Vital Statistics, Source of Data, Classification of Disease and Certification of Death

Siswanto Agus Wilopo

Program Pasca Sarjana Ilmu Kesehatan Masyarakat
Fakultas Kedokteran
Universitas Gadjah Mada
Learning Objectives:

By the end of this session, students will be able to:

- Describe the major source of health data in Indonesia and international population
- Discuss issues involved in appropriately interpreting these data sources
Topics

• **Basic understanding of:**
  – Demographic studies
  – Most commonly used mortality statistics
  – Mortality studies
  – Most commonly used morbidity statistics
  – Morbidity studies
Introduction - Epidemiologic studies

- Identify new diseases
- Identify populations at risk for disease
- Identify possible causative agents of disease
- Identify factors or behaviors that increase risk of a disease
Epidemiologic studies also:

• Determine the relative importance of a factor contributing to a disease
• Rule out factors or behaviors as contributing to a disease
• Evaluate therapies for a disease
• Guide in the development of effective public health measures
• Guide in the development of effective preventive strategies
Demographic Studies - Purpose

- The means by which the epidemiologist can assess the health status of a population from the perspective of morbidity and mortality,
- Inexpensive, and the first test of an etiologic hypothesis,
- Can be conducted by using readily available vital and health statistics
Types of Data Used in Epidemiologic Studies

- Demographic data
- Vital statistics data
- Surveillance data
- Health status and behavioral data
- Socioeconomic data
- Utilization data
National Demographic Data Sources

• National Biro Statistics
• National Health Statistics
• Centers for Disease Control & Prevention, Ministry of Health
• Vital statistics offices and reports (interior Ministry)
• Bureau of Statistics
Vital Statistics

• Maintained by CBS
  – Birth data (natality)
  – Death data (mortality)
  – Migration
  – Marriage data (no longer collected)
  – Divorce data (no longer collected)
Mortality Statistics - Introduction

• Vital events:
  – Births
  – Marriages
  – Divorces
  – Deaths
Mortality Data Sources

• Autopsy records
• Financial records (insurance, pension)
• Hospital records
• Occupational records
• Death Certificates
Mortality statistics - Autopsies

• Autopsy data and hospital records may be more accurate about details, but may not represent the general population
• Useful for investigating diseases with a high-case fatality
• Problem of selection bias - impossible to correlate an autopsy series with any well-defined population at risk, or to estimate the frequency of disease
Measures of Mortality

Elements of mortality rate:

– Specifically defined population group - (denominator)
– A time period
– Number of deaths occurring in that population group during that time period (numerator)
Annual death rate

Total # death during a specified 12 mth period \( \times 1000 \)
# persons in the population in the middle of period

Numerator of the rate is the number of deaths that occurred in the specified population and the denominator is obtained either from a census or from estimates of that population;

The numerator & denominator are related to each other in that the numerator represents those individuals who died, and the denominator are those who were at risk of death.
“Crude” or Unadjusted death rate

• In terms of a single year and a population of 1000.
• Unit of time must be specified.
• Can be made explicit for characteristics, i.e., age, gender, marital status, ethnicity and specific causes.
Case-Fatality Rate (Ratio)

- Proportion of persons who die from a particular population (cases)
- Frequently and incorrectly termed a “mortality rate”
- Represents the risk of dying during a defined period of time for those who have a particular disease
- Can be made specific for a characteristic of interest
Proportionate Mortality

- Describes the proportion of deaths attributable to inherent causes in a specific population over a period of time
- These proportions are not mortality rates - since the denominator is all deaths, NOT the population in which the deaths occurred
Death-to-Case Ratio

- # in numerator is not necessarily included in the denominator, because some of the deaths may have occurred in person who developed the disease before the specified period.
- **IT** is a RATIO - not a proportion. A ratio of cause-specific deaths to cases during a specified time.
Infant Mortality

- Infant mortality rates are the most commonly used rates for measuring the risk of dying during the first year of life.
- Most frequently used measure for comparing health services among nations.
- Indicator of the level of health in a community
Maternal Mortality Rates

There is no system for gathering information for all pregnancies - the closest useful measure is the number of live births.

