Insert your country or organisation logo here



ANACONDA mortality and cause of death assessment report

Month, year

**[country name]**

Country name:

ANACONDA mortality and cause of death assessment report, year(s)

Ministries/Offices who contributed to this report

Official logos

|  |
| --- |
| **How to use this template: this template was developed with ANACONDA version 4.1 (February 2019) – those with older versions of ANACONDA can still use this template, however some sections may not apply**This template has been developed to assist countries in writing a report about the quality of mortality and cause of death data in their countries or a sub-region. It uses ANACONDA to calculate indicators and produce charts and tables. Countries can include all the ten steps of ANACONDA or select a smaller sub-set to focus with. Additional data from other sources (such as UN agencies or country reports) can be included as appropriate.Text that is in green highlight are instructions on how to complete the section.Text that is in yellow highlight indicates placeholder text that needs to be updated (i.e. to the name of your country, or the year of the input data).Most sections have an introductory paragraph that explains what the section is about and what the step in ANACONDA does, and why it is important. Countries can decide how much of this introductory text to include.If you would like your report to be published on the CRVS Knowledge Gateway (<https://crvsgateway.info/Library~23>) or have any questions please email crvs-info@unimelb.edu.au  |

# Acknowledgments

List names and affiliations of all people who contributed to the report and include a suggested citation for the report.

ANACONDA was developed by the Melbourne School of Population and Global Health at the University of Melbourne under the direction of Dr Lene Mikkelsen and Professor Alan Lopez, and the software was built by the Swiss Tropical and Public Health Institute (Swiss TPH) at the University of Basel. Funding was provided by the Bloomberg Philanthropies Data for Health Initiative.

Update the automatic contents page

Contents

[Acknowledgments 3](#_Toc536058)

[Acronyms and abbreviations 7](#_Toc536059)

[Key terms and definitions 7](#_Toc536060)

[Summary 9](#_Toc536061)

[Civil registration and vital statistics reporting system of [country] 12](#_Toc536062)

[Data quality assessment: ANACONDA and its 10 steps 12](#_Toc536063)

[Quality assessment 15](#_Toc536064)

[Part A: Input data 15](#_Toc536065)

[A1. Population profile 15](#_Toc536066)

[A2. Mortality profile 15](#_Toc536067)

[A3. Cause of death profile 15](#_Toc536068)

[Part B: Mortality data 17](#_Toc536069)

[B1. Crude death rate 17](#_Toc536070)

[B2. Completeness of death reporting 17](#_Toc536071)

[B3. Age-specific mortality rates 18](#_Toc536072)

[B4. Sex ratio 18](#_Toc536073)

[B5. Age-sex distribution of deaths 19](#_Toc536074)

[B6. Completeness of child mortality data 19](#_Toc536075)

[Part C: Cause of death data 21](#_Toc536076)

[C1. Broad cause of death groups 21](#_Toc536077)

[C2. Total deaths by ICD-10 Chapter 22](#_Toc536078)

[C3. Garbage codes by category 23](#_Toc536079)

[C4. Garbage codes by severity 24](#_Toc536080)

[C5. Age-sex distribution of garbage codes 25](#_Toc536081)

[C6. Redistribution of garbage codes 26](#_Toc536082)

[C7. Leading packages of garbage codes 27](#_Toc536083)

[C8. Non-standard codes and biologically implausible causes of death [optional] 28](#_Toc536084)

[C9. Age distribution of mortality within broad cause of death groups 28](#_Toc536085)

[C10. Distribution of deaths by broad group and age 31](#_Toc536086)

[C11. Leading causes of death 31](#_Toc536087)

[C12. Leading causes of death (after redistribution of garbage) 31](#_Toc536088)

[Part D: Overall data quality index 34](#_Toc536089)

[D1. Vital Statistics Performance Index for Quality 34](#_Toc536090)

[Conclusions and next steps 35](#_Toc536091)

Update the automatic list of figures

[Figure 1 Percent of population by age-group and sex, [country name and year] [with comparator] 15](#_Toc536092)

[Figure 2 Percent of deaths by age-group and sex, [country and year] 15](#_Toc536093)

[Figure 3 Crude death rate, [country, year] [with comparator] 17](#_Toc536094)

[Figure 4 Completeness of death registration, [country, year] 17](#_Toc536095)

[Figure 5 Age-specific mortality rates, [country, year] 18](#_Toc536096)

[Figure 6 Ratio of male deaths to female by age group, [country, year] [with comparator] 19](#_Toc536097)

[Figure 7 Age distribution of deaths by sex, [country, year] 19](#_Toc536098)

[Figure 8 Age distribution of deaths by sex, [country, name] [with comparator] 19](#_Toc536099)

[Figure 9 Under-five mortality rate, [country, year] [with comparator] 19](#_Toc536100)

[Figure 10 Age distribution of child deaths under 1 year, [country, year] 20](#_Toc536101)

[Figure 11 Proportion of deaths by 3 broad Groups, including unusable and insufficiently specified codes, [country, year] 21](#_Toc536102)

[Figure 12 Distribution of deaths by utility of the cause of death, [country, year] 21](#_Toc536103)

[Figure 13 Garbage codes by category, [country, year] 23](#_Toc536104)

[Figure 14 Distribution of garbage codes by severity, [country, year] 25](#_Toc536105)

[Figure 13 Proportion of deaths with unusable and insufficiently specified codes by age-group, sex, and severity, [country, name] 26](#_Toc536106)

[Figure 14 Distribution of cause of death data according to three broad groups, before redistribution of garbage codes, [country, year] 26](#_Toc536107)

[Figure 16 Proportion of deaths by broad disease Group, males, [country, year] [with comparator] 30](#_Toc536108)

[Figure 17 Proportion of deaths by broad disease Group, females, [country, year] [with comparator] 30](#_Toc536109)

[Figure 18 Distribution of deaths by age group and broad Group, including unusable and insufficiently specified causes, [country, year] 31](#_Toc536110)

[Figure 19 Relative importance of VSPI(Q) components, [country, year] 34](#_Toc536111)

Update the automatic list of tables

[Table 1 ANACONDA overview, [country name], [year] 10](#_Toc536112)

[Table 2 Cause of death by broad age group and sex, [country and year] 16](#_Toc536113)

[Table 3 Leading causes of death by age group and sex [country and year] 16](#_Toc536114)

[Table 4 ICD-10 Chapters with the highest amount of garbage codes in each, [country, name] 22](#_Toc536115)

[Table 5 Garbage codes by category, [country, year] 23](#_Toc536116)

