Mortality

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Lecture Topics

- Mortality data systems
- Mortality coding systems
- Data poor environments
- Case study #1:
  - Motor vehicle fatalities in Germany
Section A

Data and Data Sources
Maria Segui-Gomez, MD, ScD
Death

- Unambiguous fact
Relevance of Injury Death Data

- Deaths per se
  - Counts
  - Rates
- Deaths in relation to life lost
  - Age at death-fixed age* = years of potential life lost (YPLL)

* Fixed Age: 65, 75, Life Expectancy at birth, Life Expectancy at time of event, etc.
# Leading Causes of Global Mortality, 2001

<table>
<thead>
<tr>
<th>Disease or Injury</th>
<th>Thousands (Deaths)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic heart diseases</td>
<td>6,880</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>5,096</td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>3,863</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>2,943</td>
</tr>
<tr>
<td>COPD</td>
<td>2,520</td>
</tr>
<tr>
<td>Perinatal conditions</td>
<td>2,438</td>
</tr>
<tr>
<td>Diarrheal disease</td>
<td>2,124</td>
</tr>
<tr>
<td>TB</td>
<td>1,660</td>
</tr>
<tr>
<td>Road traffic accidents</td>
<td>12,591</td>
</tr>
<tr>
<td>Trachea bronchus and lung cancer</td>
<td>1,210</td>
</tr>
<tr>
<td>Malaria</td>
<td>1,080</td>
</tr>
<tr>
<td>Hypertensive heart disease</td>
<td>939</td>
</tr>
<tr>
<td>Self inflicted injuries</td>
<td>814</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>808</td>
</tr>
</tbody>
</table>

What Would We Like to Know about Injury Related Deaths?

- Victim characteristics: Age, gender, ethnicity, etc.
- Injury characteristics: Where (location), what (nature)
- Event characteristics: When (time and day), where (location), while doing what (activity)
What Would We Like to Know about Injury Related Deaths?

- Comparison of mortality data across settings allows for testing of different hypotheses regarding risk factors and effectiveness of interventions.
Data Sources

**Systems:**
- Vital Statistics
- Registries
- Surveillance
- Surveys
  - Government
  - Others (e.g., community-based)
- Mortality interviews

**Documents:**
- Death Certificates
- Autopsy / Hospital / Police / Crash Reports
- Medical reports
Death Certificates

- Single most important source of mortality data
- Oldest health information system in place
- Established standardized protocols
Death Certificates

- Completed by physicians, police, or medical examiners (or coroners) who are also involved in assessing the circumstances
- Centralized depository
- Available and population-based in North and Central America, Europe, and Australia
Death Certificates

- Information on age, gender, and cause(s) of death
- Limited information on injury, event, and other factors (e.g., blood alcohol level)
- Need to investigate beyond immediate cause for accurate death

- Validity?
  - Incomplete counts
  - Biased sources
  - No investigation
  - Erroneous coding

- Need to correct after findings

- Computerized data, but delay in availability
  - Need to investigate beyond immediate cause (or accurate counts)
Autopsy Reports

- Completed by medical examiners
- Most detailed information on injury characteristics and other factors
- Standardization?
- Often not computerized
- Variable availability
- Variable level of detail and quality
Police Reports

- Not standardized
- Not computerized
- Not centralized
- Not easily available

In motor vehicle crashes:
- Undercount (on the road vs. 24hrs. vs. 30 days)
- Underreporting of pedestrian, motorcyclist, bicyclist

Other Data Sources

- Occupational reports
- Some transportation entities
- Insurance companies
- Newspaper reports
Mortality Data Comparability?

Variability in:
- Complete rates (e.g., hospital based?)
- Accuracy of diagnoses
- Sequencing of diagnoses
- Classification systems
- Definition of: Injury, time between event and death
When Comparing Mortality Data

- Check for definition of death
- Check for validity of data sources
- Age- and gender- adjust
- Other adjustments (e.g., exposure? population?)

Continued
When Comparing Mortality Data

- Statistical significance?
- Other:
  - Check for definition of location (site of death vs. site of residence)
  - Check for time from event to death
  - Example: Smith, et al.; 1996 proceedings ICE
Section B

*Data Coding*

Maria Segui-Gomez, MD, ScD
Mortality Codes

- Coding the injuries (i.e., nature of injury)
  - International Classification of Diseases
  - Basic tabulation list

- Coding how they happened (i.e., circumstances surrounding injury)
  - International Classification of Diseases
  - NOMESCO Classification of External Causes of Injuries
  - New Zealand, Australian codes
  - International Classification of External Causes of Injury (ICECI)
Coding System

- In general, coding system should be:
  - Exhaustive and exclusive
  - Simple to use and reliable
  - Flexible (over time), yet consistent
International Classification of Diseases (ICD)

- World Health Organization
- Periodic revisions, currently 10th version (9th version expired in late 1990s)
- Coding follows strict rules outlined in documentation and requires training
- Codes injury information and cause of injury (chapter XX in ICD-10)
International Classification of Diseases (ICD)

