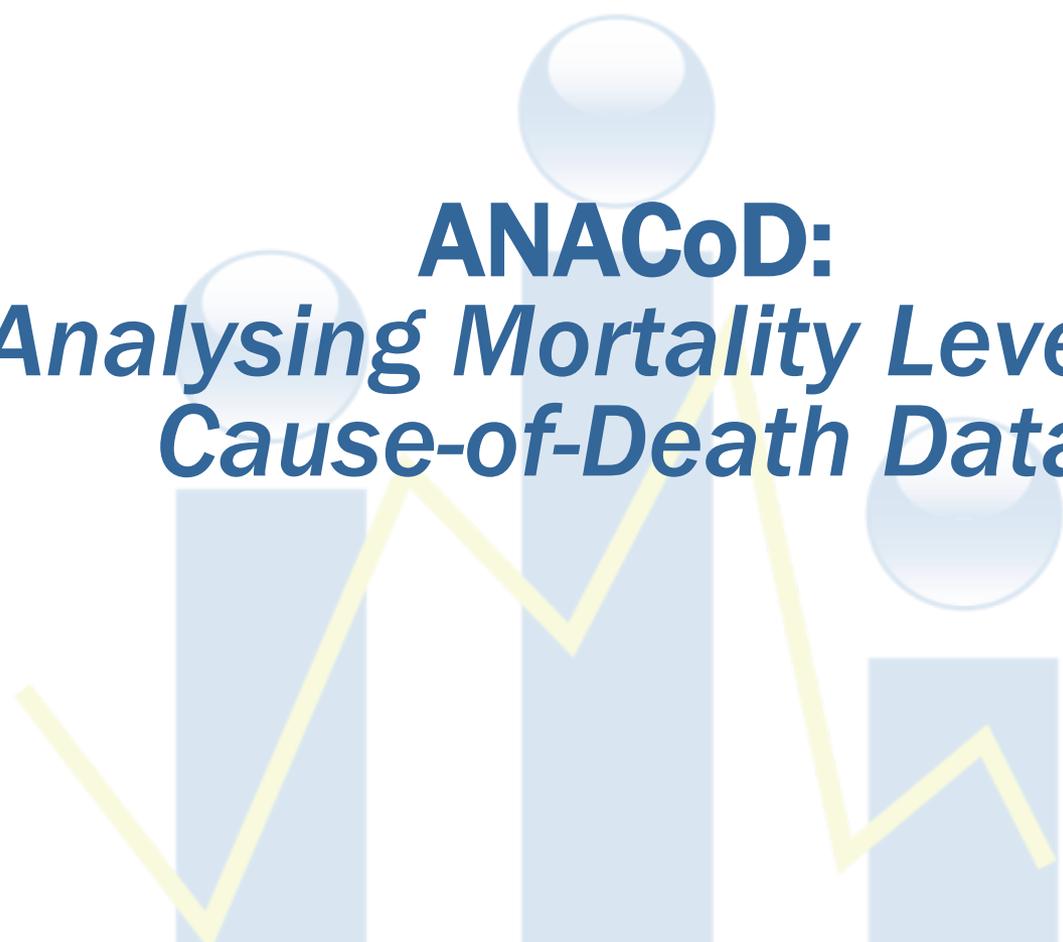


U.S. Centers for Disease Control and Prevention  
National Center for Health Statistics  
International Statistics Program



# **ANACoD:** *Analysing Mortality Levels & Cause-of-Death Data*

These materials have been developed by the National Center for Health Statistics, International Statistics Program, Hyattsville, Md., as part of the CDC Global Program for Civil Registration and Vital Statistics Improvement.



# Assessing the Quality of Mortality Data: 10 step process

- 1) Prepare basic tabulations of deaths by age, sex and cause of death
- 2) Review crude death rates
- 3) Review age and sex-specific death rates
- 4) Review the age distribution of deaths
- 5) Review child mortality rates
- 6) Review the distribution of major causes of death
- 7) Review age patterns of major causes of death
- 8) Review leading causes of death
- 9) Review ratio of noncommunicable to communicable disease deaths

SOURCES:  
World Health Organization (2011). *Analysing mortality levels and causes of death (ANACoD) Electronic Tool*. Department of Health Statistics and Information Systems. Geneva, World Health Organization. Available from [healthstat@who.int](mailto:healthstat@who.int) (ANACoD)  
AbouZahr C, Mikkelsen L, Rampatige R, and Lopez A. Mortality statistics: a tool to improve understanding and quality. Health Information Systems Knowledge Hub, University of Queensland. Working Paper Series 13. November 2010.  
<http://www.uq.edu.au/hishub/wp13> (UQ Working Paper 13)



# INTERNATIONAL FORM OF MEDICAL CERTIFICATE OF CAUSE OF DEATH

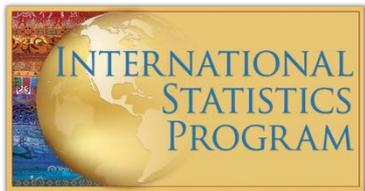
WHO recommends  
 the use of the  
 International Form  
 of Medical  
 Certification of  
 Cause of Death to  
 document the  
 underlying cause of  
 death

|  | Cause of death  | Approximate interval between onset and death        |
|--|---|---|
| <p><b>I</b><br/>           Disease or condition directly leading to death*</p> <p><i>Antecedent causes</i><br/>           Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last</p> | <p>(a) <b>Traumatic shock</b> .....</p> <p>due to (or as a consequence of)</p> <p>(b) <b>Internal injuries</b> .....</p> <p>due to (or as a consequence of)</p> <p>(c) <b>Pedestrian hit by car</b> .....</p> <p>due to (or as a consequence of)</p> <p>(d) .....</p> | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> |
| <p><b>II</b><br/>           Other significant conditions contributing to the death, but not related to the disease or condition causing it</p>   | <p>.....</p> <p><b>AIDS</b> .....</p> <p>.....</p>  | <p>.....</p> <p>.....</p> <p>.....</p>              |
| <p><i>*This does not mean the mode of dying, e.g. heart failure, respiratory failure. It means the disease, injury, or complication that caused death.</i></p>   |   |   |



# International Statistical Classification of Diseases and Related Health Problems: 10th Revision (ICD-10)

| <b>Chapter Blocks</b> | <b>Title</b> | <i>includes natural causes &amp; external causes of death</i>        |
|-----------------------|--------------|--|
| I                     | A00-B99      | Certain infectious and parasitic diseases                            |
| II                    | C00-D48      | Neoplasms  |
| III                   | D50-D89      | Diseases of the blood and blood-forming organs...                    |
| IV                    | E00-E90      | Endocrine, nutritional and metabolic diseases                        |
| V                     | F00-F99      | Mental and behavioral disorders                                      |
| VI                    | G00-G99      | Diseases of the nervous system                                       |
| VII                   | H00-H59      | Diseases of the eye and adnexa                                       |
| VIII                  | H60-H95      | Diseases of the ear and mastoid process                              |
| IX                    | I00-I99      | Diseases of the circulatory system                                   |
| X                     | J00-J99      | Diseases of the respiratory system                                   |
| XI                    | K00-K93      | Diseases of the digestive system                                     |
| XII                   | L00-L99      | Diseases of the skin and subcutaneous tissue                         |
| XIII                  | M00-M99      | Diseases of the musculoskeletal system and connective tissue         |
| XIV                   | N00-N99      | Diseases of the genitourinary system                                 |
| XV                    | O00-O99      | Pregnancy, childbirth and the puerperium                             |
| XVI                   | P00-P96      | Certain conditions originating in the perinatal period               |
| XVII                  | Q00-Q99      | Congenital malformations, deformations and chromosomal abnormalities |
| XVIII                 | R00-R99      | Symptoms, signs and abnormal clinical and laboratory findings...     |
| XIX                   | S00-T98      | Injury, poisoning and certain other consequences of external causes  |
| XX                    | V01-Y98      | External causes of morbidity and mortality                           |
| XXI                   | Z00-Z99      | Factors influencing health status and contact with health services   |
|                       | IU00-U99     | Codes for special purposes   |



# ANACoD:

## *Analysing mortality levels & cause-of-death data*

- An electronic tool to automate the 10 step process
- Step-by-step tool for analysis of data on **mortality levels** and **cause of death**



### ■ Developed by:

- WHO
- The University of Queensland Health Info. Systems Knowledge Hub
- Health Metrics Network (financial support)



#### SOURCES FOR ANACoD SLIDES:

(ANACoD) World Health Organization (2011). *Analysing mortality levels and causes of death (ANACoD) Electronic Tool*. Department of Health Statistics and Information Systems. Geneva, World Health Organization. Available from [healthstat@who.int](mailto:healthstat@who.int);

(UQWP13) AbouZahr C, Mikkelsen L, Rampatige R, and Lopez A. *Mortality statistics: a tool to improve understanding and quality*. Health Information Systems Knowledge Hub, University of Queensland. Working Paper Series 13. November 2010.

## ANACoD version 1.1

### Analysing mortality level and cause-of-death data

*Click on the buttons to select analysis*

#### Step by step core analyses

|                          |  |                          |   |
|--------------------------|--|--------------------------|---|
| <input type="checkbox"/> | Input data: raw mortality data by age, sex and ICD10 3 or 4 character codes; population by age and sex | <input type="checkbox"/> | Distribution of deaths according to the Global Burden of Disease list |
| <input type="checkbox"/> | Basic check of input data  | <input type="checkbox"/> | Age pattern of broad groups of causes of deaths                       |
| <input type="checkbox"/> | Crude death rates  | <input type="checkbox"/> | Leading causes of death   |
| <input type="checkbox"/> | Age- and sex-specific death rates  | <input type="checkbox"/> | Ratio of non-communicable to communicable causes of death             |
| <input type="checkbox"/> | Age distribution of deaths   | <input type="checkbox"/> | Ill-defined causes of death   |
| <input type="checkbox"/> | Child mortality rates  | <input type="checkbox"/> | Summary of analyses   |

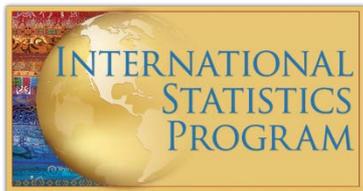
#### Supplementary analyses

|                          |  |                          |   |
|--------------------------|--|--------------------------|---|
| <input type="checkbox"/> | Age pattern of individual cause of death | <input type="checkbox"/> | Age-specific death rates of individual cause of death |
|--------------------------|--|--------------------------|---|

#### Background information

|                          |  |                          |   |
|--------------------------|--|--------------------------|---|
| <input type="checkbox"/> | About the tool   | <input type="checkbox"/> | List of ICD-10 codes valid for underlying causes of death |
| <input type="checkbox"/> | Global Burden of Disease cause categories and ICD-10 codes |                          |   |





# Getting Started

Open Excel file: *ANACoD version 1.1 2013Feb\_blank.xls*

- Enable macros

Go to sheet “step0-Input data”

- Enter information at top of page:
  - Country: Colombia
  - Year: 2009
  - Source of data: Civil registration
  - ICD level used: ICD-10, 4-character codes
- Input data from Excel file: *Country Data\_Anacod.xlsx*
  - Copy “Population” data; paste into ANACoD tool, starting in E14
  - Copy “Deaths: data; paste into ANACoD tool, starting in C20



# ANACoD - PART I: INPUT DATA

Step 0 - Input data: **raw mortality data by age and sex** and **ICD 3 or 4 character codes**; **population data by sex and age**

## Population

| Sex      | All ages | 0 year | 1-4 year | 5-9 years | 10-14 years | 15-19 years | 20-24 years | 25-29 years | 30-34 years | 35-39 years |
|----------|----------|--------|----------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1=male   | 22464882 | 466526 | 1828674  | 2250657   | 2240827     | 2201572     | 2050933     | 1894170     | 1707701     | 1510151     |
| 2=female | 23189162 | 446815 | 1753044  | 2160252   | 2155587     | 2130962     | 2019554     | 1912832     | 1774594     | 1612906     |

## Number of deaths

| Cause in ICD | Sex | All ages | 0 year | 1-4 years | 5-9 years | 10-14 years | 15-19 years | 20-24 years | 25-29 years | 30-34 years | 35-39 years |
|--------------|-----|----------|--------|-----------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| A010         | 2   | 1        | 0      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A020         | 1   | 3        | 1      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A020         | 2   | 2        | 0      | 0         | 0         | 0           | 0           | 1           | 0           | 0           | 0           |
| A021         | 1   | 1        | 1      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A021         | 2   | 2        | 1      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A039         | 2   | 1        | 0      | 0         | 0         | 0           | 1           | 0           | 0           | 0           | 0           |
| A042         | 1   | 1        | 0      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A046         | 2   | 1        | 0      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A047         | 1   | 12       | 6      | 2         | 0         | 0           | 1           | 0           | 0           | 0           | 0           |
| A047         | 2   | 7        | 2      | 2         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A049         | 1   | 12       | 1      | 3         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A049         | 2   | 8        | 1      | 0         | 0         | 0           | 0           | 0           | 0           | 1           | 0           |
| A059         | 1   | 2        | 0      | 0         | 0         | 0           | 0           | 0           | 1           | 0           | 0           |
| A060         | 1   | 1        | 0      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A060         | 2   | 2        | 0      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |
| A061         | 2   | 1        | 0      | 0         | 0         | 0           | 0           | 0           | 0           | 0           | 0           |