[Table 6 Garbage codes by severity, [country, year] 24](#_Toc536117)

[Table 7 Garbage codes, Level 1, top five packages, [country, name] 27](#_Toc536118)

[Table 8 Top five biologically implausible causes of death, [country, year] 28](#_Toc536119)

[Table 9 Top 20 causes of death, females, before and after redistribution of unusable and insufficiently specified codes [country, year] 33](#_Toc536120)

[Table 10 Weighted scores by VSPI(Q) component, [country, year] 34](#_Toc536121)

Update these as required/used in your report

# Acronyms and abbreviations

|  |  |
| --- | --- |
| ANACONDA | Analysis of Causes of (National) Deaths for Action |
| ASMR | age-specific mortality rate |
| CDR | crude death rate  |
| CRVSD4H | Civil Registration and Vital Statistics systemData for Health |
| GBD | Global Burden of Disease |
| ICD-10 | International Statistical Classification of Diseases and Related Health Problems, 10th revision |
| IHME | Institute of Health Metrics and Evaluation |
| NCD | non-communicable disease |
| NEC | not elsewhere classified |
| VSPI(Q) | Vital Statistics Performance Index (Quality) |

Update these as required/used in your report

# Key terms and definitions

**Age-specific mortality rate**: A mortality rate limited to a particular age group. The numerator is the number of deaths in that age group; the denominator is the number of persons in that age group in the population.

**ANACONDA:** An electronic tool that assesses the accuracy and completeness of mortality and cause of death data. It checks for potential errors and inconsistencies in the data and provides users with an understanding of basic epidemiological and demographic concepts to interpret their data.

**Cause of death:** Refers to ‘all those diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstance of the accident or violence which produced any such injuries’ (Twentieth World Health Assembly, 1967).

**Completeness**: The percentage of actual births or deaths in a population that are registered. Put another way, it is the number of registered births or deaths divided by the actual number of births or deaths in a population.

**Crude death rate**: The number of deaths relative to the size of that population during a given period, usually one year. It is expressed in units of deaths per 1000 population per year.

**Process map:** Describes the structure, processes and flows of an enterprise or system, for example a CRVS system.

**Garbage code:** Any code that cannot or should not be used for the underlying cause of death. For instance, a “mode of death” such as, heart failure, kidney failure, etc. or symptoms such as backpain, depression, or risk factors such as high blood pressure, are garbage codes.

**Underlying cause of death:** ‘The disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury’ (World Health Organization, 1994).

**Unusable or insufficiently specified code** (also referred to as ‘garbage codes’): Codes that are of no utility for policy and should not be used as an underlying cause of death, such as septicaemia, heart failure, senility or headache. A cause that is insufficiently specified may still have some information content for policy, ie. cancer, stroke etc, but could be improved (such as by stating the site of the cancer).

Write the Summary after you have completed the report

# Summary

The analyses presented in this report are based on a review conducted on the mortality and cause of death data collected by the civil registration and/or hospital reporting system of the [country name] for [year], representing [number] reported deaths. The review was performed using the ANACONDA software tool, [version XXX].

The report describes the mortality and cause of death situation of [country name] and provides an overall assessment of the quality of the data for use in policy, the Vital Statistics Performance Index for Quality (VSPI(Q)) score. Results from the review produced a **VSPI(Q) score of [X%]**, **which indicates a [‘X’ (eg. Low, medium, high]** **quality rank** [use data from step 10 to complete this section].

The data entered into ANACONDA came from [institution] and the analysis showed the strength and weaknesses in the data which have been summarised in 21 indicators (Table 1). Briefly describe them here beginning with those in green which indicate that the data seem to reliably represent the true situation.

However, there were some quality concerns. Describe them here. What is the most pressing issue in regard to data quality? Completeness, level of garbage codes, etc? Are the data suitable for policy use?

In the ‘comments’ column, write a few sentences about the key findings for each of the 21 core aspects/steps in ANACONDA. For example, are the results consistent with what is expected (either in looking at comparison data, or in terms of what is known about the country or topic of interest). If there are no, or very little, issues with the data, colour the ‘status’ column green. If there are some issues with the data, colour the ‘status’ column yellow. If there are clear data quality issues, colour the ‘status’ column red.

Table 1 ANACONDA overview, [country name], [year]

| **Review component** | **Comments** | **Status** |
| --- | --- | --- |
| A1. Population profile |  |  |
| A2. Mortality profile |  |  |
| A3. Cause of death profile |  |  |
| B1. Crude death rate |  |  |
| B2. Completeness of death reporting |  |  |
| B3. Age-specific mortality rates |  |  |
| B4. Sex ratio |  |  |
| B5. Age-sex distribution of deaths |  |  |
| B6. Completeness of child mortality data |  |  |
| C1. Broad cause of death groups |  |  |
| C2. Total deaths by ICD-10 Chapter |  |  |
| C3. Classification of unusable and insufficiently specified codes by category |  |  |
| C4. Classification of unusable and insufficiently specified codes by severity |  |  |
| C5. Age-sex distribution of unusable and insufficiently specified codes |  |  |
| C6. Redistribution of unusable and insufficiently specified codes |  |  |
| C7. Leading packages of garbage codes |  |  |
| C8. Non-standard codes and biologically implausible causes of death |  |  |
| C9. Age distribution of mortality within broad cause of death groups  |  |  |
| C10. Distribution of mortality by broad group and age |  |  |
| C11. Leading causes of death |  |  |
| D1. Vital Statistics Performance Index for Quality |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No action needed |  | Follow-up investigation recommended |  | Urgent data improvement required |
| 1 |  | 2 |  | 3 |

#

# Civil registration and vital statistics reporting system of [country]

Use this section to briefly introduce the CRVS system of the country, with an emphasis on the mortality system. Include topics such as:

* Why vital statistics from civil registration are important and what they are used/or should be used for in the country
* Diagrams showing the organisational structure of the system, the registration process and information flows, eg. process map showing how deaths in hospitals and the community get recorded.
* Main challenges for CRVS in the country, eg. timeliness, coverage and completeness, late registration, etc.
* It is important to discuss all major limitations in the data. For instance, if the system is not yet able to register all events and essentially cover only urban areas this should be clarified, or if not all the national territory is covered by civil registration or if some population group(s) residing in the country is not included this should be mentioned.
* In countries where not all the COD data are derived from medical certification, it is important to mention the proportion of deaths for which the cause is not diagnosed by a doctor, be that lay certified or by using verbal autopsy (VA). Whenever possible, it is useful to compile the medically certified data separately to the non-medically diagnosed so the two cause of death distributions can be compared for the 20 main causes of death.
* Processes for mortality coding, including at what level (central, hospital, etc), what version of the ICD is used, any existing processes for querying the data.