“Yet, there are differences in practice across settings even in highly developed countries”

# ICD-9 and 10
## Examples of Injury Types

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>ICD-9</th>
<th>ICD-10</th>
<th>ICD-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>Fracture of vault of skull</td>
<td>S02</td>
<td>Fracture of skull and facial bones</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S02.0</td>
<td>Fracture of vault of skull</td>
</tr>
<tr>
<td>871</td>
<td>Open wound of eyeball</td>
<td>S05</td>
<td>Open wound of eye and orbit</td>
</tr>
</tbody>
</table>
## ICD-9 and 10
### Examples of External Cause

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>ICD-9</th>
<th>ICD-10</th>
<th>ICD-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>E924.0</td>
<td>Hot liquids and vapors including steam</td>
<td>X11</td>
<td>Contact with hot tap water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X12</td>
<td>Contact with other hot fluids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X13</td>
<td>Contact with steam and hot vapors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X14</td>
<td>Contact with hot air and gases</td>
</tr>
<tr>
<td>E886</td>
<td>Fall on same level from collision, pushing or shoving, by or with other person</td>
<td>W03</td>
<td>Fall on same level due to collision with, or pushing by, another person</td>
</tr>
</tbody>
</table>

ICD-9 and 10

- When presenting ICD data you can use the framework presented in MMWR 1997; 46 RR14
For Comparability Reasons

- Mapping between ICD-9 and ICD-10
- Standard categories to present injury and event codes

- ICD-9 had injury codes and external cause codes (e-codes) needed to code both
- ICD-10 offers one single code to reflect both aspects
- ICD-10 has supplemental codes to reflect place of occurrence and activity
NOMESCO Classification of External Causes of Injury

- Nordic Medico-Statistical Committee
- Developed in 1984, revised in 1990
- It aims to describe the sequence of events leading to the injury
- The injury itself must be coded with ICD
Basic Tabulation List

- WHO constitutional mandate to maintain statistical services
- Simplified version of ICD
- World Health Statistics Annual presents data submitted by individual member states
Basic Tabulation List

- Cause-of-death data, based on underlying cause of death, is presented using a specified format for purposes of consistency and comparability
  - Basic Tabulation List for ICD-9 (BTL) prior to ICD-10
  - Tabulation List for ICD-10 (TL10) has been developed
Section C

Data-Poor Environments
Adnan Hyder, MD, PhD
Crude Mortality Rates for Selected Diseases in Taiwan, 1988

Data in Developing Countries

- Sources:
  - Vital statistics
  - Hospital discharge summaries
  - Health surveys
- Accurate

Developing Countries

- Lack of vital statistics
- Poor health information system
- No reliable data on incidence or causes of death
- True for injuries and other disease conditions
Injury Mortality Data Problems

Investigation of Injury Data

- Involves police, coroner, and pathologists
- Poor communication
- Long delays before investigation starts
- Staff shortages

Continued
Injury Mortality Data Problems

Investigation of Injury Data

- Inadequate lab tests
- Lack of transport to remote areas
- Under-reporting
  - E.g., 1995: The department of health in Taiwan reported 130% more fatalities from road crashes than the police
Injury Mortality Data Problems
Death Certificates

- Deaths recorded only in hospitals and only if death certificate completed
- Data biased heavily towards urban population (rural usually not recorded)
- Unrecorded deaths tend to bias the already small numerator, while the denominator used is the total population calculated by reasonably accurate census
Injury Mortality Data Problems
Misclassifications

- Injury deaths often attributed to other causes e.g. cardiorespiratory arrest
- Cause listed as “injury” without provision of details
- Suicides often misclassified as unintentional or intent undetermined; more prevalent in societies averse to suicide
- In countries where state terrorism is widespread, many homicides and violent deaths remain unclassified
Injury Mortality Data Problems

**Police Reports & Mortality**

- Capture only those fatalities with medico-legal significance, e.g., intentional, suspected intentional
- Inefficiencies, poor communications, informal monetary exchanges—all cause substantial under-reporting of these fatalities
- However, police data in developing countries should be considered a source of injury fatality information
Injury Mortality

Consequences of Data Problems

- Lack of accurate data!
- Not possible to evaluate importance of injuries
- Lack of will to address the issue by politicians
- International comparisons difficult or impossible
Methods for Obtaining Injury Information

- Special surveys
- Community based surveillance
- Mortality interviews / verbal autopsies
- Police reports
- Newspapers
## Community-based Surveys of Injury Mortality in Developing Countries

<table>
<thead>
<tr>
<th>Place</th>
<th>Investigators</th>
<th>Year</th>
<th>Population</th>
<th>Major Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>Zimicki</td>
<td>1990</td>
<td>Matlab Demographic</td>
<td>Drowning leading cause of death in children</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Surveillance</td>
<td></td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>Barrs</td>
<td>1991</td>
<td>Rural Pop 30,000</td>
<td>Injuries 4th leading cause of death, 50% intentional</td>
</tr>
<tr>
<td>Egypt</td>
<td>Grubb et al</td>
<td>1988</td>
<td>Married women age 15-49</td>
<td>Injuries 3rd leading cause of death, 14% of all deaths</td>
</tr>
<tr>
<td>Nepal</td>
<td>Thapa</td>
<td>1989</td>
<td>6300 rural villages</td>
<td>Injuries 4th leading cause of death</td>
</tr>
</tbody>
</table>
Community-based Surveillance—Bangladesh