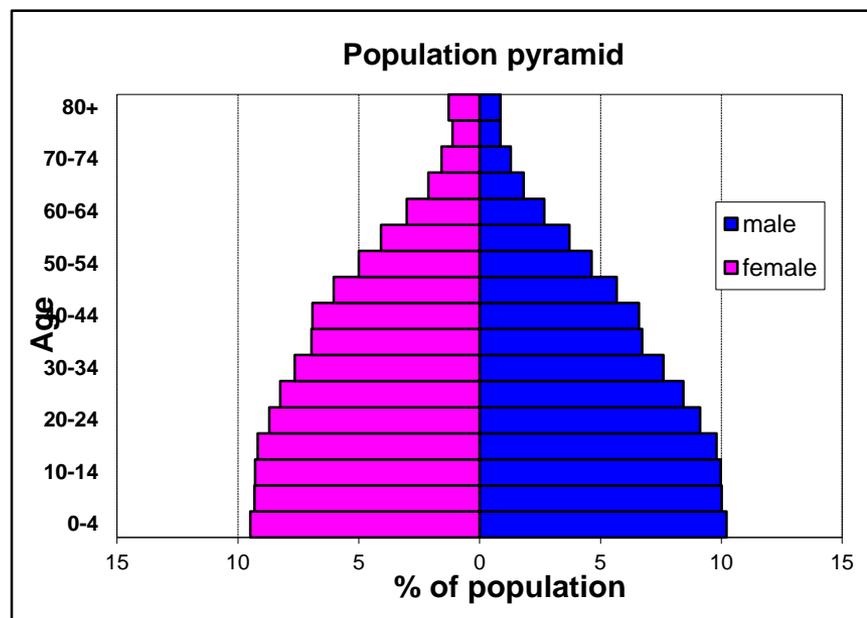
# ANACoD - PART I: INPUT DATA

## Step 1 - Basic check of input data

**Population:** The entered data automatically generate a table and population pyramid (discussed further in Step 2).

### 1. Population

| Age-group (yrs) | Population |            |
|-----------------|------------|------------|
|                 | male       | female     |
| All ages        | 22 464 882 | 23 189 162 |
| 0               | 466 526    | 446 815    |
| 1-4             | 1 828 674  | 1 753 044  |
| 5-9             | 2 250 657  | 2 160 252  |
| 10-14           | 2 240 827  | 2 155 587  |
| 15-19           | 2 201 572  | 2 130 962  |
| 20-24           | 2 050 933  | 2 019 554  |
| 25-29           | 1 894 170  | 1 912 832  |
| 30-34           | 1 707 701  | 1 774 594  |
| 35-39           | 1 510 151  | 1 612 906  |
| 40-44           | 1 479 874  | 1 603 908  |
| 45-49           | 1 275 551  | 1 399 558  |
| 50-54           | 1 040 753  | 1 158 799  |
| 55-59           | 833 936    | 945 156    |
| 60-64           | 600 560    | 697 959    |
| 65-69           | 408 106    | 492 649    |
| 70-74           | 289 037    | 366 559    |
| 75-79           | 193 494    | 261 311    |
| 80+             | 192 360    | 296 717    |





**Any non-zero numbers indicate age groups for which country data are not consistent.**

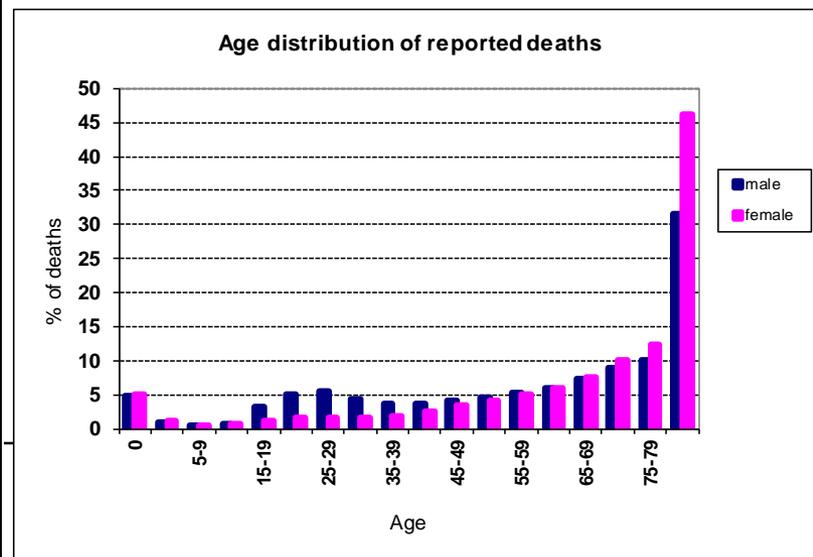
# ANACoD - PART I: INPUT DATA

## Step 1 - Basic check of input data

| sex                              | all ages | 0    | 1-4  | 5-9 | 10-14 | 15-19 | 20-24 | ... |
|----------------------------------|----------|------|------|-----|-------|-------|-------|-----|
| No deaths in "AAA": all causes   |          |      |      |     |       |       |       |     |
| m                                | 113327   | 5333 | 1121 | 629 | 848   | 3604  | 5622  | ... |
| f                                | 83354    | 4225 | 931  | 469 | 523   | 1042  | 1255  | ... |
| Sum of deaths in all other codes |          |      |      |     |       |       |       |     |
| m                                | 113327   | 5333 | 1121 | 629 | 848   | 3604  | 5622  | ... |
| f                                | 83354    | 4225 | 931  | 469 | 523   | 1042  | 1255  | ... |
| Difference: should be zero       |          |      |      |     |       |       |       |     |
| m                                | 0        | 0    | 0    | 0   | 0     | 0     | 0     | ... |
| f                                | 0        | 0    | 0    | 0   | 0     | 0     | 0     | ... |

### 2.2 Distribution of total death

| Age-group (yrs) | No of deaths |        | Percentage of total deaths |        |
|-----------------|--------------|--------|----------------------------|--------|
|                 | male         | female | male                       | female |
| All ages        | 113 327      | 83 354 |                            |        |
| 0               | 5 368        | 4 234  | 4.7                        | 5.1    |
| 1-4             | 1 128        | 933    | 1.0                        | 1.1    |
| 5-9             | 633          | 470    | 0.6                        | 0.6    |
| 10-14           | 854          | 524    | 0.8                        | 0.6    |
| 15-19           | 3 628        | 1 044  | 3.2                        | 1.3    |
| 20-24           | 5 659        | 1 258  | 5.0                        | 1.5    |
| 25-29           | 6 112        | 1 289  | 5.4                        | 1.5    |
| 30-34           | 4 863        | 1 361  | 4.3                        | 1.6    |
| 35-39           | 4 197        | 1 582  | 3.7                        | 1.9    |
| 40-44           | 4 187        | 2 117  | 3.7                        | 2.5    |
| 45-49           | 4 646        | 2 791  | 4.1                        | 3.3    |
| 50-54           | 5 129        | 3 525  | 4.5                        | 4.2    |
| 55-59           | 6 046        | 4 132  | 5.3                        | 5.0    |
| 60-64           | 6 808        | 4 863  | 6.0                        | 5.8    |
| 65-69           | 8 366        | 6 323  | 7.4                        | 7.6    |
| 70-74           | 9 990        | 8 396  | 8.8                        | 10.1   |
| 75-79           | 11 431       | 10 206 | 10.1                       | 12.2   |
| 80+             | 24 281       | 28 307 | 31.5                       | 46.2   |



**An attempt should be made to query and correct the specific death certificate.**

See cite slide 54.

# ANACoD - PART I: INPUT DATA

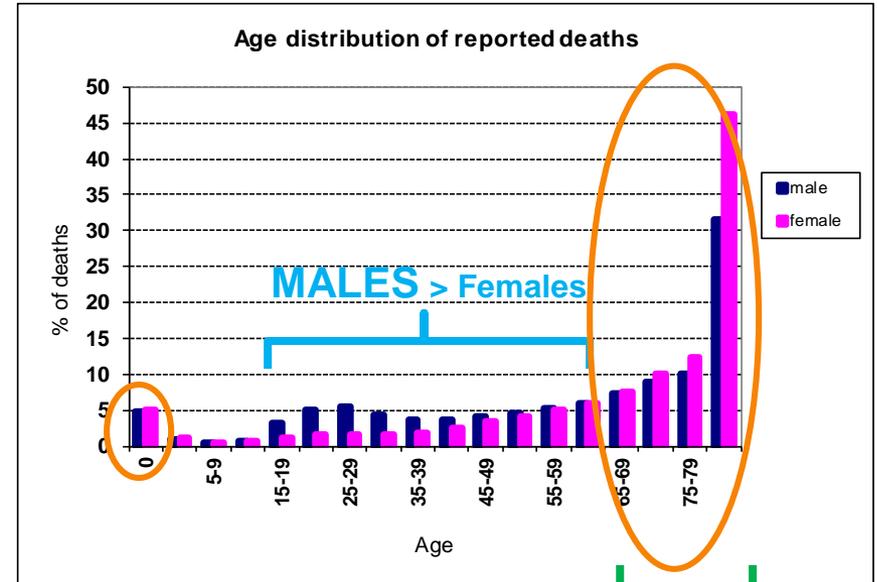
## Step 1 - Basic check of input data

**Look for expected patterns:**

**Deviations may indicate errors in age or sex information.**

2.2 Distribution of total death

| Age-group (yrs) | No of deaths |        | Percentage of total deaths |        |
|-----------------|--------------|--------|----------------------------|--------|
|                 | male         | female | male                       | female |
| All ages        | 113 327      | 83 354 | 4.7                        | 5.1    |
| 0               | 5 368        | 4 234  | 1.0                        | 1.1    |
| 1-4             | 1 128        | 933    | 0.6                        | 0.6    |
| 5-9             | 633          | 470    | 0.8                        | 0.6    |
| 10-14           | 854          | 524    | 3.2                        | 1.3    |
| 15-19           | 3 628        | 1 044  | 5.0                        | 1.5    |
| 20-24           | 5 659        | 1 258  | 5.4                        | 1.5    |
| 25-29           | 6 112        | 1 289  | 4.3                        | 1.6    |
| 30-34           | 4 863        | 1 361  | 3.7                        | 1.9    |
| 35-39           | 4 197        | 1 582  | 3.7                        | 2.5    |
| 40-44           | 4 187        | 2 117  | 4.1                        | 3.3    |
| 45-49           | 4 646        | 2 791  | 4.5                        | 4.2    |
| 50-54           | 5 129        | 3 525  | 5.3                        | 5.0    |
| 55-59           | 6 046        | 4 132  | 6.0                        | 5.8    |
| 60-64           | 6 808        | 4 863  | 7.4                        | 7.6    |
| 65-69           | 8 366        | 6 323  | 8.8                        | 10.1   |
| 70-74           | 9 990        | 8 396  | 10.1                       | 12.2   |
| 75-79           | 11 431       | 10 206 | 31.5                       | 46.2   |
| 80+             | 24 281       | 28 307 |                            |        |



Males < FEMALES

- Higher percentages in the 0 and 65+ age groups
- Higher percentages for males compared to females in the 15-64 age groups, due to a higher number of deaths from external causes
- Higher percentages for females compared to males in the oldest age groups



# ANACoD - PART I: INPUT DATA

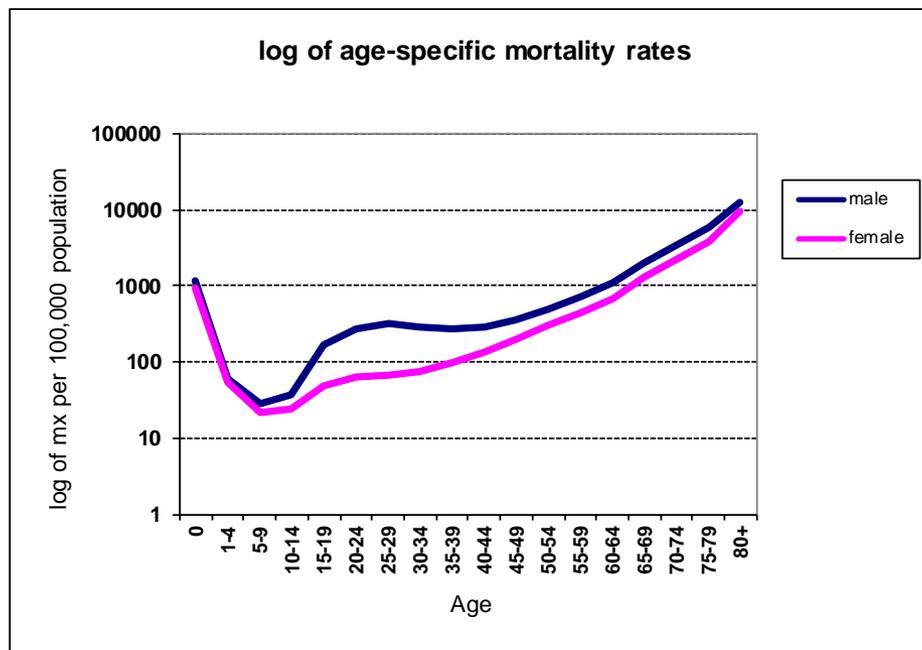
## Step 1 - Basic check of input data

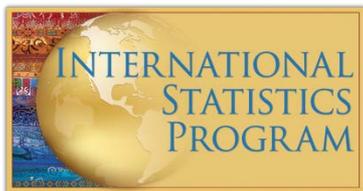
### Check for standard patterns:

- Generally higher rates of male versus female mortality.
- Smooth, increasing lines after age 35 years.