## Data quality assessment: ANACONDA and its 10 steps

This section describes ANACONDA. Countries can select to leave-as is, move to the end of the section, or delete if the audience is well familiar with the tool. If the dataset is hospital data not all 10 steps can be performed due to the lack of suitable population data, the step description can therefore be limited to the included steps.

All countries need accurate and up-to-date mortality statistics for a variety of purposes, including:

* informing health and social policy debates,
* monitoring progress relative to national and global development goals,
* monitoring trends in diseases and injuries, and
* evaluating policies designed to improve health outcomes.

The optimal source of cause of death data for a population is a functioning civil registration and vital statistics (CRVS) system, which registers all deaths and assigns a medically certified underlying cause of death. This individual cause of death data, once aggregated at the national level, forms the basis of mortality statistics for a country. It is therefore very important to ensure that the collected data are as accurate as possible and hence, assessing the quality of the data before dissemination is crucial to ensure users and policy-makers can have confidence in the resulting statistics.

As a first step to any data improvement, gaining a detailed understanding of the types of problems with the data, particularly regarding completeness and diagnostic accuracy, is critical. A common concern with any mortality statistics produced from civil registration systems is how reliable they are in describing the actual mortality patterns in the population to which they refer.

The **Analysis of Causes of (National) Deaths for Action, or ANACONDA**,[[1]](#footnote-1) software tool used in this analysis was developed by the Melbourne School of Population and Global Health at the University of Melbourne, with the support of the Swiss Tropical and Public Health Institute at the University of Basel.

ANACONDA is specifically designed to be applied to large datasets such as those from civil registries, or any other sources that routinely collects and generates cause of death data coded to the International Standard Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), classified by age and sex.

ANACONDA is designed to *identify problems* that need to be addressed to improve the value of mortality data for guiding health policies and practices. When applied on an annual basis it can be used to monitor the impact of improvement actions undertaken. Knowing the quality of the data from the ANACONDA analysis will allow analysts and policy makers to make greater use of existing (potentially flawed) data by understanding the probable biases. It also provides critically important intelligence to guide strategies and interventions designed to improve the collection and analysis of cause of death data.

ANACONDA is built around **10 steps**, which can be grouped into four broad categories:

1. data inputs and general background checks(**step 1**),
2. mortality data(**steps 2–5**),
3. cause of death data (**steps 6–9**), and
4. overall data quality index: VSPI(Q)(**step 10**).

To diagnose possible problems in the mortality input dataset, ANACONDA performs the following operations and analyses:

* Tabulates and/or graphs the input data in different ways to assess the plausibility of the data based on fundamental demographic and epidemiological relationships.
* Calculates the proportion and type of garbage codes that are of limited or no value for public health analysis.
* Compares the input data to a global source or estimate for the country or geographic region, to assess consistency.
* Allows users to monitor annual changes in the quality of the dataset through the VSPI(Q).

To assess plausibility, the national mortality data for a country are compared with the most recent estimates for that country or a neighbouring region. Most of the comparators are from the Global Burden of Disease (GBD) Study prepared by the Institute for Health Metrics and Evaluation (IHME) in Seattle.[[2]](#footnote-2) Applying the newly developed Lopez-Adair method,[[3]](#footnote-3) ANACONDA calculates the estimated completeness of death registration using widely available country data. It investigates the amounts and types of “garbage codes” found in the data set. It provides users with the option of identifying the most frequently misused causes of death.[[4]](#footnote-4) Using this new classification system, ANACONDA offers countries the possibility to design focused strategies for improving the quality of cause of death data, according to their needs and resources.

ANACONDA also calculates standard mortality indicators and produces charts and tables that describe the mortality situation in the country or subregion, and so can be used for reporting on leading causes of death by age and sex, along with an assessment of how reliable that information is.

# Quality assessment

Mortality and COD data that have been collected – often at great expense – should be of sufficient quality and representativeness to be used to their full potential. ANACONDA was specifically designed to help producers and users of mortality datasets to assess whether they are ‘fit for purpose’, and to monitor the impact of activities implemented to improve data quality.

## Part A: Input data

### A1. Population profile

Population data used in the ANACONDA analysis was sourced from the [name and date of source, ie. Census, with reference to online version if available] (**Figure 1**). Understanding the local demographic situation is important for assessing the plausibility of the tabulations and graphs produced by the steps that follows. Describe Figure 1, comment on the reliability of the source and explain any difference to the comparator. If your population data is not correct and the pyramid does not conform to expected patterns, you should try to correct the data before proceeding as biased population data will affect all your rates and indicators. Please note that in cases where the source is hospital data, it is not possible to enter any correct population and so the steps requiring any population denominator cannot be performed.

Figure 1 Percent of population by age-group and sex, [country name and year] [with comparator]

Insert population pyramid from step 1.3

### A2. Mortality profile

**Figure 2** shows the profile of mortality (‘death pyramid’) by age group and sex for [country name] in [year]. Describe Figure 2. Comment on differences between males and females and why dissimilarities are normal. If your graph does not conform to expected patterns, explain why.

Figure 2 Percent of deaths by age-group and sex, [country and year]

Insert death pyramid from step 1.4.

### A3. Cause of death profile

Young children and adults have different disease patterns and showing the COD for these two groups separately is a useful and a quick way of identifying inconsistencies in the data (**Table 2**).

Describe table 2 from step 1.5.

To generate the table, first rank the diseases in the table in ANACONDA by each age group and sex (from highest number of deaths to least) and copy and paste the top five causes for children and adults, by male and female

Table 2 Cause of death by broad age group and sex, [country and year]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   |   | **Children (<5 years)** |   | **Adults (5+ years)** |
| **Males** |   | 1 |  |   | 1 |  |
|   | 2 |  |   | 2 |  |
|   | 3 |  |   | 3 |  |
|   | 4 |  |   | 4 |  |
|   | 5 |  |   | 5 |  |
|  |  |  |  |  |  |  |  |  |
| **Females** |   | 1 |  |   | 1 |  |
|   | 2 |  |   | 2 |  |
|   | 3 |  |   | 3 |  |
|   | 4 |  |   | 4 |  |
|   | 5 |  |   | 5 |  |

Age remains one of the most important predictors of the risk of death, with epidemiological patterns of disease at different ages well-established. As such, understanding and showing the disease pattern of mortality by age group provides a relatively simple method of both checking the plausibility of the input data and showing the disease pattern in a country. **Table 3** shows the leading causes of death for males and females by age group, after redistributing for garbage codes. Describe table 3.