Denominator does not include all pregnancies, but number of live births
Other Demographic Measures: Survival Analysis

- Life Table Analysis -
- Studies of survivorship in actuarial populations for use by insurance companies to predict survivorship and set premium charge
- Used to make demographic predictions and to analyze data in clinical trials
Other Demographic Measures: Years of Potential Life Lost (YPPL)

- Measures the impact of premature mortality on a population
- The sum of the differences between a determined end point and the ages of death for those who died before that end point
- Two most common endpoints are age 65 and average life expectancy. Gives more weight to early deaths
Mortality Studies

- **Distribution of mortality in populations**
  - **Time**: Trend in mortality rates - secular trends - trends over time
  - **Place**: Migrant studies - helps to establish an environmental contribution to disease
  - **Person**: Age, gender, race & ethnicity, social class, birth cohort
Morbidity Statistics

- Disease control programs
- Tax-financed public assistance programs
- School & employment records
- Insurance data
- Special research programs
- Morbidity surveys on population samples for illness in general and for specific diseases
Morbidity statistics: Surveillance Systems

- Focused on identification of infected individuals, with the goal of isolation to minimize disease transmission
- Ongoing collection of data by a data center, analysis, dissemination and implementation of a response based upon analyses
- Sentinel Surveillance
Morbidity statistics:
Cross-Sectional studies

• **Prevalence surveys**

• **Other Sources:**
  – National Health Survey (riskesdas and SDKI)
  – National Hospital Discharge Survey
  – National Ambulatory Medical Care Survey
Measures of Morbidity

• Incidence Rate - direct estimate of probability or risk of developing disease during a specified time period
• Prevalence Rate - number of cases that are present at, or during a specified time period
• Disability (WHO)
Morbidity Studies

- Time - Incubation period; Time & Space clusters
- Place -
- Person - age, gender, ethnicity and social status can influence morbidity.
## History of mortality classification

<table>
<thead>
<tr>
<th>Code</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICD-3</td>
<td>1921 to 1930</td>
</tr>
<tr>
<td>ICD-4</td>
<td>1931 to 1940</td>
</tr>
<tr>
<td>ICD-5</td>
<td>1941 to 1949</td>
</tr>
<tr>
<td>ICD-6</td>
<td>1950 to 1957</td>
</tr>
<tr>
<td>ICD-7</td>
<td>1958 to 1968</td>
</tr>
<tr>
<td>ICDA-8</td>
<td>1969 to 1978</td>
</tr>
<tr>
<td>ICD-9</td>
<td>1979 to 1999</td>
</tr>
<tr>
<td>ICD-10</td>
<td>2000 to present</td>
</tr>
</tbody>
</table>
How is Underlying Cause of Death determined in ICD-10?

• The General Principle
  – “When more than one condition is entered on the certificate, select the condition entered alone on the lowest used line of Part 1 only if it could have given rise to all the conditions entered above it.” (ICD-10, Volume 2)

• Selection Rules 1 to 3

• Modification Rules A to F
Major category and code changes from ICD-9 to ICD-10: Mortality

- Alphanumeric code structure (A00-Y89)
- Number and order of chapters
  - Chapters I to XVIII (A00-R99) Diseases
  - Chapter XIX (S00-T98) Injury, poisoning and certain other consequences of external causes
  - Chapter XX (V01-Y89) External causes of morbidity and mortality
CAUSES OF DEATH
Population Causes of Death: Key Health Information

• Reliable information on leading causes of death is a key input for health policy.
• Causes of death should guide both investment decisions as well as help track progress of priority health programs.
• MDG indicators such as maternal mortality, HIV, TB and malaria mortality are illustrations of the importance of cause of death data.
Challenges in Measuring Causes of Death

• Availability of data in low- and middle-income countries
  • Some countries lack vital registration systems
  • Some existing systems capture only a biased subset of deaths

• Quality of recorded data
  • Death are sometimes recorded without the necessary information to ascertain a true cause of death
  • “Garbage coding” - deaths are miscoded to a cause other than the underlying cause of death
Availability of vital registration data

2004: All-cause and cause-specific mortality data availability

Availability
- No data
- All-cause mortality data
- Cause-specific mortality data
Quality of cause-of-death information from national civil registration systems, based on latest data received from WHO Member States, circa 2003

Source: WHO, Sept. 2007
Data Sources I

– Vital Registration with Certification of Cause of Death
– Sample Registration Systems
– Verbal Autopsies
– Household Surveys
– Population Surveillance Systems
Methods

- Epidemiological Estimates
- Cause-of-Death Models
- Deaths In-Hospital
- Cancer Registries
Underlying cause of death

– In 1967, the 20th World Health Assembly defined the COD to be entered on the medical certificate as “all those diseases, morbid conditions or injuries that either resulted in or contributed to death and the circumstance of the accident of violence which produced any such injuries”

– When only one cause of death is recorded, this cause is selected for tabulation. When more than one is recorded, selection should be made following the rules based on the concept of underlying cause of death.