### 2.3 Age-specific mortality rate

| Age-group (yrs) | Age-specific mortality rate per 100 000 ( $m_x$ ) |        |
|-----------------|---|--------|
|                 | male  | female |
| 0               | 1 151   | 948    |
| 1-4             | 62  | 53     |
| 5-9             | 28  | 22     |
| 10-14           | 38  | 24     |
| 15-19           | 165   | 49     |
| 20-24           | 276   | 62     |
| 25-29           | 323   | 67     |
| 30-34           | 285   | 77     |
| 35-39           | 278   | 98     |
| 40-44           | 283   | 132    |
| 45-49           | 364   | 199    |
| 50-54           | 493   | 304    |
| 55-59           | 725   | 437    |
| 60-64           | 1 134   | 697    |
| 65-69           | 2 050   | 1 283  |
| 70-74           | 3 456   | 2 290  |
| 75-79           | 5 908   | 3 906  |
| 80+             | 12 623  | 9 540  |





# ANACoD - PART I: INPUT DATA

## Step 1 - Basic check of input data

**Checking for invalid ICD codes -- All cells should contain a "0" or "0%."**

### 2.4 Deaths (in years) labelled with codes not valid for underlying cause of death according to ICD10

2 cases: Deaths with ICD10 codes that should not be used for causes of deaths.  
Codes not existing in ICD10.

|               | sex | all ages | 0  | 1-4 | 5-9 | 10-14 | 15-19 |
|---------------|-----|----------|----|-----|-----|-------|-------|
| No            | m   | 0        | 0  | 0   | 0   | 0     | 0     |
|               | f   | 0        | 0  | 0   | 0   | 0     | 0     |
| As % of total | m   | 0%       | 0% | 0%  | 0%  | 0%    | 0%    |
|               | f   | 0%       | 0% | 0%  | 0%  | 0%    | 0%    |

ICD10  
Go

Go to the list of valid ICD10 codes for underlying causes of deaths

Go to step1-Input data sheet, column AB flags non valid codes



**Click to see a list of valid ICD codes for underlying cause of death or to see where non valid codes are flagged.**



# ANACoD - PART I: INPUT DATA

## Step 1 - Basic check of input data

### 2.5 Cause, age, sex specific check

Includes invalid codes

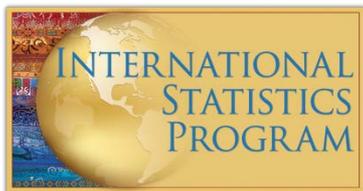
| Sex specific codes. Pink: female only, blue: male only |  |              |
|--|--|--------------|
| ICD  | Disease  | No of deaths |
| O00-O99  | Pregnancy, child birth and the puerperium - male | 0            |
| C53  | Cervix uteri cancer - male                       | 0            |
| C54-C55  | Corpus uteri cancer - male                       | 0            |
| C56  | Ovary cancer - male                              | 0            |
| C61  | Prostate cancer - female                         | 0            |
| N40  | Benign prostatic hypertrophy - female            | 0            |
| Pls check if sum is not equal to zero --->             |  | 0            |

***An attempt should be made to query and correct the death certificate for any deaths listed in these columns that indicate unlikely disease/sex combinations or unlikely causes of death.***

| Diseases unlikely to cause death           |                                |              |
|--|--------------------------------|--------------|
| ICD  | Disease                        | No of deaths |
| F32-F33                                    | Unipolar major depression      | 3            |
| F43  | Post-traumatic stress disorder | 0            |
| F42  | Obsessive-compulsive disorders | 0            |
| NA in ICD103                               | Panic disorder                 | 0            |
| F51  | Sleep disorders                | 0            |
| G43  | Migraine                       | 0            |
| F70-F79                                    | Mental Retardation             | 5            |
| NA in ICD103                               | Presbyopia                     | 0            |
| H90-H91                                    | Deafness                       | 0            |
| K02  | Dental caries                  | 0            |
| Pls check if sum is not equal to zero ---> |                                | 8            |

# ANACoD - PART I: INPUT DATA

## Step 1 - Basic check of input data



### 2.5 Cause, age, sex specific check

*Includes invalid codes*

#### Disease-Age-specific check: for some diseases, ages unlikely to have deaths.

| ICD                        | Disease   | Ages       | No of deaths |
|----------------------------|---|------------|--------------|
| <b>000-099</b>             | <b>Maternal conditions</b>                            | <10&> 54yr | 0            |
| <b>P00-P96</b>             | <b>Conditions arising during the perinatal period</b> | > 4yr      | 28           |
| P05-P07                    | Prematurity and low birth weight                      | > 4yr      | 0            |
| P03, P10-P15, P20-P29      | Birth asphyxia and birth trauma                       | > 4yr      | 23           |
| P00-P02, P04, P08, P35-P96 | Other conditions arising during the perinatal period  | > 4yr      | 5            |
| <b>C00-C97</b>             | <b>Malignant neoplasms</b>                            |            |              |
| C00-C20                    | Mouth and oropharynx cancers                          | 0-4yr      | 0            |
| C15                        | Oesophagus cancer                                     | 0-4yr      | 0            |
| C16                        | Stomach cancer  | 0-4yr      | 0            |
| C18-C21                    | Colon and rectum cancers                              | 0-4yr      | 0            |
| C22                        | Liver cancer  | 0-4yr      | 3            |
| C25                        | Pancreas cancer                                       | 0-4yr      | 0            |
| C33-C34                    | Trachea, bronchus and lung cancers                    | 0-4yr      | 3            |
| C43-C44                    | Melanoma and other skin cancers                       | 0-4yr      | 0            |
| C50                        | Breast cancer   | 0-4yr      | 0            |
| C53                        | Cervix uteri cancer                                   | 0-9yr      | 1            |
| C54-C55                    | Corpus uteri cancer                                   | 0-9yr      | 1            |
| C56                        | Ovary cancer  | 0-9yr      | 0            |
| C61                        | Prostate cancer                                       | 0-9yr      | 0            |
| C67                        | Bladder cancer  | 0-4yr      | 1            |
| C81-C90, C96               | Lymphomas and multiple myeloma                        | 0-4yr      | 13           |
| C91-C95                    | Leukaemia   | 0-4yr      | 0            |
| <b>I00-I99</b>             | <b>Cardiovascular diseases</b>                        |            |              |
| I01-I09                    | Rheumatic heart disease                               | 0-4yr      | 3            |
| I10-I13                    | Hypertensive disease                                  | 0-4yr      | 1            |
| I20-I25                    | Ischaemic heart disease                               | 0-4yr      | 23           |
| I60-I69                    | Cerebrovascular disease                               | 0-4yr      | 59           |
| I30-I33, I38, I40, I42     | Inflammatory heart diseases                           | 0-4yr      | 74           |
| N40                        | Benign prostatic hypertrophy                          | 0-34yr     | 0            |
| X60-X84                    | Self-inflicted injuries                               | 0-4yr      | 0            |

***An attempt should be made to query and correct the death certificate for any deaths listed in this column that indicates an unlikely disease/age combination.***



# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Steps 2-5

Focus on simple steps to assess the plausibility of the mortality levels.

The tool compiles and formats the raw data to enable the calculation of:

- crude death rates
- age-specific mortality rates
- life expectancy at birth
- child mortality

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 2: Crude death rates (CDR)

*Enables users to:*

- Calculate the CDR and use the country's population pyramid to help in the interpretation of the CDR

$$\text{Crude death rate} = \frac{\text{Number of deaths in resident population in given year}}{\text{Size of the midyear resident population in that year}} \times 1000$$

Size of the midyear resident population in that year

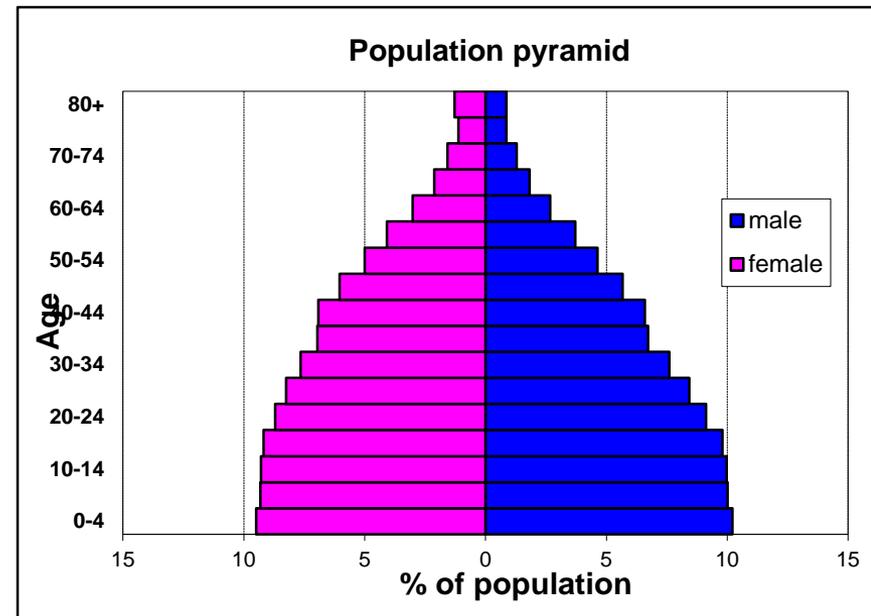
- Use the CDR as an approximate indicator of completeness of death registration
- Compare the CDR to the expected CRD based on life expectancy and population growth rates

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 2: Crude death rates

### Population data to aid in interpretation of crude death rates:

| Age-group (yrs) | No of deaths |        | Population |            |
|-----------------|--------------|--------|------------|------------|
|                 | male         | female | male       | female     |
| All ages        | 113 327      | 83 354 | 22 464 882 | 23 189 162 |
| 0               | 5 368        | 4 234  | 466 526    | 446 815    |
| 1-4             | 1 128        | 933    | 1 828 674  | 1 753 044  |
| 5-9             | 633          | 470    | 2 250 657  | 2 160 252  |
| 10-14           | 854          | 524    | 2 240 827  | 2 155 587  |
| 15-19           | 3 628        | 1 044  | 2 201 572  | 2 130 962  |
| 20-24           | 5 659        | 1 258  | 2 050 933  | 2 019 554  |
| 25-29           | 6 112        | 1 289  | 1 894 170  | 1 912 832  |
| 30-34           | 4 863        | 1 361  | 1 707 701  | 1 774 594  |
| 35-39           | 4 197        | 1 582  | 1 510 151  | 1 612 906  |
| 40-44           | 4 187        | 2 117  | 1 479 874  | 1 603 908  |
| 45-49           | 4 646        | 2 791  | 1 275 551  | 1 399 558  |
| 50-54           | 5 129        | 3 525  | 1 040 753  | 1 158 799  |
| 55-59           | 6 046        | 4 132  | 833 936    | 945 156    |
| 60-64           | 6 808        | 4 863  | 600 560    | 697 959    |
| 65-69           | 8 366        | 6 323  | 408 106    | 492 649    |
| 70-74           | 9 990        | 8 396  | 289 037    | 366 559    |
| 75-79           | 11 431       | 10 206 | 193 494    | 261 311    |
| 80+             | 24 281       | 28 307 | 192 360    | 296 717    |



**CDR as approximate indicator of completeness of death registration:  $\geq 90\%$  is defined as “good” by UN standards.**

Completeness of civil registration data is estimated by dividing the reported deaths by the UN estimates\* => **78%**