If we tabulate the input data according to the GBD classification and leaves out all the garbage codes, we can generate a table like table 3, which shows that the 5 leading causes for each age group varies. First sort the data in step 1.7 in ANACONDA for each age group and sex (from highest number of deaths to least), and copy and paste the 5 first causes in the list.

Table 3 Leading causes of death by age group and sex [country and year]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   |   | **Males**  |   | **Females** |
| **<5 years** |   | 1 |  |   | 1 |  |
|   | 2 |  |   | 2 |  |
|   | 3 |  |   | 3 |  |
|   | 4 |  |   | 4 |  |
|   | 5 |  |   | 5 |  |
|  |  |  |  |  |  |  |
| **5–29 years** |   | 1 |  |   | 1 |  |
|   | 2 |  |   | 2 |  |
|   | 3 |  |   | 3 |  |
|   | 4 |  |   | 4 |  |
|   | 5 |  |   | 5 |  |
|  |  |  |  |  |  |  |
| **30–69 years** |  | 1 |  |  | 1 |  |
|  | 2 |  |  | 2 |  |
|  | 3 |  |  | 3 |  |
|  | 4 |  |  | 4 |  |
|  | 5 |  |  | 5 |  |
|  |  |  |  |  |  |  |
| **70+ years** |  | 1 |  |  | 1 |  |
|  | 2 |  |  | 2 |  |
|  | 3 |  |  | 3 |  |
|  | 4 |  |  | 4 |  |
|  | 5 |  |  | 5 |  |

## Part B: Mortality data

### B1. Crude death rate

As a mortality indicator, the crude death rate (CDR) is the simplest measure of population health status. It is a measure of the number of deaths relative to the size of that population during a given period, usually one year. It is expressed in units of deaths per 1000 population per year. The CDR is also an important measure of data quality, as in a system where not all deaths are registered, the CDR will underestimate the true level of mortality (ie. the calculated CDR will be lower than the ‘true’ CDR).

Describe Figure 3. How does the calculated CDR compare with the comparators? Does it indicate that all deaths are being registered?

Figure 3 Crude death rate, [country, year] [with comparator]

Insert the graph of the CDR from step 2.1

### B2. Completeness of death reporting

Using the Lopez-Adair method,3 which calculates the completeness of death registration from widely-available country data such as the population age structure and under-five mortality rate, the **estimated registration completeness in [year] was X% for males and X% for females** (**Figure 4**). Describe figure 4. Compare it with the previous section to discuss if the results are plausible and mention how much it has increased since a given year, if that is known e.g. since 2000 or 2010.

Figure 4 Completeness of death registration, [country, year]

If you have a single year’s worth of data: Insert the graph of completeness from step 2.2

If you have more than one years’ worth of data: Use the data from step 2.2 to complete the graphs below. You can report on up to four periods (ie. single years, or every five years) (double-click on the graph to open the embedded Excel sheet to make changes).

|  |  |
| --- | --- |
|  |  |

### B3. Age-specific mortality rates

Age-specific mortality rates (ASMRs) can be used to assess the quality of mortality data by comparing the rates calculated from the input data with expected age patterns of mortality risk. Generally, mortality rates are high during infancy and early childhood, and fall to their lowest levels between ages five and 14 years. After this, mortality rates rise with increasing age. Male mortality is usually higher than female at all ages, with a peak of excess mortality between ages 15 to 24 years. From the age of mid-thirties, the rates for both males and females generally increase on an almost straight line.

Describe figure 5. How does the input data compare with the above expectations? What might deviations mean in terms of quality?

Figure 5 Age-specific mortality rates, [country, year]

Insert the graph from step 3.1. If there are significant differences between the input data and comparators, you can insert additional graphs to show this (ie. males and females separately, with their comparators).

### B4. Sex ratio

If males and females died at the same rate at each age group, the ratio between the male and female death rate would equal one. As discussed previously, male death rates are generally higher than female at all ages, and so the ratio should be above one. The ratio between the two is typically 2-3:1 at ages 15-34 due to much higher male mortality associated with accidents, suicides and violence (eg. for every two or three male deaths at these ages, there is only one female death). Sometimes there is also a secondary, lower peak, in the ratio between ages 50 to 64 years due to the higher number of men dying prematurely from NCDs. At the very highest ages the female rates might be identical or slightly higher than the male rates so that the ratio becomes negative and dips below one.

As shown in **Figure 6**, [describe figure 6 here, how does the input data compare with the expected trend?]

Figure 6 Ratio of male deaths to female by age group, [country, year] [with comparator]

Insert the graph from step 3.2

### B5. Age-sex distribution of deaths

The age and sex distribution of registered deaths varies considerably depending on the overall level of mortality in a country, which determines the risk of dying at each age, and also the size of the population currently alive at each age. Irrespective the level of mortality, the number of deaths should gradually increase from the age of five years onwards.

Use these paragraphs to describe age distribution shown in the input data (figure 7). What are the ages of highest and lowest number of deaths? Also describe how the input data compares with the comparator data (figure 8), and what this might mean in terms of data quality

Figure 7 Age distribution of deaths by sex, [country, year]

Insert the graph from step 4 (no comparator first)

Figure 8 Age distribution of deaths by sex, [country, name] [with comparator]

Insert the graph from step 4 (with comparator, if there is a substantial difference between the input data and comparator point out the potential reasons why).

### B6. Completeness of child mortality data

More than any other age group, the level of mortality among children under five years old reflects a country’s economic, social and health conditions. However, research also shows that this is the age group for which deaths are most likely to go unreported to the civil registration system. To assess the potential level of under-registration of child mortality in civil registration data, the Interagency Group for Child Mortality Estimation (IGME) compares reported child deaths with survey- and census-derived estimated of child mortality, which are more likely to be accurate.[[5]](#footnote-5)

As **Figure 9** highlights, describe figure 9 (how does the input data compare with the comparator? Are all child deaths being registered? Link with results from previous sections to see if common themes around completeness appears in the data. Estimate the proportion of child deaths that are missed from the table in Step 5.1, if relevant)

Figure 9 Under-five mortality rate, [country, year] [with comparator]

Insert the graph from step 5.1

#### Age distribution of child deaths

It is important to know the age distribution of child deaths, as this can help determine which types of child deaths are not reported and hence being missed. Deaths that occur in the first week after birth (ie. in the early neonatal period) are least likely to be reported compared with child deaths at older ages, for several reasons.

