{\text{Number of registered deaths}}{\text{Actual number of deaths}} * 100$$

## How is death registration completeness measured?

Existing methods to estimate the level of completeness of death registration can be classified into three broad groups:

1. death distribution methods (DDMs), or indirect methods,[1]
2. capture-recapture methods, or direct methods,[2] and
3. comparing registered deaths to total deaths estimated using a range of data sources and methods.[3]

### What are the limitations with these methods?

Despite the importance of measuring the completeness of death registration, existing methods suffer from a number of problems. These include:

- Often unrealistic assumptions about population dynamics upon which the indirect methods are based.
- Uncertainty of indirect estimates,[4] which are often so high (+/- 15 percentage points) as to not be useful for monitoring improvements in death registration in a population.
- Significant data and/or cost requirements to conduct capture-recapture studies.
- Inconsistent estimates of death registration completeness depending on the method used.

1 Timaeus I, Dorrington R, Hill K. Introduction to adult mortality analysis. In: Moultrie T, Dorrington R, Hill A, Hill K, Timaeus I, Zaba B. *Tools for demographic estimation*. Paris: IUSSP; 2013. pp. 191-194. Available at: http://demographicestimation.iussp.org

2 Chandrasekar C, Deming W. On a method of estimating birth and death rates and the extent of registration. *Journal of American Statistics Association*. 1949; 44: 101–115.

3 GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet*. 2016; 388: 1459–1544; United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2017 Revision. New York: United Nations, Department of Economic and Social Affairs, Population Division; 2017. Available at: https://esa.un.org/unpd/wpp/

4 Murray CJL, Rajaratnam JK, Marcus J, Laakso T, Lopez AD. What can we conclude from death registration? Improved methods for evaluating completeness. *PLoS Medicine*. 2010; 7: e1000262. Available at: http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000262

- Lack of timeliness due to the need for using data from two censuses (ie the methods produce estimates of death registration completeness for several years in the past).
- Considerable analytical complexity in their application that limits their utility, especially at the subnational level.

Overall, **current methods to estimate the completeness of death registration are complex, cumbersome and generally unsuitable to more widespread application** by national and subnational governments. There is therefore a clear need for a relatively straightforward and accurate method to estimate completeness of registration utilising data that are timely and widely available, including at the subnational level, which avoids these disadvantages.

## What are the components of the empirical method of estimating death registration completeness?

As part of the Bloomberg Philanthropies Data for Health (D4H) Initiative, researchers at the University of Melbourne have developed a new method to estimate completeness of death registration that can be applied to any routine mortality data source using data that are widely available. The method estimates completeness of death registration using data on:

- the **registered crude death rate (RegCDR**, based on vital registration data),
- the **population age structure**,
- the **true level of mortality** (as reflected in the under-five mortality rate) and
- the **completeness of under-five registration**.

The true level of mortality and population age structure are included as components because they are the primary determinants of the crude death rate (CDR) in a population, a summary measure of mortality that can be used to estimate death registration completeness. The CDR in turn is dependent on the fraction of the population living at ages where the risk of death is highest (ie at the oldest ages, and to a much lesser extent, among infants). Essentially, the method compares the predicted CDR based on these determinants with the registered (ie observed) CDR in a population to estimate the completeness of death registration.

The CDR is measured as:

$$CDR = \frac{Total\ deaths}{Population} * 1000$$

### Calculating the registered Crude Death Rate (regCDR)

RegCDR is defined as:

$$RegCDR = \frac{Registered\ deaths}{Population} * 1000$$

In all populations with a death registration system, national or subnational, *RegCDR* should be readily available.

### Calculating the population age structure

Population age structure is important because the risk of mortality is highest among older adults, and especially at the oldest ages. Hence, all else being equal, it is **likely that the CDR will be higher in ageing populations** because there are many more people alive at older ages where the risk of death is highest. This is the reason that a high CDR can be found even in populations with a very low risk of mortality, such as Japan.

The percentage of the population aged 65 and over is used to capture the impact of population age structure. This is readily available from population data such as the national census.

### Calculating the under-five mortality rate and completeness of under-five registration

This method uses the level of under-five mortality as a proxy for the overall level of mortality prevailing in a population at all ages. Because of decades of interest in monitoring improvements in child survival, reliable data on the under-five mortality rate (*5q0*) are widely available, including at the subnational level, and can be calculated from censuses and surveys (eg Demographic and Health Surveys) using established methods.

The true completeness of under-five death registration is calculated as the *5q0* from registration data divided by the estimated most reliable available estimate of *5q0*. This is included because it is expected to be strongly associated with registration completeness over all ages.[5]

5 A separate version of the method does not include under-five completeness for countries where deaths data are derived primarily from health facilities. In such countries, completeness of under-five death registration is likely to be high relative to completeness of registration at all ages, because facility deaths are commonly biased towards younger ages (particularly neonatal deaths). This would result in estimated completeness of registration at all ages being too high.

## Estimating completeness

The method uses these data inputs in a statistical model to predict the completeness of registration. The model was developed using data from 108 countries with available death registration data, and death registration completeness estimated by the Global Burden of Disease Study (GBD).[6] Various statistical tests support the model's accuracy. The model's level of precision (typically +/- 5%) is likely to be sufficient to inform those responsible for improving vital registration systems about the need for action, and for monitoring interventions.

**Figure 1** shows the predicted completeness from the method versus the completeness generated from the GBD database (defined as 'observed completeness'). For most country-years there are less than five percentage points difference between completeness predicted by the method and GBD estimates of completeness. This suggests that the model can be used with confidence to reliably estimate death registration completeness in any population, national or subnational, where the basic input parameters defined above are known.