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

**CDRs < 5.0 are suspiciously low and indicate under-reporting.**

## Step 2: Crude deaths rates

| Observed                                 |            |            |  |            |      |
|--|------------|------------|--|------------|------|
| Crude death rate per 1000 population     | Both sexes | <b>4.3</b> | Life expectancy at birth (years)   | Both sexes | 77.2 |
|  | Males      | <b>5.0</b> |  | Males      | 73.6 |
|  | Females    | <b>3.6</b> |  | Females    | 80.8 |
| % Annual rate of population growth (UN*) | Both sexes | 1.46       | <b>Compare the observed CDR to the expected CRD based on life expectancy and population growth rates</b> |            |      |
|  | Males      | 1.43       |  |            |      |
|  | Females    | 1.48       |  |            |      |

\*UN source: United Nations, World Population Prospects the 2010 revision

| Expected crude death rates at different levels of life expectancy and population growth (based on Coale-Demeny West model) |     |  |      |      |      |            |             |      |      |      |      |
|--|-----|--|------|------|------|------------|-------------|------|------|------|------|
| Male   |     | Annual rate of population growth (percent) |      |      |      |            |             |      |      |      |      |
|  |     | 5  | 3    | 2.5  | 2    | 1.5        | 1           | 0.5  | 0    | -0.5 | -1   |
| Life expectancy at birth (years)   | 40  | 26.7                                       | 23.6 | 23.2 | 23.1 | 23.1       | 23.4        | 24.1 | 25.0 | 26.3 | 27.9 |
|  | 45  | 20.8                                       | 19.0 | 18.9 | 19.1 | 19.4       | 20.1        | 21.0 | 22.2 | 23.8 | 25.7 |
|  | 50  | 16.0                                       | 15.2 | 15.4 | 15.8 | 16.4       | 17.3        | 18.5 | 20.0 | 21.8 | 24.0 |
|  | 55  | 12.0                                       | 12.1 | 12.5 | 13.1 | 14.0       | 15.1        | 16.5 | 18.2 | 20.2 | 22.6 |
|  | 60  | 8.7  | 9.5  | 10.1 | 10.9 | 11.9       | 13.2        | 14.8 | 16.7 | 18.9 | 21.4 |
|  | 65  | 5.9  | 7.3  | 8.0  | 9.0  | 10.2       | 11.6        | 13.3 | 15.4 | 17.7 | 20.4 |
|  | 70  | 3.8  | 5.6  | 6.4  | 7.4  | 8.7        | <b>10.2</b> | 12.1 | 14.3 | 16.8 | 19.6 |
|  | 75  | 2.3  | 4.2  | 5.1  | 6.2  | 7.6        | 9.2         | 11.1 | 13.3 | 15.9 | 18.8 |
| Female   |     | Annual rate of population growth (percent) |      |      |      |            |             |      |      |      |      |
|  |     | 5  | 3    | 2.5  | 2    | 1.5        | 1           | 0.5  | 0    | -0.5 | -1   |
| Life expectancy at birth (years)   | 40  | 27.4                                       | 24.1 | 23.6 | 23.4 | 23.6       | 24.1        | 24.1 | 25.0 | 26.2 | 27.8 |
|  | 45  | 21.6                                       | 19.5 | 19.3 | 19.4 | 19.6       | 20.2        | 21.1 | 22.2 | 23.7 | 25.6 |
|  | 50  | 16.8                                       | 15.7 | 15.8 | 16.1 | 16.7       | 17.5        | 18.6 | 20.0 | 21.8 | 23.9 |
|  | 55  | 12.7                                       | 12.5 | 12.9 | 13.4 | 14.2       | 15.2        | 16.5 | 18.2 | 20.2 | 22.5 |
|  | 60  | 9.4  | 9.9  | 10.4 | 11.1 | 12.1       | 13.3        | 14.8 | 16.7 | 18.8 | 21.3 |
|  | 65  | 6.6  | 7.7  | 8.4  | 9.2  | 10.3       | 11.7        | 13.4 | 14.8 | 16.7 | 19.5 |
|  | 70  | 4.3  | 5.8  | 6.6  | 7.6  | 8.8        | 10.4        | 12.2 | 14.3 | 16.7 | 19.5 |
|  | 75  | 2.6  | 4.4  | 5.2  | 6.3  | 7.6        | 9.2         | 11.1 | 13.3 | 15.9 | 18.8 |
| 80   | 1.5 | 3.4  | 4.2  | 5.3  | 6.7  | <b>8.3</b> | 10.2        | 12.5 | 15.1 | 18.1 |      |

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 3. Age and sex-specific death rates

*Enables users to:*

- Calculate the mortality rate specific to a population age group (usually a five-year grouping), known as the **age-specific mortality rate (ASMR)**

deaths in a specific age group in a

$$\text{ASMR} = \frac{\text{population during a specified time period}}{\text{total mid-year population in the same age group, population and time period}} \times 100\,000$$

- Compare relative age patterns in ASMR for country to expected global patterns to identify potential under registration at certain ages
- Compare patterns in male:female ASMR ratio to countries with various infant mortality rates to identify issues with completeness of registration
- Look for deviations in expected patterns of the log ASMR to indicate under-reporting at certain ages or mis-reporting of correct age of death

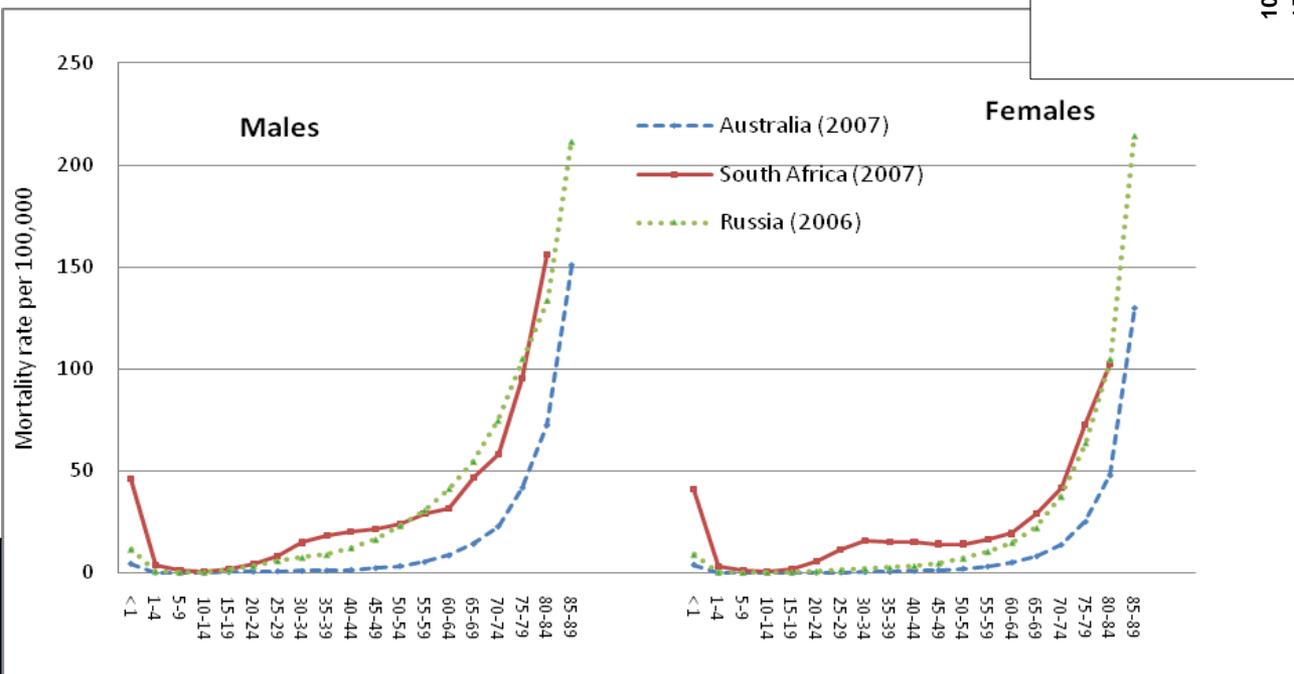
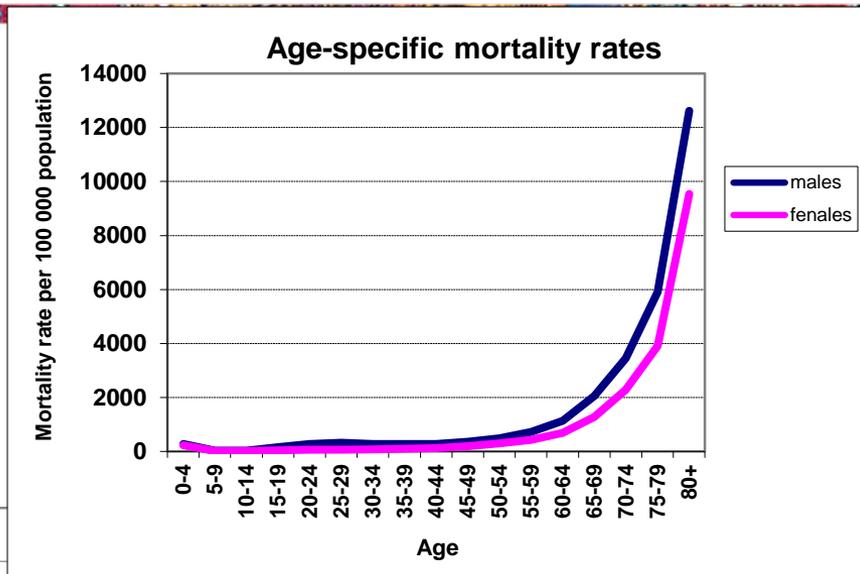


# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 3. Age and sex-specific death rates

Compare relative age patterns to expected patterns in ASMR: ***Deviations may indicate under-registration in certain age groups and/or missing age or sex information.***

Figure 3: ASMR for Australia, Russia and South Africa, males and females, 2000 (ANACoD)

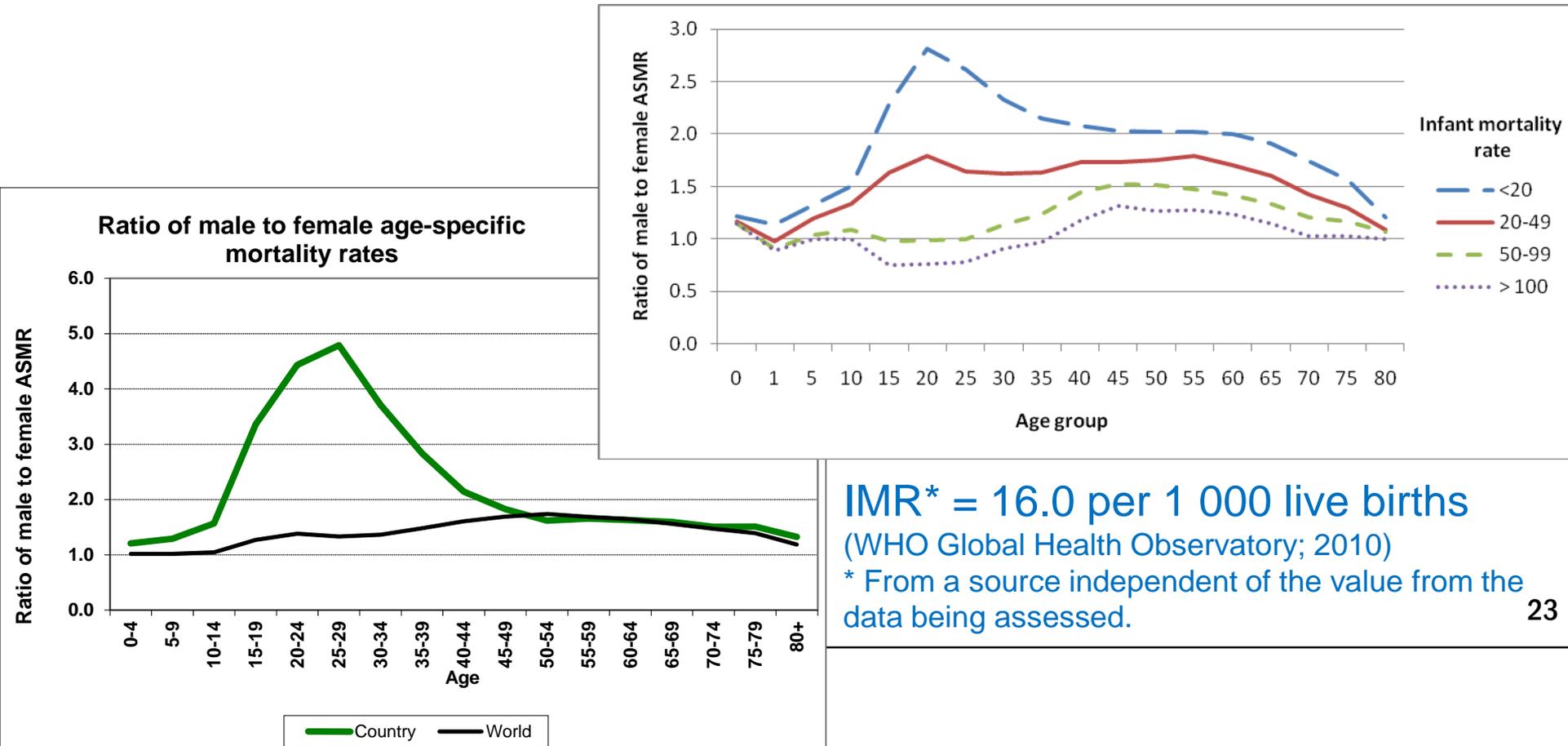


# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 3. Age and sex-specific death rates