If your system is recording the age distribution of child deaths under the age of 1 year present these in figure 10.

Figure 10 Age distribution of child deaths under 1 year, [country, year]

Insert here the graph from step 5.2 (note this is a new feature in ANACONDA, so if you have used an earlier version, this feature will not be working) Describe figure 10, how does the input data compare with the comparators?

#### Life expectancy

As part of this step, ANACONDA also calculates a life table based on the input data. A life table provides the probability of death at any age, as well as the number of expected years left to live at any age, including at age zero. From the input data, life expectancy was calculated at [X] years for males and [X] years for females. Remember that if not all deaths are recorded your life table is going to be biased. Discuss here if the life expectancy seems plausible, or if it is overly high due to under-registration. You can include other sources of life expectancy (from your national statistics office or the WHO) to compare, if they are available.

## Part C: Cause of death data

### C1. Broad cause of death groups

A first step in checking the quality of cause of death data is to look at the distribution of deaths by three broad groups to assess if the observed pattern is consistent with what is known about the extent of the epidemiological transition in the country. The three groups are:

* Group 1: Communicable, maternal, neonatal, and nutritional diseases
* Group 2: Non-communicable diseases, including mental health conditions
* Group 3: External causes and injuries (eg. accidents, homicide, suicide, war deaths and natural disasters.[[6]](#footnote-6)

Of critical importance from a data quality perspective, is understanding the number of deaths that have been coded to an **unusable or insufficiently-specified code**. Also referred to as ‘garbage codes’, these codes contain no or very little useful information about the probable cause of death for that individual, and hence are of dubious value for guiding public health policy. When the proportion of garbage causes is large (above 10–15%) it will bias the distribution of deaths shown in the three broad groups, as the data will not represent the true health status of the population.[[7]](#footnote-7)

Describe figures 11 (distribution of deaths by broad GBD cause groups) and figure 12 (distribution of deaths by usability). Refer to the ratio of group 2 to group 1 – is it close to the comparator or very different?

Figure 11 Proportion of deaths by 3 broad Groups, including unusable and insufficiently specified codes, [country, year]

Insert the bar graph from step 6.1

Figure 12 Distribution of deaths by utility of the cause of death, [country, year]

If you have a single year’s worth of data: Insert the pie chart from step 6.1

If you have more than one year’s data: update the chart data below (for this, click the picture with the right mouse button and then click "Edit Data "). You can delete this chart from your report if you do not want to use it.

Optional extra figure: If you have sub-national data, an optional figure to include is the Proportion of garbage codes by [State / Regional / Municipality]. [Country / State], [year]. Identify the locations with the largest proportions of garbage codes.

### C2. Total deaths by ICD-10 Chapter

The ICD-10 classifies mortality codes into 22 broad chapters. Displaying the proportion of deaths belonging to each chapter of the ICD-10, and the fraction of garbage codes your data record in each chapter, is a useful first step to know where these codes are coming from and where the major areas of concern are (**Table 4**).

Describe table 4 – what chapters contain most of the garbage codes?

Table 4 ICD-10 Chapters with the highest amount of garbage codes in each, [country, name]

To generate this table, sort the original table in ANCONDA (step 7.2) by the column “% total garbage codes” from largest to smallest. Then copy and paste the top five rows across (an example has been provided)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rank | Chapter | ICD-10 code range | Deaths (%) | Garbage codes (%) |
| 1 | Chapter IX: Diseases of the circulatory system | I00-I99 | 27.5 | 35.3 |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| TOTAL (top five Chapters) |  |  |

### C3. Garbage codes by category

To further understand the origin and types of garbage codes in the cause of death data ANACONDA classifies all unusable and insufficiently specified causes into five different categories based on ICD concepts, as follows:

* *Category 1:* Codes relating to symptoms, signs and ill-defined conditions (mostly drawn from R00–R99 in ICD‑10).
* *Category 2:* Codes that have an impossible underlying cause of death.
* *Category 3:* Codes relating to intermediate causes of death.
* *Category 4:* Codes relating to immediate causes of death, such as heart or respiratory failure.
* *Category 5:* Insufficiently specified codes within ICD chapters within a larger disease category. These include causes like ‘ill-defined site of cancer’ and ‘ill-defined injuries’. Use of these codes is unhelpful in guiding prevention efforts. Such efforts are usually cause-specific (eg. lung cancer, early diagnosis of breast and prostate cancer).

As shown in **Table 5**, describe the main aspects of the table. What categories are causing the most garbage? What implications does this have for data quality?

Table 5 Garbage codes by category, [country, year]

Copy the table from step 7.3

|  |  |  |  |
| --- | --- | --- | --- |
| Category of garbage code | Number of deaths with a garbage code | Deaths assigned to garbage code (%) | Relative share of total garbage codes (%) |
| 1: Symptoms, signs and ill-defined conditions |  |  |  |
| 2: Impossible underlying causes of death |  |  |  |
| 3: Intermediate causes of death |  |  |  |
| 4: Immediate causes of death |  |  |  |
| 5: Insufficiently specified causes within ICD-10 Chapters |  |  |  |
| TOTAL |  |  | **100%** |

Option: if you want to show a comparison with another point in the historical series, or display the data from table 5 in a figure, update the data in the charts below (for this, right click on each figure and then click on "Edit Data "). You can delete this chart from your report if you do not want to use it.

Figure 13 Garbage codes by category, [country, year]

|  |  |
| --- | --- |
|  |  |

C1 = symptoms, signs and ill-defined conditions; C2 = impossible as underlying cause of death; C3 = intermediate COD; C4 = immediate COD; C5 = insufficiently specified within ICD chapters

### C4. Garbage codes by severity

ANACONDA also provides an alternative approach to classifying unusable or insufficiently specified codes. It regroups them according to their potential impact for guiding or misguiding public policy to prevent premature deaths. In this classification four levels of ICD-10 codes that should be avoided are defined, depending on how serious their impact is for misinforming public policy. These four levels are defined as:

* **Level 1 –** Codes with serious implications likely to have a ***very high impact*** for health policy. These are codes relating to such vague causes, that the true underlying cause of death could belong to more than one broad cause group.
* **Level 2 –** Codes with substantial implications likely to have a ***high impact***. These are codes relating to vague causes, where the true cause of death is likely to belong to only one of the three broad groups.
* **Level 3 –** Codes with important implications likely to have a ***medium impact***. These are codes for which the true underlying cause of death is known to be within the same ICD chapter. For instance, a death assigned to ‘ill-defined site of cancer’ indicates that the true cause of death was cancer but does not specify the site.
* **Level 4 –** Codes with limited implications likely to have ***low impact***. These are codes for which the true cause of death is likely to be confined to a single disease or injury category. For example, ‘unspecified stroke’ would still be assigned as a stroke death, and not to some other disease category. The implications for public policy of unusable causes classified at this level will generally be minor.