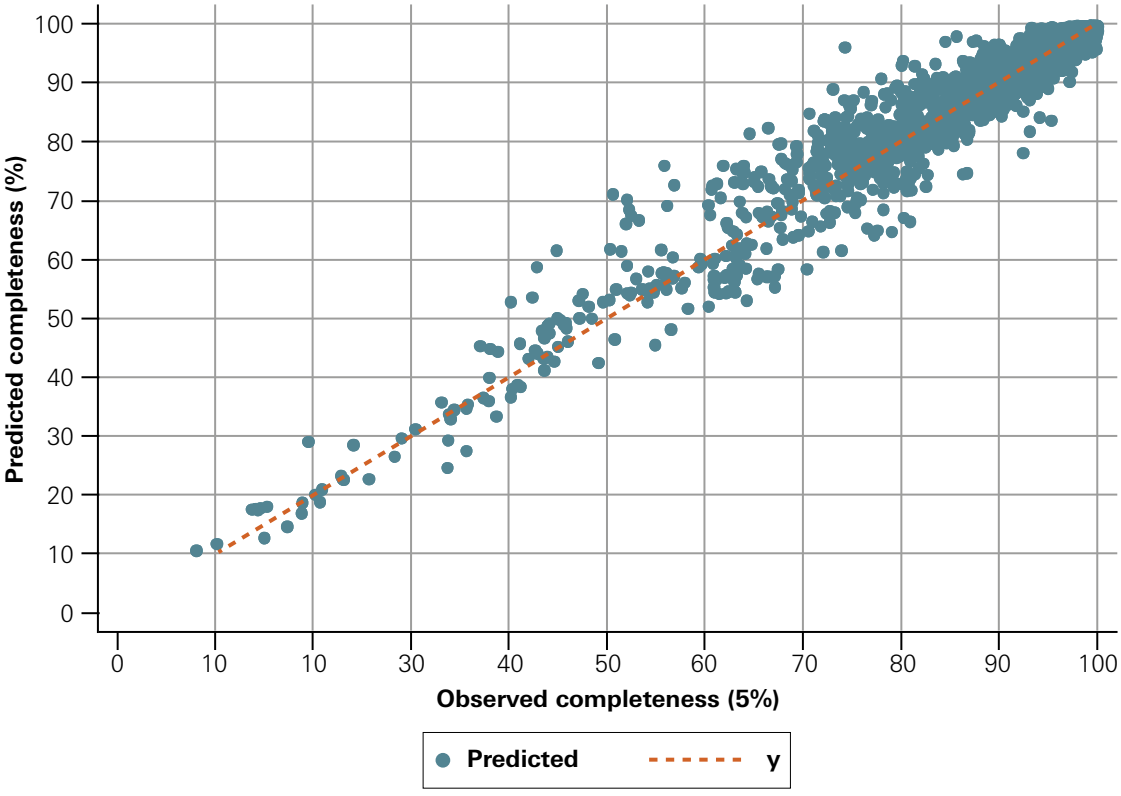
**Table 1** shows an application of the method to death registration data from Peru in 2014, yielding an estimate of death registration completeness of 73%.

**Table 1: Demonstration of method to estimate completeness of death registration for Peru, 2014**

| RegCDR | % pop. 65+ | 5q0[6] | Under-five completeness | Estimated completeness |
|---|---|---|---|---|
| 3.077 | 6.6% | 18.1 | 45% | 73% |

Pop.: Population

**Figure 1: Predicted versus observed completeness, both sexes**




6 GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016; 388: 1459–1544.

## Summary

This new empirical method to estimate the completeness of death registration is relatively simple to apply and interpret, and is based on a common-sense understanding of the factors which affect the crude death rate in a population. An additional advantage of the method is that it is costless, and uses data that are timely and widely available, including at the subnational level. It can thus produce policy-relevant information on subpopulations where death registration completenessis comparatively poor. Moreover, the method avoids many of the disadvantages of traditional direct and indirect methods, and can be implemented by national and subnational governments with minimal training.[7]

7 Application of the method has been integrated into the data quality assessment tool, ANACONDA, which includes a comprehensive training package. For more information, see https://crvsgateway.info/courses

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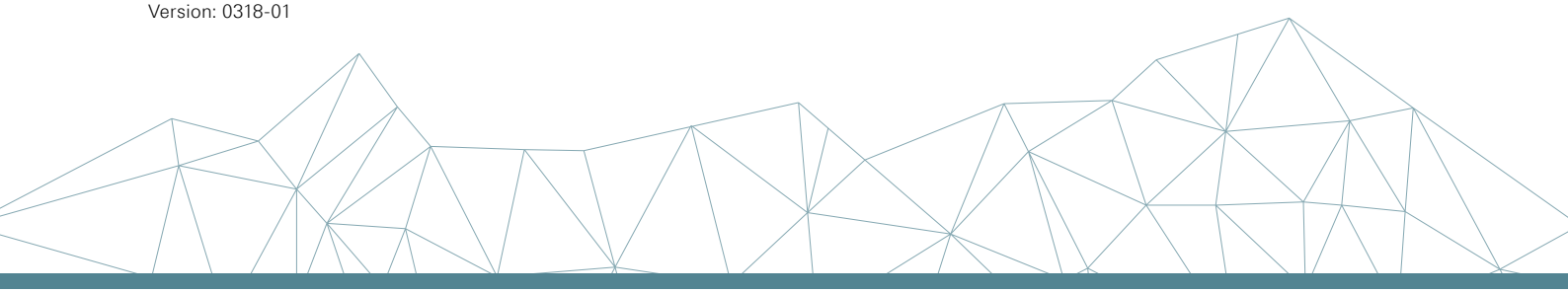

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