Compare patterns in ratio of male:female ASMR: **Deviations may indicate country abnormalities or under-registration.**

Figure 5: Ratio of male to female age-specific mortality rates at different levels of infant mortality (expected patterns)

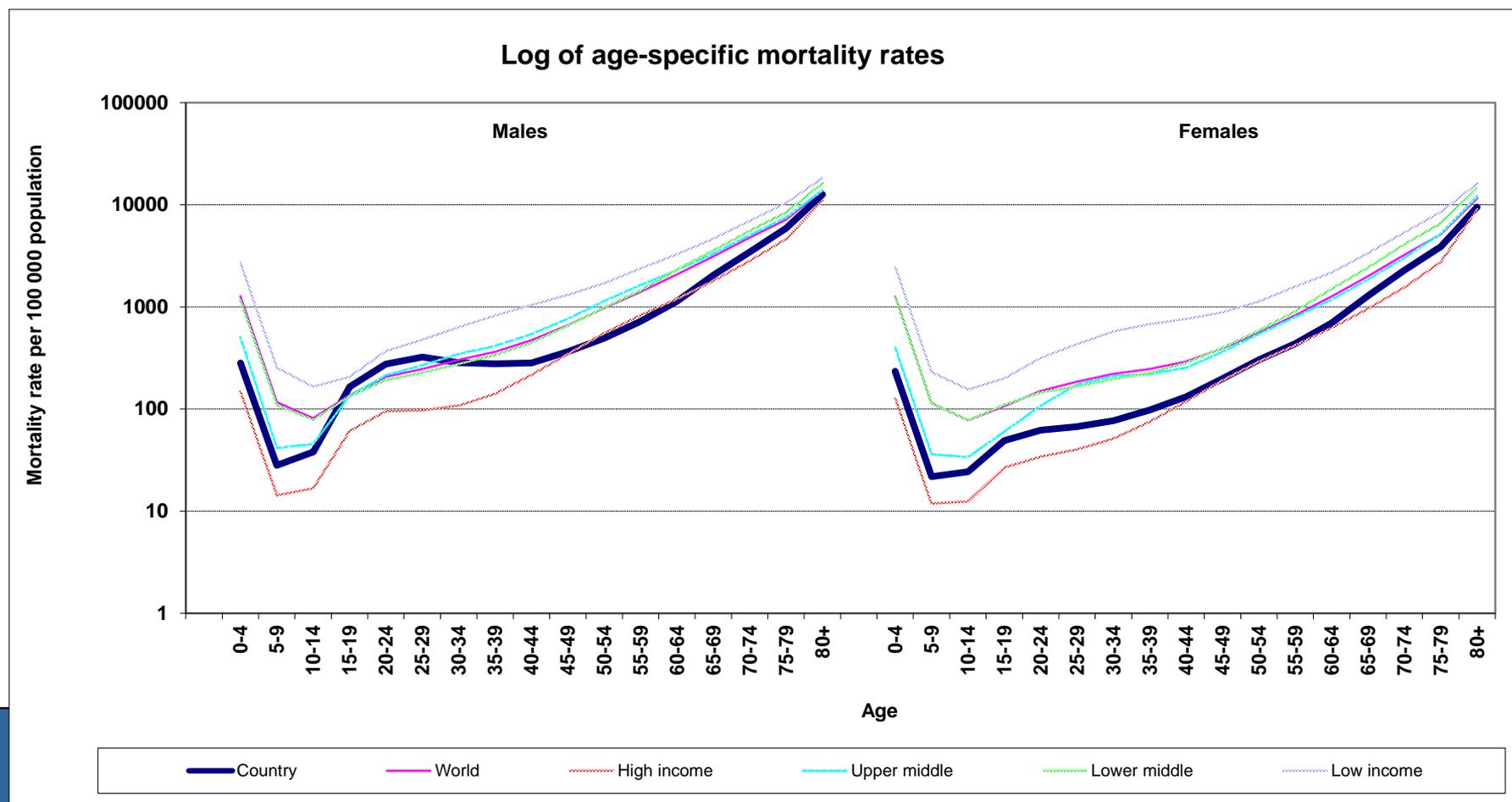


**IMR\* = 16.0 per 1 000 live births**  
 (WHO Global Health Observatory; 2010)  
 \* From a source independent of the value from the data being assessed.

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 3. Age and sex-specific deaths rates

Look for deviations in the expected patterns of the log ASMR: **Deviations may indicate systematic underreporting at a given age.**





# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## *Step 4: Review the age distribution of deaths*

---

*Enables users to:*

- Examine the *age distribution* of reported deaths
- Compare the calculated distribution of deaths to expected distributions corresponding to:
  - Country income group (ANACoD guidance)
  - Country infant mortality rate (UQ Working Paper 13)

# Step 4: Review the age distribution of deaths

**Look for expected patterns in age-specific mortality:**

**Deviations may indicate selective bias in age-specific death reporting.**

- **MALE > female mortality, except in oldest age groups**

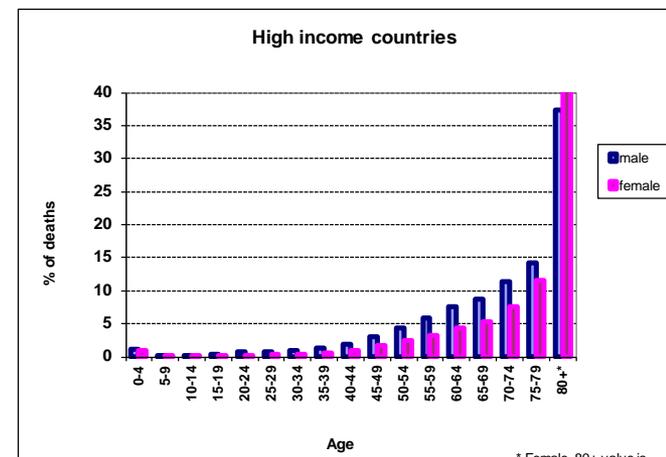
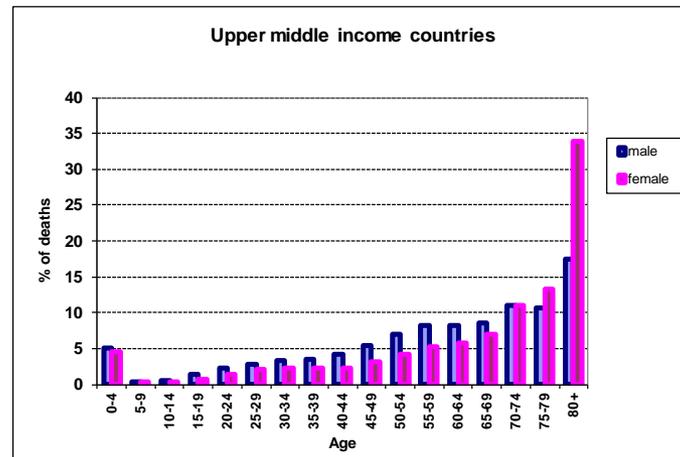
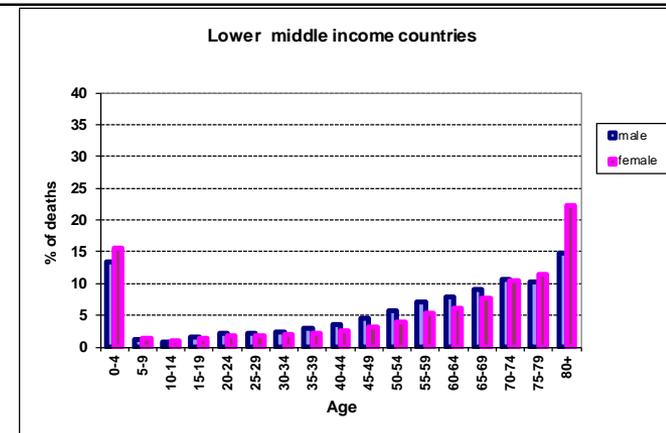
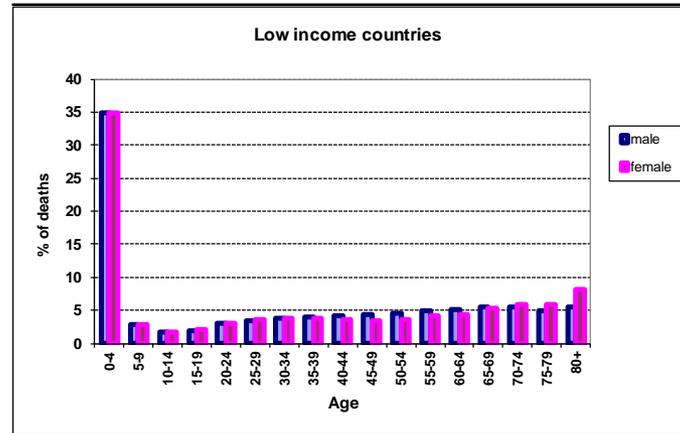
- In countries with *low income/high infant mortality*, female rates may be comparable to male rates.

- **Peak in overall mortality in:**

- **0-4 years**  
(less so in countries with *high income/low infant mortality*)

- **Oldest age groups**  
(less so in countries with *low income/high infant mortality*)

- **Peak in male mortality between 15-44 years due to external causes**

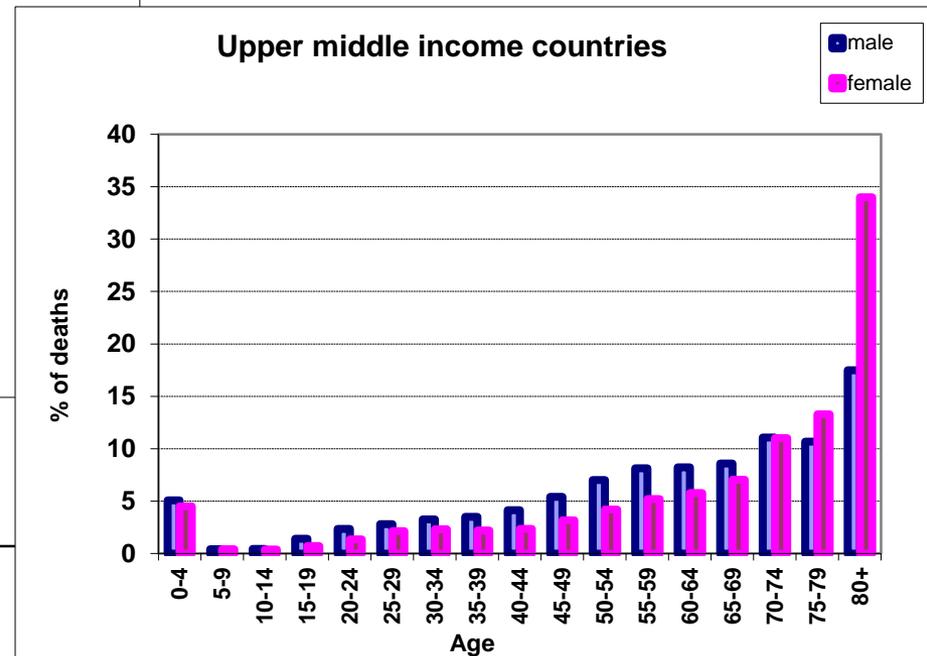
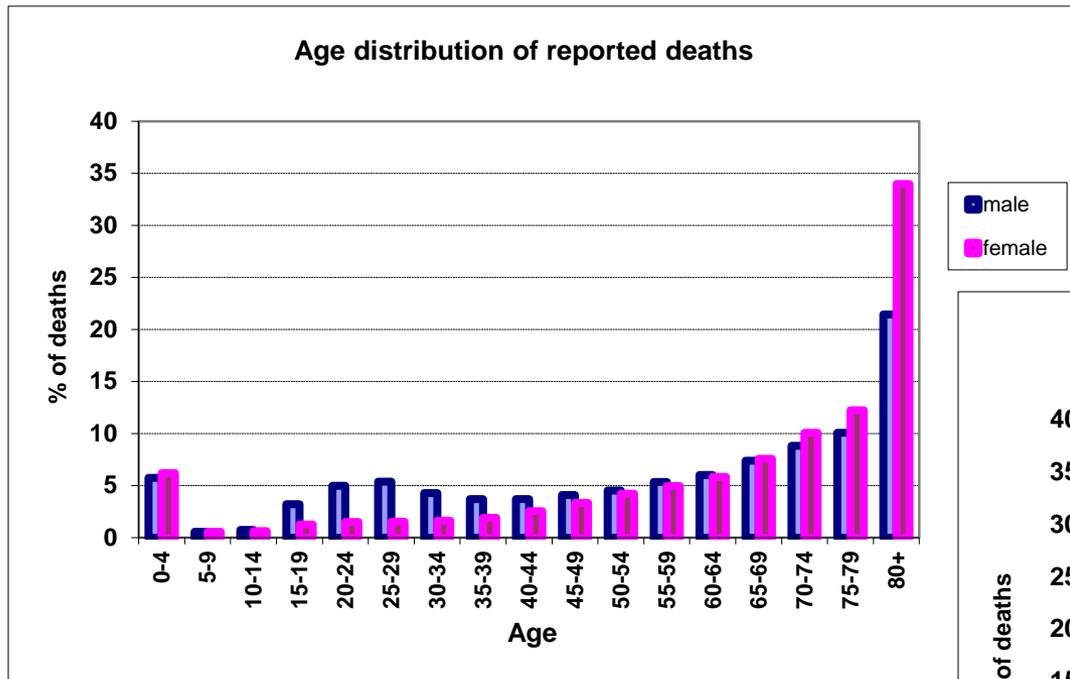