**Table 6** provides the break-down of unusable codes by severity for the [year] input data. Describe the main aspects of the table (from step 7.4). What categories are causing the most issues? How many codes have a potentially ‘severe’ impact on policy? What implications will this have on data quality?

Table 6 Garbage codes by severity, [country, year]

|  |  |  |  |
| --- | --- | --- | --- |
| Severity of garbage codes | Number of deaths with a garbage code | Deaths assigned to garbage code (%) | Relative share of total garbage codes (%) |
| Very high (Level 1) |  |  |  |
| High (Level 2) |  |  |  |
| Medium (Level 3) |  |  |  |
| Low (Level 4) |  |  |  |
| TOTAL |  |  | **100%** |

Option: if you want to show a comparison with another point in the historical series, update the data in the charts below (for this, right click on each figure and then click on "Edit Data "). You can delete this chart from your report if you do not want to use it.

Figure 14 Distribution of garbage codes by severity, [country, year]

|  |  |
| --- | --- |
|  |  |

Optional extra figure: If you have sub-national data, an optional figure to include is the Proportion of deaths with high level garbage codes by [States / Regional / Municipalities]. [Country / State], [year]. Describe the main aspects of the figure. Which places have the highest proportions of high-level garbage codes? How can the observed distribution contribute to the planning of interventions to reduce these codes?

### C5. Age-sex distribution of garbage codes

Examining the age and sex distribution of the four levels of garbage codes helps to assess whether certain garbage codes are more frequent in different population groups. As people age, they are more likely to suffer from diseases and conditions concurrently. This makes it difficult for physicians to identify a single underlying cause. As a result, it is to be expected that garbage codes increase with age, as clearly shown in **Figure 13**. The fact that women usually survive to a higher age than men means that it is also likely to be the explanation for the taller bar for women usually seen in the 65+ age group.

Describe here figure 13. Does the figure align with the expected trends, as described above?

Figure 13 Proportion of deaths with unusable and insufficiently specified codes by age-group, sex, and severity, [country, name]

Enter the graph from step 7.5 or, if you prefer, edit the figures below by entering the proportions shown in ANACONDA (for this, right-click each figure and then click "Edit Data"). You can delete this chart from your report if you do not want to use it.

|  |  |
| --- | --- |
|  |  |

### C6. Redistribution of garbage codes

As discussed previously, unusable or insufficiently specified causes of death and their corresponding codes have a significant impact on the true mortality composition of the population. **Figure 14** shows two pie charts; the first is based on the input data from [year] and shows the distribution of deaths across the three broad groups including unusable or insufficiently specified codes. The second has applied a redistribution algorithm developed by the IHME for use in the GBD Studies,[[8]](#footnote-8) which removes garbage codes and redistributes them to their most likely group.

As the second pie chart shows, after redistributing the garbage codes, describe here how the redistribution changes the proportion of deaths in each of the three broad cause groups.

Figure 14 Distribution of cause of death data according to three broad groups, before redistribution of garbage codes, [country, year]

Insert the pie charts from step 7.6, or enter data into the figures below (for this, right-click each figure and then click "Edit Data").

|  |  |
| --- | --- |
|  |  |

### C7. Leading packages of garbage codes

ANACONDA has the ability to identify which are the most important ‘packages’ of garbage codes within each of the four levels of severity and shows the number of deaths assigned to each specific ICD garbage code in the package. Each package, is a collection of poor diagnostic practices that are being applied during medical certification and coding, resulting in specific, identifiable misdiagnoses that are resulting in unusable and insufficiently specified codes.

**Table 7** provides a summary of the ICD-10 codes and category names (causes of death) for the top five packages within Level 1 (very high severity), which should be the focus of any improvement efforts. Describe table 7. What are the main garbage cause packages that cause the most garbage codes?

Table 7 Garbage codes, Level 1, top five packages, [country, name]

Use the top 5 packages within Level 1 to complete this table (step 7.7). When you click on each of the package names, the table on the right will then display the top category name and ICD code. Examples have been provided

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Rank | Package name | Number of deaths | Causes in level (%) | Category name and ICD-10 code | Number of deaths |
| 1 | All, ill-defined | 13,723 | 20.7 | Other ill-defined and unspecified causes of mortality (R99) | 8,059 |
| 2 | Shock and cardiac arrest | 11,724 | 17.7 | Cardiac arrest (I46) | 11,171 |
| 3 | Left heart failure | 9,122 | 13.8 | Heart failure (I50) | 9,122 |
| 4 | Sepsis | 6,986 | 10.5 | Other septicaemia (A41) | 6,606 |
| 5 | Senility | 6,363 | 9.6 | Senility (R54) | 6,363 |
| TOTAL (top five packages) | **47,918** | **72.4** | **TOTAL (top five categories)** | **41,341** |
| TOTAL (Level 1) | **66,226** | **100.0** |

### C8. Non-standard codes and biologically implausible causes of death [optional]

If your dataset contains causes of death that seem implausible given the age and sex of the decedent they will be listed in step 7.9. If there are many, insert a table with the top 5 and provide an explanation (if possible) about why they are in the input data.

**Table 8** provides a summary of the top five biologically implausible causes of death; given the sex and/or age group. Describe here table 8 – can you explain any of these (especially if the total number is very high)

To generate this table, first sort the data in the original table in step 7.9 by “% unlikely observations” and copy across the top five. Examples have been provided

Table 8 Top five biologically implausible causes of death, [country, year]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Rank | Cause of death | Observations | Unlikely observations | Unlikely observations (%) | Reason for implausibility |
| 1 | Malignant testicular cancer | 85 | 9 | 10.6 | Under 15 years |
| 2 | Genital prolapse | 29 | 2 | 6.9 | Under 10 years |
| 3 | Malignant skin melanoma | 107 | 2 | 1.9 | Under 15 years |
| 4 | Non-melanoma skin cancer | 149 | 2 | 1.3 | Under 15 years |
| 5 | Liver cancer | 6,262 | 41 | 0.7 | Under 15 years |

### C9. Age distribution of mortality within broad cause of death groups

The causes of death in a population generally follow a predictable age pattern that has been identified from decades of global epidemiological observations. This is because the risk of dying from the different diseases and injuries covered in each group varies with age. The diseases in Group 1 (communicable diseases) are known to cause significant mortality in younger children (particularly those aged less than one year). After this the proportion of deaths declines to a low level, and only gradually begins to increase again towards the older ages where people become more susceptible to infectious diseases such as pneumonia. Group 2 (NCDs) has very few deaths in younger age groups (mostly due to congenital malformations), with most of deaths found in the adult and older age groups for both men and women. A clear gender difference is usually observed in Group 3, with more males dying from external causes during young adulthood, while the proportion of women dying remains relatively even at each age group.