– According to the ICD the underlying cause of death has been defined as “the disease or injury, which initiated the train of morbid events leading directly to death, or the circumstance of the accident or violence which produced the fatal injuries”
## Proper Assignment of Underlying Cause

### INTERNATIONAL FORM OF MEDICAL CERTIFICATE OF CAUSE OF DEATH

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Approximate interval between onset and death</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong></td>
<td></td>
</tr>
<tr>
<td>Disease or condition directly leading to death*</td>
<td>(a) ...........................................</td>
</tr>
<tr>
<td></td>
<td>due to (or as a consequence of)</td>
</tr>
<tr>
<td>Antecedent causes</td>
<td>(b) ...........................................</td>
</tr>
<tr>
<td>Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last</td>
<td>due to (or as a consequence of)</td>
</tr>
<tr>
<td></td>
<td>(c) ...........................................</td>
</tr>
<tr>
<td></td>
<td>due to (or as a consequence of)</td>
</tr>
<tr>
<td></td>
<td>(d) ...........................................</td>
</tr>
<tr>
<td><strong>II</strong></td>
<td></td>
</tr>
<tr>
<td>Other significant conditions contributing to the death, but not related to the disease or condition causing it</td>
<td>...........................................</td>
</tr>
</tbody>
</table>

*This does not mean the mode of dying, e.g. heart failure, respiratory failure. It means the disease, injury, or complication that caused death.*
Garbage Code in ICD

- The International Classification of Diseases (ICD) is used to code causes of death in countries with vital registration systems.

- In its old revisions (I-V), the ICD was used only for cause of death coding.

- Since VI revision it has grown into a coding scheme for all disease, including fatal and non-fatal health conditions which is inherently problematic for the purpose of cause of death analysis.

- The ICD includes many codes that signify signs, symptoms, conditions, or intermediate and immediate causes of death. These conditions are unlikely to cause death, but the codes are sometimes used as a cause of death on death certificates or in mortality datasets.

- **Garbage codes in mortality data are those codes which do not signify an underlying cause of death, including ill-defined, intermediate, immediate, and unlikely or ambiguous causes of death.**
Effects of Garbage Codes in Cause of Death Analysis

• Garbage codes lead to a vague and sometimes inaccurate representation of the causes of death in a given population.

• The type and proportion of garbage codes differ by country and by time period within countries. As such, the comparability of death patterns between countries and time periods is a major challenge.

• It is necessary to correct mortality data in order to:
  – improve comparability of mortality patterns across countries, regions and time periods, and
  – to maximize the use of available cause of death data in order to better inform policy decisions about priority health interventions and resource allocation.
Evolution GC on GBD studies

• 1990 ill defined; hearth failure; cancer ill defined and injuries ill defined
• 2000 same codes of 1990 with better methods of redistribution
• 2005: Completely different approach, conceptual and methods
  – more Garbage codes, and more targets
  – Sequences for redistribution
  – Methods of redistribution
Deaths:

Variation of magnitude of the problem using ill-defined, GBD90 and 2005 criteria

Ill-defined diseases and injuries


added GBD 2005

added GBD 1990-2002

Ill-defined diseases and injuries


added GBD 2005

added GBD 1990 - 2002

Ill-defined diseases and injuries
Types of Garbage Codes

- Group 1: Causes that cannot lead to death
- Group 2: Neoplasm (malignant or benign) with an ill-defined site or behavior
- Group 3: Unspecified diseases and injuries from a specific chapter or disease group
- Group 4: Intermediate cause of death
- Group 5: Consequence of disease [Sequelae]
- Group 6: Immediate cause of death
- Group 7: Special garbage codes
Garbage Codes by GBD region, circa 2002