\* Female 80+ value is

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 4: Review the age distribution of deaths

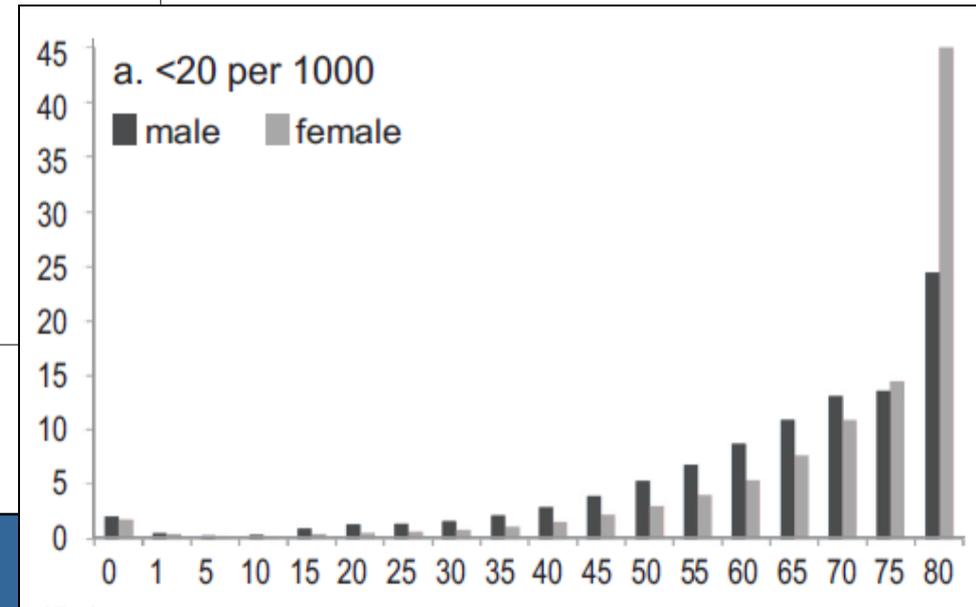
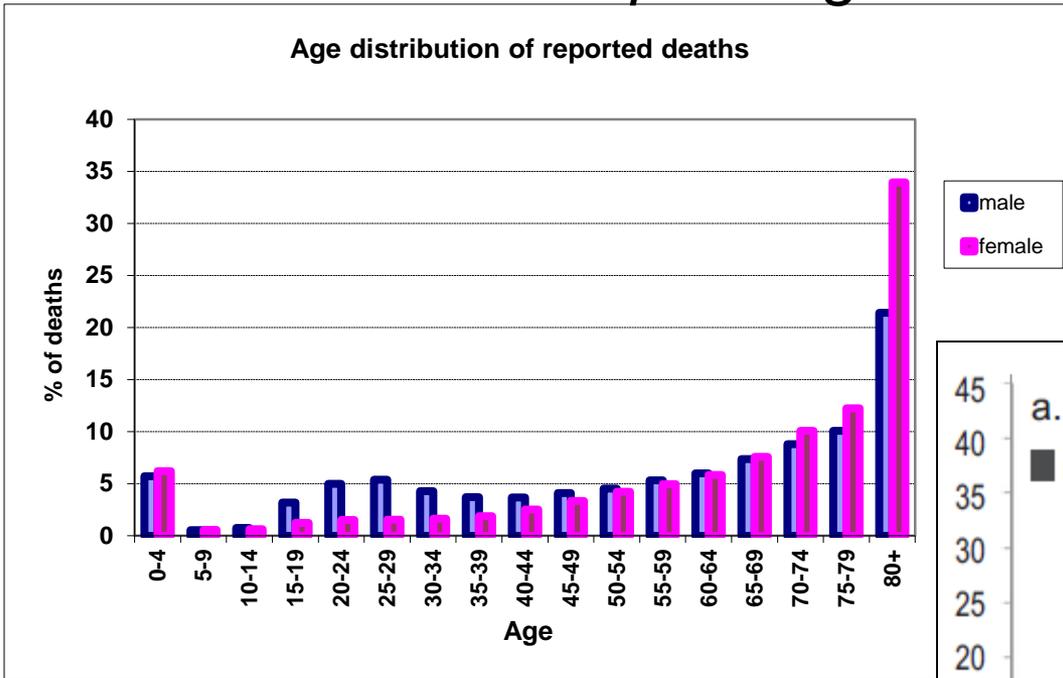
Compare the calculated distribution of deaths to expected distributions corresponding to: **country income group**



# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 4: Review the age distribution of deaths

Compare the calculated distribution of deaths to expected distributions corresponding to: *infant mortality group*



# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 5: Child mortality rates

*Enables users to:*

- Calculate & interpret indicators of under-five mortality
  - Infant mortality rate (ANACoD, UQWP13)  
*Probability (per 1,000 live births) of a child born in a specified year dying before reaching the age of 1 if subject to current ASMRs*
  - Under 5 mortality rate (ANACoD, UQWP13)  
*Probability (1,000 live births) of a child born in a specified year dying before reaching the age of 5 if subject to current ASMRs*
  - Neonatal mortality rate (UQWP13)
  - Post neonatal mortality rate (UQWP13)
- Use under-five mortality indicators from various sources to analyze the quality of mortality data

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

Calculate indicators of under-five mortality:

## Step 5: Child mortality rates

| 1. Child deaths by age and calculation of mortality indicators: |          |          |                   |               |   |                    |
|---|----------|----------|-------------------|---------------|---|--------------------|
| Data from Civil registration, 2009                              |          |          |                   |               |   |                    |
|   | <b>x</b> | <b>n</b> | <b>Population</b> | <b>Deaths</b> | ${}_n m_x$                                    | ${}_n q_x$         |
|   | 0        | 1        | 913341            | 9601.941      | 0.0105  | 0.0104             |
|   | 1        | 4        | 3581718           | 2061.323      | 0.0006  | 0.0023             |
| Infant mortality rate per 1000 live births                      |          |          |                   |               | = $1000 * {}_1 q_0$                           | <b>==&gt; 10.4</b> |
| Under-5 mortality rate per 1000 live births                     |          |          |                   |               | = $1000 * [1 - (1 - {}_1 q_0)(1 - {}_4 q_1)]$ | <b>==&gt; 12.7</b> |

**x** = beginning of the age interval

**n** = number of years in the interval

**Population** = from entered data; sum of male and female population in Step 2.

**Deaths** = from entered data; sum of male and female deaths in Step 2.

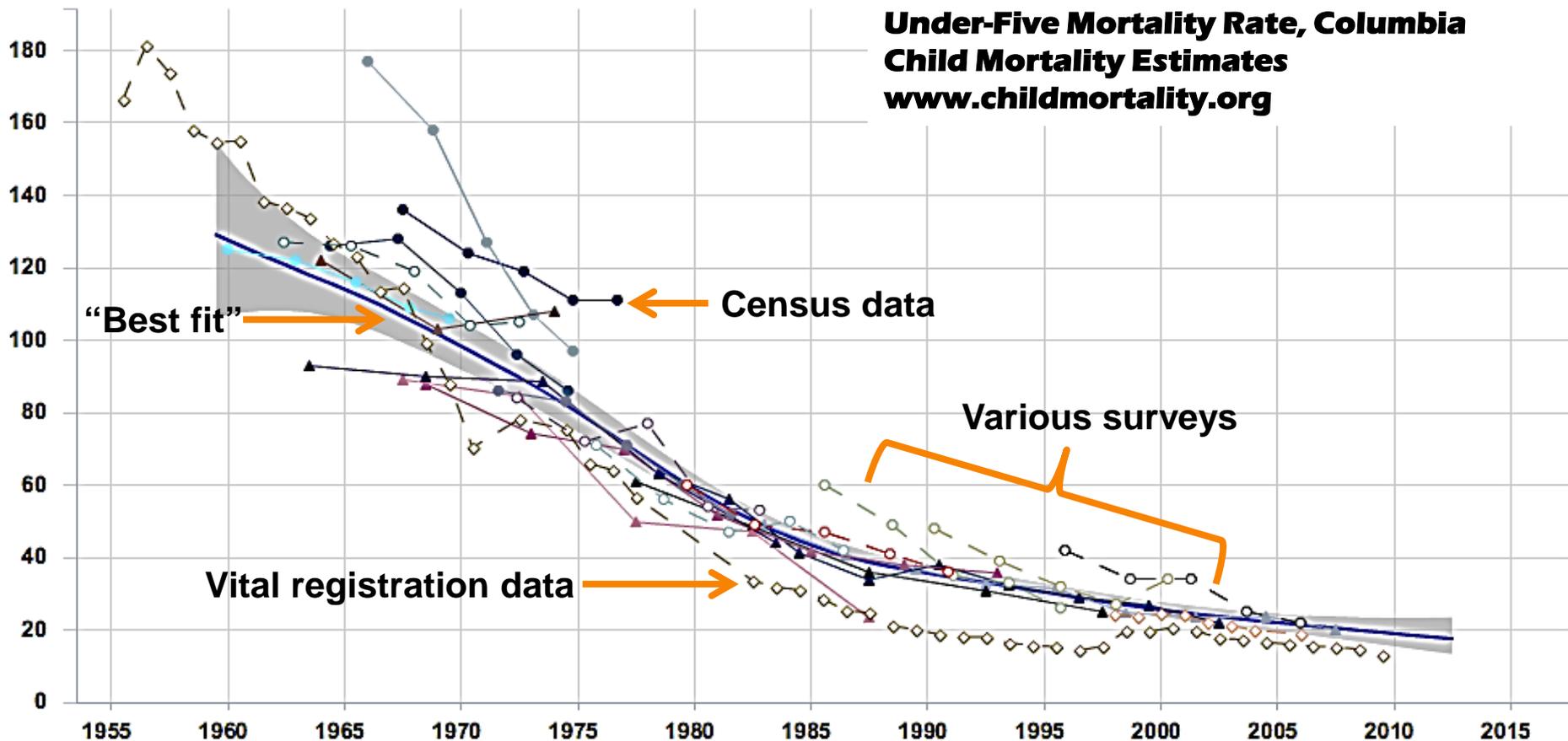
${}_n m_x$  = mortality rate (ASMR) for age x to age n; Deaths/Population.

${}_n q_x$  = probability of a child dying between age x and age n; automatically calculated (see ANACoD guidance for calculation details).