**Figures 16 & 17** show the age pattern of deaths found for each of the three groups together with comparator data for [country], provided by the IHME’s GBD 2015 Study.Describe here the graphs – how does the input data compare with the comparator? Are they consistent or very different? What might this mean in terms of completeness and data quality?

Figure 16 Proportion of deaths by broad disease Group, males, [country, year] [with comparator]

Insert the graphs from step 8.1 (males with comparator) – see example below for format



Figure 17 Proportion of deaths by broad disease Group, females, [country, year] [with comparator]

Insert the graphs from step 8.1 (females with comparator)

### C10. Distribution of deaths by broad group and age

In this step of ANACONDA, the age distribution of deaths by broad group (as discussed above) are merged into one figure, which also includes the potential bias introduced by the proportion of deaths with an unusable or insufficiently specified code in each age group. **Figure 18** shows, describe the figure here. What ages are responsible for most of the garbage codes? Does the pattern for Groups 1,2 and 3 follow the expected distributions?

Figure 18 Distribution of deaths by age group and broad Group, including unusable and insufficiently specified causes, [country, year]

Insert the graph from step 8.2

### C11. Leading causes of death

All vital statistics systems should be able to produce a table showing the leading causes of death for the population. Such rankings are an important source of policy-relevant information. An analysis of the leading causes of death can also indicate the reliability and plausibility of the cause of death data. **Tables 8 and 9** show the top 20 causes of death in the input data for males and females separately, as coded to the ICD-10 for the [year] input data. All causes of death that are considered unusable (Level 1-3) are coloured in red and those that are insufficiently specified are coded in orange (Level 4).

Describe here the main quality issues from the table and why a table with many leading causes coloured red and orange is misleading (they obscure the actual pattern and misguide policy). This ranking based on the input data focuses on the number of causes that are garbage, and the implications this has for policy and planning

### C12. Leading causes of death (after redistribution of garbage)

The impact of garbage codes on the leading causes of death can be significant and distort the true pattern of mortality in country. To show this, ANACONDA applies a redistribution algorithm developed by the GBD Study,[[9]](#footnote-9) which reallocates garbage codes to valid causes to produce more likely patterns of mortality for males and females. These are presented in the ‘after redistribution’ column in **Tables 8 & 9**. A comparison of the 20 leading diseases of death in these two distributions illustrates the bias introduced by the garbage causes in the ranking of causes of death . Focus on describing how the lists have changed once the garbage codes have been redistributed. Are there any new causes that weren’t in the original list? Have some causes moved up or down in priority? What implications does this have for policy and planning if people were to only use the original list (from the ‘before redistribution’ column)?

Table 8 Top 20 causes of death, males, before and after redistribution of unusable and insufficiently specified codes [country, year]

Copy the table in step 9.1 and use colour to show the deaths that have been coded to an unusable or insufficiently specified code (orange for level 4 and red for levels 1-3)

Copy the data from table from step 9.2 for the ‘after redistribution’ table

|  |  |  |
| --- | --- | --- |
| **Before redistribution** |   | **After redistribution** |
| **1** | C43.- | Malignant melanoma of skin |   | **1** |  |
|  | Malign |  |   |  |  |  |
| **2** | I64.- | Stroke, not specified as haemorrhage or infarction |   | **2** |  |
|  |  |  |   |  |  |  |
| **3** |  |  |   | **3** |  |
|  |  |  |   |  |  |  |
| **4** |  |  |   | **4** |  |
|  |  |  |   |  |  |  |
| **5** |  |  |   | **5** |  |
|  |  |  |   |  |  |  |
| **6** |  |  |   | **6** |  |
|  |  |  |   |  |  |  |
| **7** |  |  |   | **7** |  |
|  |  |  |   |  |  |  |
| **8** |  |  |   | **8** |  |
|  |  |  |   |  |  |  |
| **9** |  |  |   | **9** |  |
|  |  |  |   |  |  |  |
| **10** |  |  |   | **10** |  |
|  |  |  |   |  |  |  |
| **11** |  |  |   | **11** |  |
|  |  |  |   |  |  |  |
| **12** |  |  |   | **12** |  |
|  |  |  |   |  |  |  |
| **13** |  |  |   | **13** |  |
|  |  |  |   |  |  |  |
| **14** |  |  |   | **14** |  |
|  |  |  |   |  |  |  |
| **15** |  |  |   | **15** |  |
|  |  |  |   |  |  |  |
| **16** |  |  |   | **16** |  |
|  |  |  |   |  |  |  |
| **17** |  |  |   | **17** |  |
|  |  |  |   |  |  |  |
| **18** |  |  |   | **18** |  |
|  |  |  |   |  |  |  |
| **19** |  |  |   | **19** |  |
|  |  |  |   |  |  |  |
| **20** |  |  |   | **20** |  |
|   |   |   |   |   |   |   |
|   |   | Very high, high, and medium severity (Levels 1–3) |   |   |   |  |
|  |  | Low severity (Level 4) |  |  |  |  |

Table 9 Top 20 causes of death, females, before and after redistribution of unusable and insufficiently specified codes [country, year]

Copy the table in step 9.1 and use colour to show the deaths that have been coded to an unusable or insufficiently specified code (orange for level 4 and red for levels 1-3)