- Study of the epidemiology of child deaths from drowning
- During 1983–95 drownings caused 10–25% of all deaths in children aged 1–4 years
- Risk increases with age of mother and with the number of children living in family

Community-based Surveillance—Bangladesh

- International Center for Diarrheal Disease Research, Bangladesh (ICDDR, B) maintains registration system of births, deaths, and migration in Matlab since 1966
- Injury deaths peak in July
- Shows greatest variability of all causes of deaths
- Percentage of injury deaths from drowning is 25% in January & 75% in September—great seasonal variation

Seasonality of Drowning Deaths of Children
Aged 1-4 Years in Matlab, 1983-95

Verbal Autopsies

- Interview with relatives or companions of injury victims to determine the following:
  - Cause of death
  - Type of injury by external cause
  - Circumstances of injury death

Source: Barrs, 1997
Verbal Autopsies

- In Bangladesh:
- Verbal autopsy methodology found 8.8% of all deaths in children under five years of age caused by "injuries"
- Injuries ranked third as cause of death after Acute Lower Respiratory Infection (18.9%) & Diarrhea (13.3%)
- Very useful source of data in the absence of death certificates

Police Reports

- Potential source of information about roadside crashes and intentional injuries
- Data can be obtained directly from the local files of crash reports
- The development of a transport database which can be used to generate indicators to monitor trends in transport performance
Police Reports

- http://www.trl.co.uk/dfid/projects/r5613.htm
- Considerable under-reporting
- Injuries of pedestrian and cyclists often under-reported
Newspapers: A Source of Injury Data?

- Public health surveillance essential for injury control
- Newspapers: Inexpensive form of potential information
- Newspapers covered 96% of the fire fatalities and 78% of drownings over a 13 month period in North Carolina
- Beside surveillance, increases public awareness about injury risks and protective measures
Surveillance for Injuries in Developing Countries

**Design Issues:**
- Purpose of surveillance
- Consider realities associated in the setting

**Data Issues:**
- Use minimal data set for surveillance
- Large data (many variables, increased cost) increased expectation of usefulness of surveillance system
- Use local data
Limitations of Methods for Injury Data

- Few standards or guidelines
- Lack of population based data (mostly facility based)
- Inflexibility of existing data systems
- Inability to integrate different data systems
- Important data elements often not collected
Section D

Case Study in Mortality
Maria Segui-Gomez, MD, ScD
Motor Vehicle Occupant Fatalities in Germany
Background

- In the developed world, motor vehicle crashes are the leading cause of injury mortality among people 1–44 years old.
- It is the 4th–5th cause for all ages.
- Motor vehicle crashes are an emerging cause of death throughout the world.
Background

Motor Vehicle Fatalities and Area Economy are Correlated

Source: van Beeck, et al., 2000
The Question

Does sudden wealth affect motor vehicle fatality rates?
The Setting

- West Germany (formerly Federal Republic of Germany)
- East Germany (formerly German Democratic Republic)
- November 1989, reunified

Map courtesy of CIA World Factbook
Fig 1. Death Rates for Occupants of Cars for Former East and West Germany

Adapted from: Winston et al., 1999
What Would You Like to Know?

- What do they call an MV death?
  - Immediate death
  - Death after some hours/days
  - Crash in any road
  - Crash in public road

- What do they call an East German or West German death?
  - Residents
  - Place of crash
  - Place of death

Continued
What Would You Like to Know?

- Which unit did they evaluate?  
  - Death counts  
  - Death rates

- What data source(s) did they compare?  
  - Death certificates  
  - Police reports  
  - Special survey
What Would You Like to Know?

- If rates, were they adjusted?
  - By Age
  - By Gender
  - By number of vehicles
  - By amount of travel

- Were there any changes in data . . .
  - Completeness
  - Accuracy
  - Definition
  - Coding?
Some Answers

- International Road Traffic and Accident Database (German Federal Ministry of Transport) is a police-based system
- MV deaths are any deaths within 30 days from an MV crash
- East or West MV deaths are located depending on where the crash occurred
- In summary, according to authors, no changes over time (comparable data)
Possible Explanations

- Changes in definitions and reporting
- Increase in number of motor vehicles
- Increase in driving exposure
- Increase in traffic volume
- Increase in speeds
- Increase in alcohol involvement
Remember

- This is an ecological study (no evidence that those dead were East Germans driving the new cars)
- East Germany underwent a big economic recession right after the study period with major health repercussions (no follow up on MV deaths to date)

*Source: Nolte, 2000, *J Epidemiol; Community Health* 54: 565*