# ANACoD - PART II: MORTALITY LEVELS ANALYSIS

## Step 5: Child mortality rates

Use under-five mortality indicators from various sources to analyze the quality of mortality data: *Deviations from “best fit” line indicate over- or under-reporting.*



## Steps 6-10

Focus on simple steps to assess the plausibility of data on causes of death

The objectives of steps 6-10 are to enable users to:

- Calculate broad patterns of causes of death
- Critically analyse and interpret cause of death data
- Assess the plausibility of the cause of death patterns emerging from the data



# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## *Step 6: Distribution of death according to the Global Burden of Disease list*



*Enables users to:*

- Calculate the percentage distribution of deaths by broad disease groups
- Compare distribution to what would be expected for the population (based on level of life expectancy)
- Identify potential problems in quality of data based on deviations from expected patterns

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 6: Distribution of death according to the Global Burden of Disease list

### Global Burden of Disease cause list:

Group I: Communicable diseases, e.g.:

- TB, pneumonia, diarrhoea, malaria, measles
- Maternal and perinatal causes (e.g. maternal haemorrhage, birth trauma)
- Nutritional conditions (e.g. protein-energy malnutrition)

Group II: Non-communicable diseases, e.g.:

- Cancer, diabetes, heart disease, stroke

Group III: External causes of mortality , e.g.:

- Accidents, homicide, suicide

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 6: Distribution of death according to the Global Burden of Disease list

Compare distribution to what would be expected for the population (based on life expectancy):

**Deviations suggest potential problems with the certification and/or coding of causes of deaths.**

Calculating proportions of groups 1, 2 and 3 after redistribution of deaths from unknown sex and ill-defined diseases

...

Proportions to total deaths

|      |      |
|------|------|
| grp1 | 0.11 |
| grp2 | 0.71 |
| grp3 | 0.18 |

1.00

New totals after all the above adjustments **196681**

**Colombia life expectancy, 2011: 78 years**  
(WHO Global Health Observatory)

Table 2: Expected distribution of causes of death according to life expectancy by broad groups

| Life Expectancy                             | 55 years | 60 years | 65 years | 70 years |
|---|----------|----------|----------|----------|
| Group I causes of death (communicable)      | 22%      | 16%      | 13%      | 11%      |
| Group II causes of death (non-communicable) | 65%      | 70%      | 74%      | 78%      |
| Group III causes of death (external)        | 13%      | 14%      | 13%      | 11%      |

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 7: Age pattern of broad groups of causes of death (Distribution of major causes of death)

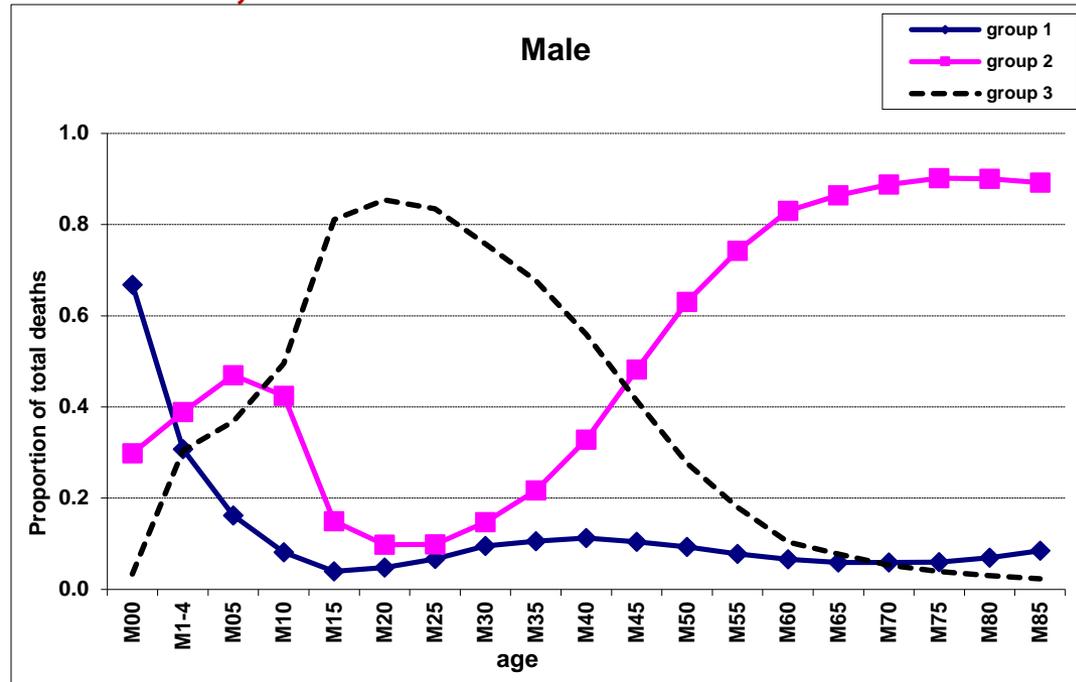
*Enables users to:*

- Observe age-pattern of deaths from broad causes
- Check if pattern is consistent with expected patterns of countries from same income level
- Identify potential problems associated with:
  - Poor medical certification of cause of death
  - Poor coding practices
  - Age-misreporting of deaths
  - Bias in reporting certain infectious diseases

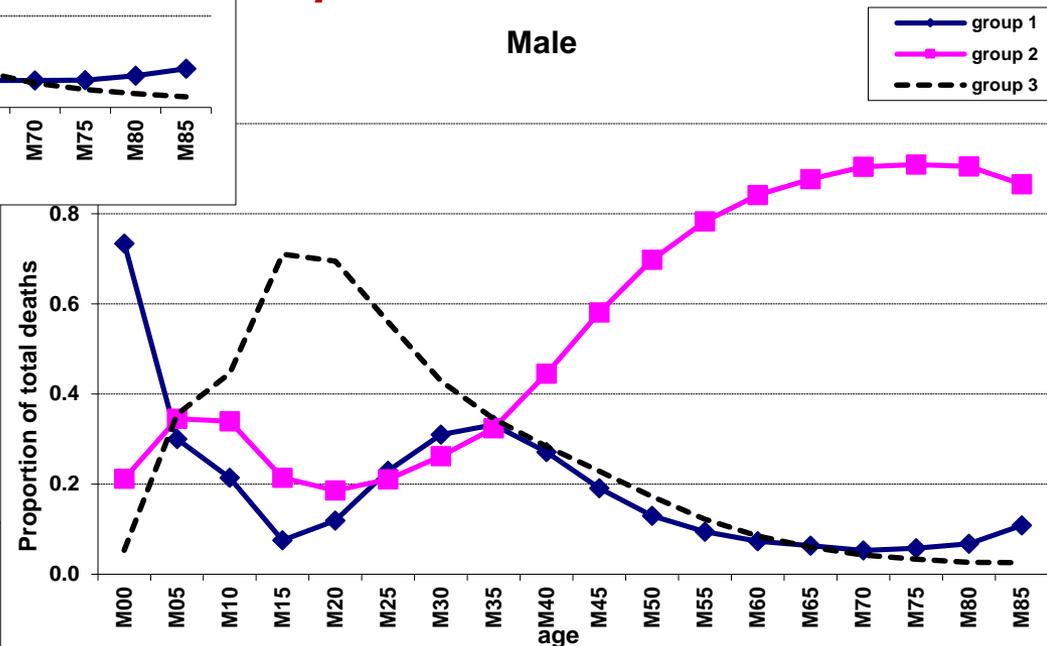
# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 7: Age pattern of broad groups of causes of death (Distribution of major causes of death)

**Colombia, 2009 -- Observed**



**Upper middle income countries -- Expected**



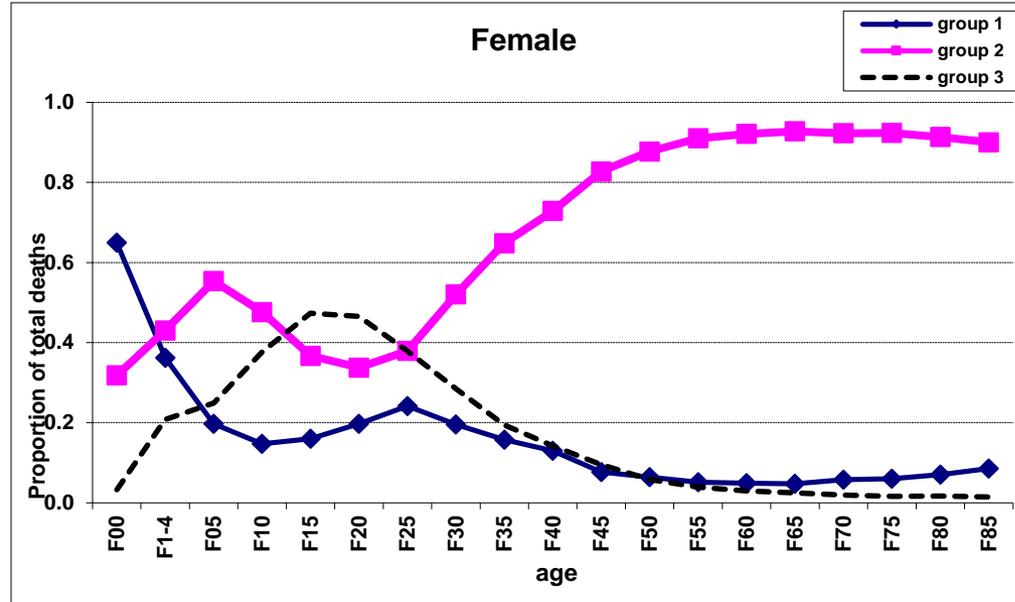
**Group 1: Communicable**  
**Group 2: Non-communicable**  
**Group 3: External**

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

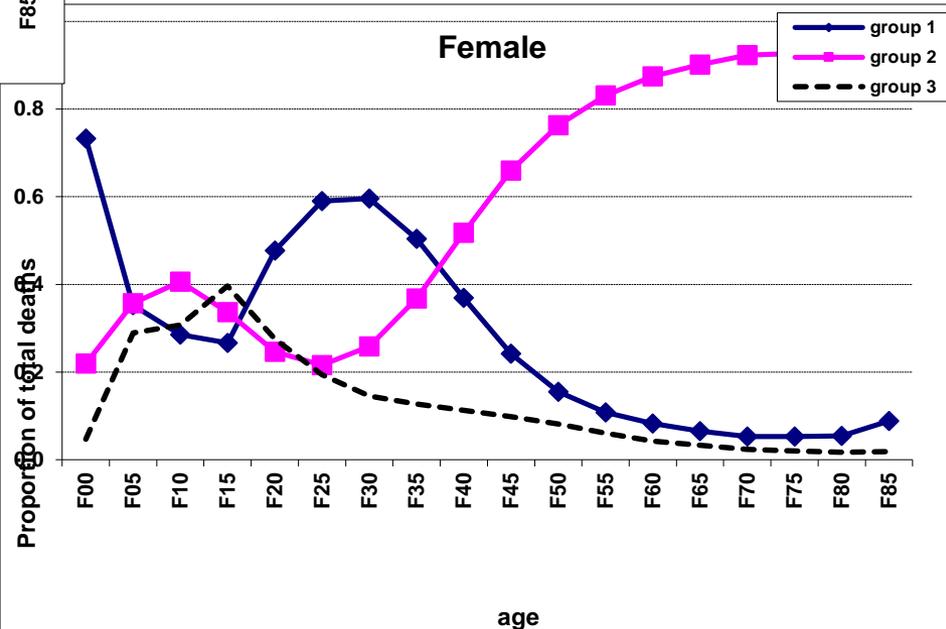
## Step 7: Age pattern of broad groups of causes of death

(Distribution of major causes of death)

Colombia, 2009 -- Observed



Upper middle income countries -- Expected



**Group 1: Communicable**  
**Group 2: Non-communicable**  
**Group 3: External**

### *Enables users to:*

- Determine the distribution of leading causes of death for the country
- Compare observed distribution to distributions expected in other countries of similar income level
- Identify deviations that would be indicative of potential biases in certification and coding practices

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 8: Leading causes of death

Compare distribution of leading causes: *Deviations may indicate biases in certification or coding practices*

### 20 leading causes of death, all ages

| Both sexes                             | Nos    | %total |
|--|--------|--------|
| 1 Ischaemic heart disease              | 27,597 | 14.0   |
| 2 Homicide                             | 19,680 | 10.0   |
| 3 Cerebrovascular disease              | 13,870 | 7.1    |
| 4 Chronic obstructive pulmonary dis.   | 10,265 | 5.2    |
| 5 Other cardiovascular diseases        | 8,674  | 4.4    |
| 6 Other digestive diseases             | 7,111  | 3.6    |
| 7 Diabetes mellitus                    | 6,469  | 3.3    |
| 8 Lower respiratory infections         | 6,442  | 3.3    |
| 9 Other malignant neoplasms            | 6,441  | 3.3    |
| 10 Road traffic accidents              | 6,377  | 3.2    |
| 11 Hypertensive disease                | 5,664  | 2.9    |
| 12 Stomach cancer                      | 4,450  | 2.3    |
| 13 Ill-defined diseases (ICD10 R00-99) | 4,289  | 2.2    |
| 14 Trachea, bronchus and lung cancers  | 3,898  | 2.0    |
| 15 Nephritis and nephrosis             | 3,199  | 1.6    |
| 16 Other respiratory diseases          | 2,732  | 1.4    |
| 17 Colon and rectum cancers            | 2,575  | 1.3    |
| 18 Prostate cancer                     | 2,419  | 1.2    |
| 19 HIV                                 | 2,340  | 1.2    |
| 20 Self-inflicted injuries             | 2,259  | 1.1    |