Copy the data from table from step 9.2 for the ‘after redistribution’ table

|  |  |  |
| --- | --- | --- |
| **Before redistribution** |   | **After redistribution** |
| **1** |  |  |   | **1** |  |
|  |  |  |   |  |  |  |
| **2** |  |  |   | **2** |  |
|  |  |  |   |  |  |  |
| **3** |  |  |   | **3** |  |
|  |  |  |   |  |  |  |
| **4** |  |  |   | **4** |  |
|  |  |  |   |  |  |  |
| **5** |  |  |   | **5** |  |
|  |  |  |   |  |  |  |
| **6** |  |  |   | **6** |  |
|  |  |  |   |  |  |  |
| **7** |  |  |   | **7** |  |
|  |  |  |   |  |  |  |
| **8** |  |  |   | **8** |  |
|  |  |  |   |  |  |  |
| **9** |  |  |   | **9** |  |
|  |  |  |   |  |  |  |
| **10** |  |  |   | **10** |  |
|  |  |  |   |  |  |  |
| **11** |  |  |   | **11** |  |
|  |  |  |   |  |  |  |
| **12** |  |  |   | **12** |  |
|  |  |  |   |  |  |  |
| **13** |  |  |   | **13** |  |
|  |  |  |   |  |  |  |
| **14** |  |  |   | **14** |  |
|  |  |  |   |  |  |  |
| **15** |  |  |   | **15** |  |
|  |  |  |   |  |  |  |
| **16** |  |  |   | **16** |  |
|  |  |  |   |  |  |  |
| **17** |  |  |   | **17** |  |
|  |  |  |   |  |  |  |
| **18** |  |  |   | **18** |  |
|  |  |  |   |  |  |  |
| **19** |  |  |   | **19** |  |
|  |  |  |   |  |  |  |
| **20** |  |  |   | **20** |  |
|   |   |   |   |   |   |   |
|   |   | Very high, high, and medium severity (Levels 1–3) |   |   |   |  |
|  |  | Low severity (Level 4) |  |  |  |  |

## Part D: Overall data quality index

### D1. Vital Statistics Performance Index for Quality

The Vital Statistics Performance Index for Quality, or VSPI(Q), is a summary score of overall system performance that considers five essential components of quality:[[10]](#footnote-10)

1. Completeness of death registration
2. Quality of cause of death reporting (fraction of unusable or insufficiently specified codes)
3. Level of cause-specific detail available (amount of detail in the cause of death list used for tabulation)
4. Quality of age and sex reporting (extent to which age and/or sex are missing in the data)
5. Number of biologically implausible underlying causes.

Scores on each of these five components are then modelled and weighted according to their importance in determining the correct cause of death distribution in a population, and combined into a VSPI(Q) score, ranging from 0 to 100. The higher the score; the better the overall quality of the mortality data, with values above 85% suggesting a well-functioning CRVS system that will meet most policy needs for reliable data.

**Table 10 shows that, for the [country, year] input data, the overall VSPI(Q) score was X%, representing [classification, ie. low, medium, high] quality**. Describe here the main features of table 11 and the components of the VSPI(Q) score

Table 10 Weighted scores by VSPI(Q) component, [country, year]

Copy across the data from the table on step 10.1

|  |  |
| --- | --- |
| Component | Score (weighted) |
| Quality of age and sex reporting |  |
| Quality of cause of death reporting |  |
| Biologically plausible causes of death |  |
| Level of cause-specific detail available |  |
| Completeness of death registration |  |
| Summary score |  |

The pie chart (**Figure 19**) shows the specific contribution of each component expressed as a percentage to the gap between the VSPI(Q) score and 100%. The larger the share a component has, the more important the component is in lowering the overall VSPI(Q) score, and the more urgent efforts are needed to increase the quality of the input data. Describe here the main features of figure 19, and what is having the greatest impact on the quality of the input data

Figure 19 Relative importance of VSPI(Q) components, [country, year]

Insert the pie chart from step 10.1

# Conclusions and next steps

Write a few sentences/paragraphs here about the key findings, eg. Does your system manage to record all deaths that take place? If not, which are the population groups that you are missing? What are people dying from? Are some of these deaths preventable? Are your cause of death data biased because of garbage codes? What is needed to be done to improve further the quality of the data?

If the assessment is also used to show the impact of different data improvement programs (i.e. introduction of medical certification training in hospitals or verbal autopsy for community deaths) it is recommended that comparators from before and after are inserted. The ANACONDA results from before the intervention can be exported and copied into the current assessment report.

Apart from giving a full detailed assessment of the quality of the dataset used, the ANACONDA report also provides a very useful overview of the mortality and cause of death situation of the population it describes. You can decide yourself the focus of the report and how much information to include.

By focusing only on specific steps and adding available related material from other sources the report can be targeted to specific audiences.

The ANACONDA results are easy to share with others and can be instrumental in improving your mortality and cause of death reporting system. MAKE THE MOST OUT OF THEM!



## For more information contact:

CRVS-info@unimelb.edu.au

https://crvsgateway.info/

1. Mikkelsen L, Lopez AD. *Guidance for assessing and interpreting the quality of mortality data using ANACONDA*. CRVS Resources and tools. Melbourne, Australia; Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, University of Melbourne; 2017. [↑](#footnote-ref-1)
2. Institute for Health Metrics and Evaluation. Global burden of disease cause list 2015. [www.healthdata.org/sites/default/files/files/Projects/GBD/GBDcause\_list.pdf](http://www.healthdata.org/sites/default/files/files/Projects/GBD/GBDcause_list.pdf) [↑](#footnote-ref-2)
3. Adair T, Lopez AD. Estimating the completeness of death registration: An empirical method. PLoS ONE 13(5):e0197047. https:///doi.org/10.1371/journal.pone0197047 [↑](#footnote-ref-3)
4. Mikkelsen L, Richards N, Lopez AD. *Redefining ‘garbage codes’ for public health policy: Report on the expert group meeting, 27­–28 February 2017*. CRVS technical outcome series. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, and Civil Registration and Vital Statistics Improvement, University of Melbourne; 2018. [↑](#footnote-ref-4)
5. For more information on the United Nations Inter-agency Group for Child Mortality Estimation, see <https://resourcecentre.savethechildren.net/publishers/un-igme-united-nations-inter-agency-group-child-mortality-estimation> [↑](#footnote-ref-5)
6. Murray CJL, Lopez AD (eds.). The Global Burden of Disease. A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Boston, USA: Harvard School of Public Health on behalf of the World Health Organization and The World Bank; 1996. [↑](#footnote-ref-6)
7. Mikkelsen L, Lopez AD. *Guidance for assessing and interpreting the quality of mortality data using ANACONDA*. CRVS Resources and tools. Melbourne, Australia; Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, University of Melbourne; 2017. [↑](#footnote-ref-7)
8. Lozano R, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2013: 380(9859);2095–128. [↑](#footnote-ref-8)
9. Lozano R, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. [↑](#footnote-ref-9)
10. Philips DE, Lozano R, Naghavi M, et al. A composite metric for assessing data on mortality and causes of death: the vital statistics performance index. *Population Health Metrics* 2014: 12(14). [↑](#footnote-ref-10)