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of deaths millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe, Eastern</td>
<td>0.1</td>
</tr>
<tr>
<td>Asia, Central</td>
<td>0.06</td>
</tr>
<tr>
<td>Asia, East</td>
<td>0.02</td>
</tr>
<tr>
<td>North America, High Income</td>
<td>2.3</td>
</tr>
<tr>
<td>Latin America, Central</td>
<td>0.8</td>
</tr>
<tr>
<td>Caribbean</td>
<td>0.1</td>
</tr>
<tr>
<td>Asia Pacific, High Income</td>
<td>2.5</td>
</tr>
<tr>
<td>Europe, Western</td>
<td>3.2</td>
</tr>
<tr>
<td>Europe, Central</td>
<td>1.7</td>
</tr>
<tr>
<td>World</td>
<td>16.6</td>
</tr>
<tr>
<td>Latin America, Tropical</td>
<td>2.3</td>
</tr>
<tr>
<td>Latin America, Southern</td>
<td>1.0</td>
</tr>
<tr>
<td>Sub-Saharan Africa, Southern</td>
<td>0.3</td>
</tr>
<tr>
<td>Latina America, Andean</td>
<td>0.2</td>
</tr>
<tr>
<td>North Africa/Middle East</td>
<td>0.2</td>
</tr>
<tr>
<td>Asia, Southeast</td>
<td>1.7</td>
</tr>
</tbody>
</table>
## Results

### Descriptive

<table>
<thead>
<tr>
<th>Country</th>
<th>Deaths from Garbage</th>
<th>Total Number of Deaths</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>1,682,693</td>
<td>2,690,161</td>
<td>62.6%</td>
</tr>
<tr>
<td>Egypt</td>
<td>209,754</td>
<td>382,138</td>
<td>54.9%</td>
</tr>
<tr>
<td>Haiti</td>
<td>18,273</td>
<td>38,517</td>
<td>47.4%</td>
</tr>
<tr>
<td>Argentina</td>
<td>817,661</td>
<td>2,290,641</td>
<td>35.7%</td>
</tr>
<tr>
<td>Peru</td>
<td>59,446</td>
<td>170,932</td>
<td>34.8%</td>
</tr>
<tr>
<td>El Salvador</td>
<td>90,520</td>
<td>262,749</td>
<td>34.5%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>166,993</td>
<td>494,246</td>
<td>33.8%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>54,582</td>
<td>167,153</td>
<td>32.7%</td>
</tr>
<tr>
<td>South Africa</td>
<td>1,354,234</td>
<td>4431,023</td>
<td>30.6%</td>
</tr>
<tr>
<td>Suriname</td>
<td>3,771</td>
<td>12,540</td>
<td>30.1%</td>
</tr>
</tbody>
</table>
## Results