### Upper middle income countries

| Both sexes                      | Nos (000) | %total |
|---------------------------------|-----------|--------|
| 1 Ischaemic heart disease       | 1,508     | 19.1   |
| 2 Cerebrovascular disease       | 1,035     | 13.1   |
| 3 Other cardiovascular diseases | 419       | 5.3    |
| 4 HIV                           | 377       | 4.8    |
| 5 Lower respiratory infections  | 295       | 3.7    |
| 6 Diabetes mellitus             | 248       | 3.2    |
| 7 Hypertensive disease          | 224       | 2.8    |
| 8 Road traffic accidents        | 196       | 2.5    |
| 9 Chronic obstructive pulm. dis | 189       | 2.4    |
| 10 Other malignant neoplasms    | 189       | 2.4    |
| 11 Other digestive diseases     | 183       | 2.3    |
| 12 Other unintentional injuries | 178       | 2.3    |
| 13 Trachea, bronchus ,lung can. | 175       | 2.2    |
| 14 Homicide                     | 171       | 2.2    |
| 15 Cirrhosis of the liver       | 146       | 1.8    |
| 16 Stomach cancer               | 122       | 1.5    |
| 17 Other respiratory diseases   | 117       | 1.5    |
| 18 Colon and rectum cancers     | 113       | 1.4    |
| 19 Other infectious diseases    | 108       | 1.4    |
| 20 Inflammatory heart diseases  | 104       | 1.3    |



# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## *Step 9: Ratio of non-communicable to communicable causes of death*

---

*Enables users to:*

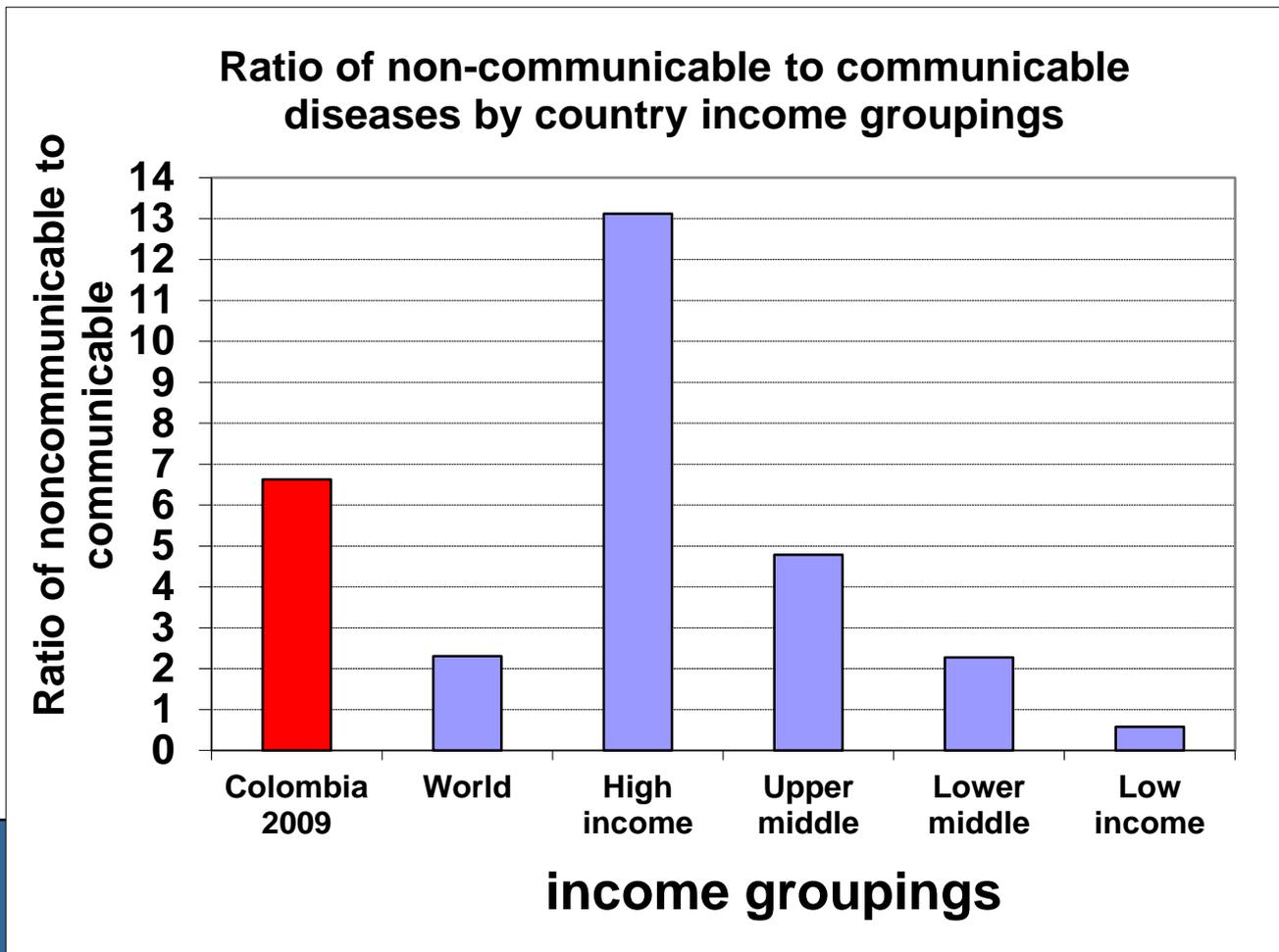
- Calculate the ratio of deaths from non-communicable diseases to communicable diseases for the country
- Compare the country ratio to the world and 4 income groupings
- Identify deviations that are suggestive of errors in cause of death data

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 9: Ratio of non-communicable to communicable causes of death

Compare ratio for country to similar income group:

***Deviations indicate potential errors in cause of death data***





# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## *Step 10: Ill-defined causes of death*

---

*Enables users to:*

- Calculate the proportion of deaths attributed to ill-defined causes of death
- Evaluate the proportion of ill-defined causes of death against recommended levels
- Identify target areas for remedial action to reduce usage of ill-defined causes of death



***Ill-defined causes are:*** ‘symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified.’ They arise from:



- **Deaths classified as ill-defined (Chapter XVIII of ICD-10)**
- **Deaths classified to any one of the following vague or unspecific Dx:**
  - A40-A41 Streptococcal and other septicaemia
  - C76, C80, C97 Ill-defined cancer sites
  - D65 Disseminated intravascular coagulation [defibrination syndrome]
  - E86 Volume depletion
  - I10 Essential (primary) hypertension
  - I269 Pulmonary embolism without mention of acute cor pulmonale
  - I46 Cardiac arrest
  - I472 Ventricular tachycardia
  - I490 Ventricular fibrillation and flutter
  - I50 Heart failure
  - I514 Myocarditis, unspecified
  - I515 Myocardial degeneration
  - I516 Cardiovascular disease, unspecified
  - I519 Heart disease, unspecified
  - I709 Generalized and unspecified atherosclerosis
  - I99 Other and unspecified disorders of circulatory system
  - J81 Pulmonary oedema
  - J96 Respiratory failure, not elsewhere classified
  - K72 Hepatic failure, not elsewhere classified
  - N17 Acute renal failure
  - N18 Chronic renal failure
  - N19 Unspecified renal failure
  - P285 Respiratory failure of newborn
  - Y10-Y34, Y872 External cause of death not specified as accidentally or purposely inflicted

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 10: Ill-defined causes of death

**% ill-defined should ideally be:**

**≤ 10% for deaths at ages 65 years and over**

**< 5% for deaths at ages below 65 years**

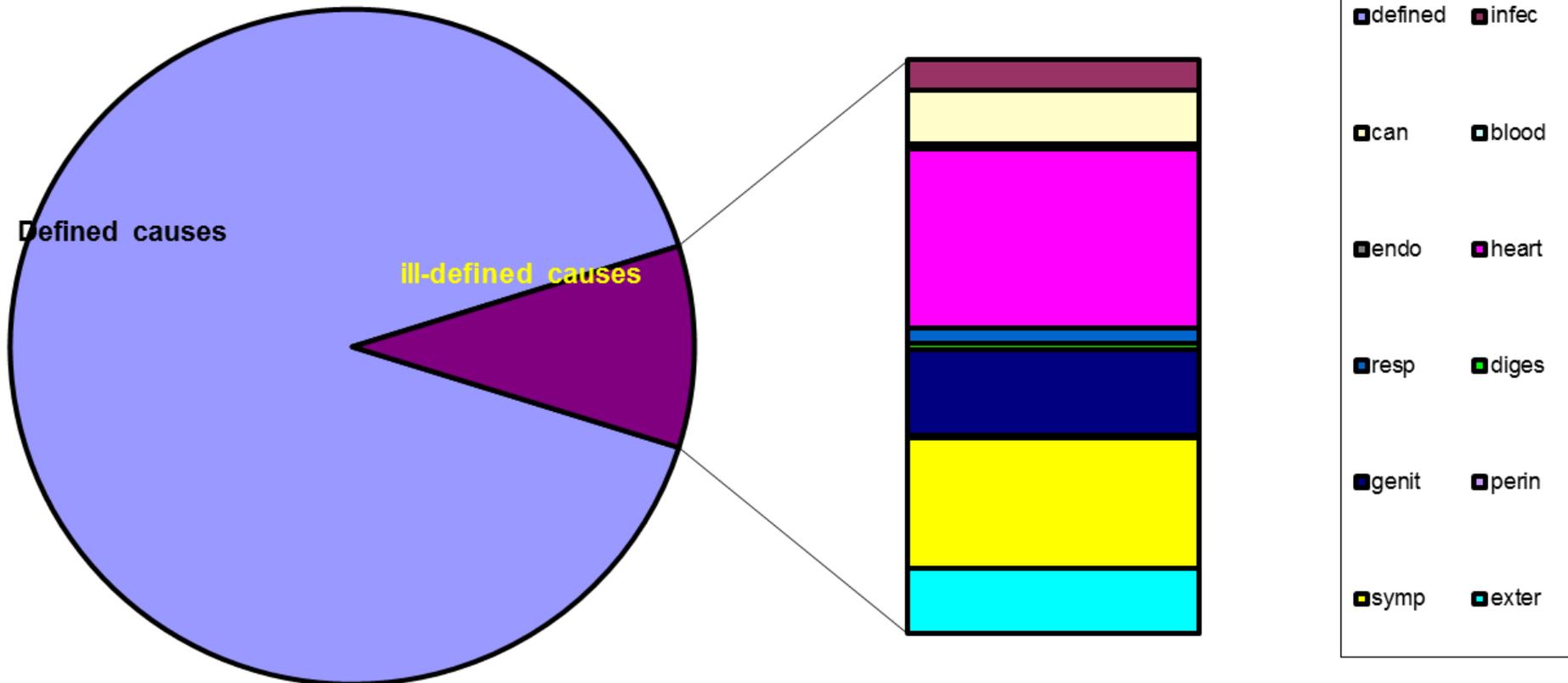
|  | Both          | Male          | Female       | Male |       |       |     |
|--|---------------|---------------|--------------|------|-------|-------|-----|
|  | All ages      |               |              | 0    | 1-4   | 5-9   | ... |
| <b>All causes</b>                            | <b>196681</b> | <b>113327</b> | <b>83354</b> | 5333 | 1121  | 629   | ... |
| <b>Ill-defined causes by ICD-10 chapter:</b> |               |               |              |      |       |       |     |
| I. Infectious and parasitic diseases         | 1024          | 502           | 522          | 56   | 16    | 5     | 5   |
| II. Neoplasms                                | 1773          | 843           | 930          | 2    | 7     | 5     | 4   |
| III. ...                                     | 74            | 37            | 37           | 13   | 4     | 1     | 1   |
| <b>Total of ill-defined</b>                  | <b>18989</b>  | <b>10395</b>  | <b>8594</b>  | 415  | 145   | 80    | 69  |
| <b>as % of All causes</b>                    | <b>9.7%</b>   | <b>9.2%</b>   | <b>10.3%</b> | 7.8% | 12.9% | 12.7% | ... |

# ANACoD - PART III: CAUSES OF DEATH ANALYSIS

## Step 10: Ill-defined causes of death

***Specific causes among ill-defined causes can be used to target improvement efforts.***

**Proportion of defined causes v/s ill-defined causes**



➤ The “Summary” sheet provides a summary report of findings

With ANACoD, the user is able to:

- Derive the mortality profile of the country/area analysed
- Develop a critical view on the quality of mortality data
- Understand further cause-of-death statistics

Limitations of ANACoD include:

- Partial data are not adjusted for incompleteness by the tool
- The tool cannot improve the quality of poor data, but it can provide insights on medical certification or coding problems
- Currently only data coded to ICD-10 three or four characters can be analysed