### Descriptive

<table>
<thead>
<tr>
<th>Country</th>
<th>Deaths from Garbage</th>
<th>Total Number of Deaths</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Republic of Moldova</td>
<td>27,307</td>
<td>469,262</td>
<td>5.8%</td>
</tr>
<tr>
<td>Estonia</td>
<td>12,716</td>
<td>164,893</td>
<td>7.7%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>27,614</td>
<td>327,279</td>
<td>8.4%</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>17,939</td>
<td>210,024</td>
<td>8.5%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>13,049</td>
<td>139,911</td>
<td>9.3%</td>
</tr>
<tr>
<td>Austria</td>
<td>36,646</td>
<td>377,116</td>
<td>9.7%</td>
</tr>
<tr>
<td>Hungary</td>
<td>135,269</td>
<td>1,371,308</td>
<td>9.9%</td>
</tr>
<tr>
<td>Finland</td>
<td>55,050</td>
<td>536,765</td>
<td>10.3%</td>
</tr>
<tr>
<td>Latvia</td>
<td>34,172</td>
<td>329,846</td>
<td>10.4%</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>4,061</td>
<td>38,869</td>
<td>10.5%</td>
</tr>
</tbody>
</table>
## Leading Garbage causes (4 digits)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Description</th>
<th>ICD 10th</th>
<th>Deaths</th>
<th>% of Garbage</th>
<th>Accumulated %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complications and ill-defined descriptions of heart disease</td>
<td>I50.9</td>
<td>1,720,794</td>
<td>11.5%</td>
<td>11.5%</td>
</tr>
<tr>
<td>2</td>
<td>Senility</td>
<td>R54</td>
<td>1,310,606</td>
<td>8.8%</td>
<td>20.3%</td>
</tr>
<tr>
<td>3</td>
<td>Other ill-defined and unspecified causes of mortality</td>
<td>R99</td>
<td>1,203,215</td>
<td>8.0%</td>
<td>28.3%</td>
</tr>
<tr>
<td>4</td>
<td>Generalized and unspecified atherosclerosis</td>
<td>I70.9</td>
<td>832,333</td>
<td>5.6%</td>
<td>33.9%</td>
</tr>
<tr>
<td>5</td>
<td>Left ventricular failure</td>
<td>I50.0</td>
<td>772,462</td>
<td>5.2%</td>
<td>39.0%</td>
</tr>
<tr>
<td>6</td>
<td>Unattended death</td>
<td>R98</td>
<td>765,121</td>
<td>5.1%</td>
<td>44.2%</td>
</tr>
<tr>
<td>7</td>
<td>Malignant neoplasm without specification of site</td>
<td>C80</td>
<td>746,358</td>
<td>5.0%</td>
<td>49.2%</td>
</tr>
<tr>
<td>8</td>
<td>Septicaemia, unspecified</td>
<td>A41.9</td>
<td>645,574</td>
<td>4.3%</td>
<td>53.5%</td>
</tr>
<tr>
<td>9</td>
<td>Essential (primary) hypertension</td>
<td>I10</td>
<td>469,294</td>
<td>3.1%</td>
<td>56.6%</td>
</tr>
<tr>
<td>10</td>
<td>Chronic renal failure, unspecified</td>
<td>N18.9</td>
<td>389,967</td>
<td>2.6%</td>
<td>59.2%</td>
</tr>
<tr>
<td>11</td>
<td>Sequelae of stroke, not specified as haemorrhage or infarction)</td>
<td>I69.3</td>
<td>379,598</td>
<td>2.5%</td>
<td>61.8%</td>
</tr>
<tr>
<td>12</td>
<td>Exposure to unspecified factor : Unspecified place</td>
<td>X59.9</td>
<td>347,012</td>
<td>2.3%</td>
<td>64.1%</td>
</tr>
<tr>
<td>13</td>
<td>Unspecified renal failure</td>
<td>N19</td>
<td>334,777</td>
<td>2.2%</td>
<td>66.3%</td>
</tr>
<tr>
<td>14</td>
<td>Pulmonary embolism without mention of acute cor pulmonale</td>
<td>I26.9</td>
<td>314,221</td>
<td>2.1%</td>
<td>68.4%</td>
</tr>
<tr>
<td>15</td>
<td>Cardiac arrest, unspecified</td>
<td>I46.9</td>
<td>245,631</td>
<td>1.6%</td>
<td>70.1%</td>
</tr>
<tr>
<td>16</td>
<td>Sequelae of other and unspecified cerebrovascular diseases</td>
<td>I69.4</td>
<td>242,979</td>
<td>1.6%</td>
<td>71.7%</td>
</tr>
<tr>
<td>17</td>
<td>Heart failure, unspecified</td>
<td>I50.1</td>
<td>227,903</td>
<td>1.5%</td>
<td>73.2%</td>
</tr>
<tr>
<td>18</td>
<td>Respiratory arrest</td>
<td>R09.2</td>
<td>206,955</td>
<td>1.4%</td>
<td>74.6%</td>
</tr>
<tr>
<td>19</td>
<td>Respiratory failure, unspecified</td>
<td>J96.9</td>
<td>180,504</td>
<td>1.2%</td>
<td>75.8%</td>
</tr>
<tr>
<td>20</td>
<td>Congestive heart failure</td>
<td>I49.9</td>
<td>177,853</td>
<td>1.2%</td>
<td>77.0%</td>
</tr>
</tbody>
</table>
Descriptive

Typology

Type 1

Type 2
Descriptive

Typology

Type 3

Type 4
Descriptive

Typology

Type 5

Type 6
Causes of death process I

VR
(good data)

Redistribution of ill-defined and garbage codes

External estimates
Lit. review, models

Projection to reference year
Causes of death process II

**Correction of quality**

VR (poor data)

External estimates

Lit. review, models

**CODMOD**

- uncovered pop
- uncovered deaths
- GDP in uncovered areas

**Distribution of causes covered areas**

+ Distribution of causes uncovered areas (regional template)

Redistribution of garbage codes

Projection to reference year
Causes of death process III

CODMOD
- total mortality
- GDP in uncovered areas

Projection to reference year

External estimates
Lit. review, models
• COD process I  70-80 countries (33%)
• COD process II 20-30 countries (11%)
• COD process III 120-130 countries (55%)
Matur Nuwun
Terima Kasih
Thank you
Asante Tina
Gracias