Indices of Morbidity and Mortality

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Knowledge of Science

“One's knowledge of science begins when he can measure what he is speaking about and express it in numbers.”

— Lord Kelvin (1824–1907)

Source: http://zapatopi.net/lordkelvin.html
Image of Lord Kelvin is in the public domain.
Review of Ratio, Proportion, and Rate

- **Ratio** is one number divided by another number (numerator doesn’t have to be included in denominator—and vice versa)

- **Proportion** is a ratio in which the numerator is included in the denominator
  - It has no dimension because the unit of the numerator cancels out the unit of the denominator

- **Rate** is a ratio
  - The numerator is the number of events
    - The unit is event (i.e., number of cases)
  - The denominator is the sum of follow-up time contributed by the people at risk of the event
    - The unit is time or, more accurately, person-time to account for duration of time of follow-up
Quick Check

- What are they—ratio, proportion, or rate? (give reasons)
  - The number of people who ate tuna salad divided by the number of people who did not eat tuna salad
  - The number of people who ate egg salad divided by the number of people who ate tuna salad
Quick Check

- What are they—ratio, proportion, or rate? (give reasons)
  - The number of people who ate tuna salad divided by the number of people who did not eat tuna salad
  - The number of people who ate egg salad divided by the number of people who ate tuna salad
  - The number of sick people who ate tuna salad divided by the number of people who ate tuna salad
  - The number of people diagnosed with influenza on a cruise ship divided by the number of person-weeks of follow-up of people on the cruise ship
Section A

Incidence and Prevalence
“In 1997, new cases of TB totaled an estimated 7.96 million, … and there were 16.2 million existing cases of disease. An estimated 1.87 million people died of TB and the global case fatality rate was 23% but exceeded 50% in some African countries with high HIV rates. Global prevalence of Mycobacterium TB infection was 32% (1.86 billion people). Eighty percent of all incident TB cases were found in 22 countries, with more than half the cases occurring in 5 Southeast Asian countries. “

— JAMA (Aug 18, 1999);282(7):677–86
Incidence

- **Incidence** is the number of new cases of a disease occurring in an at-risk population during a defined time interval
  - Example: 80% of all incident TB cases were found in 22 countries
Incidence Proportion

Incidence per 1,000

\[
\text{Incidence per 1,000} = \frac{\text{Number of NEW cases of a disease occurring in the population during a specified period of time}}{\text{Number of persons at risk of developing the disease during that period of time}} \times 1000
\]
Incidence Proportion

- Incidence proportion
  - A measure of risk
  - Example: number of sick people who ate egg salad divided by the total number of people who ate egg salad at a luncheon (time duration is implied)

- Cumulative incidence
  - Example: number of people who have ever had asthma divided by total number of people who were asked the question about ever having asthma

- Attack rate
  - Same as incidence proportion and often used in a disease outbreak
  - It implies rate but is not actually a rate
Incidence Rate

- The numerator is the same as the numerator of incidence proportion
- The denominator accumulates time at risk of the event
  - It is not just the number of people at risk
  - In a study of tuberculosis, an individual who was followed for 5 years will contribute 5 person-years of follow-up to the denominator, while another individual with 3 years of follow-up will contribute 3 years to the denominator
  - Example: incidence rate of tuberculosis = 25 per 10,000 person-years
- Incidence density
  - Same as incidence rate
Incidence Proportion or Incidence Rate

- Sometimes the term **incidence rate** is used even though the measure is a cumulative incidence.
- Example: annual incidence rate of lung cancer in U.S. in 2000 was calculated with the number of new lung cancer cases in 2000 as the numerator and the number of people at risk of lung cancer in the U.S. in 2000 as the denominator (and not person-years).
  - In the denominator, it implies that all individuals were followed for one year.
  - Annual incidence rate of lung cancer = 6 per 10,000 per year.
Prevalence

- **Prevalence** is the proportion of population with the disease

\[
\text{Prevalence per 1,000} = \frac{\text{Number of cases of disease present in the population at a specified time}}{\text{Number of persons in the population at that specified time}} \times 1,000
\]

- Example: global prevalence of *Mycobacterium TB* infection was 32% (1.86 billion people).
About Prevalence

- Prevalence is a proportion
- It measures the extent (amount) of the event (disease) in the population in a specified time
- The numerator includes both new and existing cases of disease
- Time is a descriptor of the measure but is not a part of the denominator (does not use person-time)
- Sometimes, the term prevalence rate is used even though it is a proportion
  - Example: prevalence rate of HIV/AIDS in Botswana in 2003 = 37.3%

Source: http://www.nationmaster.com/graph-T/hea_hiv_aid_adu_pre_rat&int=-1
Point and Period Prevalence

- Two types of prevalence
  - **Point prevalence**
  - **Period prevalence**

- Examples of point and period prevalence and cumulative incidence in interview studies of asthma
  - “Do you currently have asthma?”
    - Point prevalence
  - "Have you had asthma during the last n years?"
    - Period prevalence
  - “Have you ever had asthma?”
    - Cumulative or life-time incidence
Low Incidence and High Prevalence and Vice Versa

- A chronic, incurable disease, such as diabetes, can have a **low incidence but high prevalence**, because the disease is not very fatal—but it cannot be completely cured either
  - Its prevalence is the sum of new and existing cases from past years
- A short-duration, curable disease, such as the common cold, can have a **high incidence but low prevalence**, because many people get a cold each year—but it lasts for a short time
Counts for Numerators of Incidence and Prevalence

- Disease developed
- Cured
- Died
- Continued
Incidence/Prevalence

Community Population

Incidences of Disease

Prevalence

19
Prevalence increases as new incidences are added to the population.
Prevalence decreases as incidences are subtracted from the population by death or cure

Rate per 100,000

Prostate
Lung
Colon and rectum
Urinary bladder
Non-Hodgkin lymphoma

Age-adjusted to the 2000 US standard population.


Rate per 100,000

Age-adjusted to the 2000 US standard population.

Cancer Prevalence

- As of January 1, 1999, it is estimated that there are 8.9 million cancer survivors in the United States
  - This represents approximately 3% of the U.S. population
- Breast, prostate, and colon/rectum cancer are the three most prevalent cancer sites

Prevalence of Characteristics

- Prevalence can also refer to the status of a characteristic in the population
- Examples
  - Cigarette smoking prevalence
  - Mammogram prevalence
Trends in Cigarette Smoking Prevalence (%) by Gender, Adults 18 and Older, U.S., 1965–2001

Redesign of survey in 1997 may affect trends.


Relation between Incidence and Prevalence

- **Prevalence ~ incidence x duration of disease**
  - Higher incidence results in higher prevalence
  - Longer duration results in higher prevalence
A Hypothetical Example of Chest X-Ray Screening

<table>
<thead>
<tr>
<th></th>
<th>Number with Positive X-Ray</th>
<th>Population</th>
<th>Point Prevalence per 1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>High SES</td>
<td>100</td>
<td>1,000</td>
<td>100</td>
</tr>
<tr>
<td>Low SES</td>
<td>60</td>
<td>1,000</td>
<td>60</td>
</tr>
</tbody>
</table>
## A Hypothetical Example of Chest X-Ray Screening

<table>
<thead>
<tr>
<th></th>
<th>Point Prevalance per 1,000</th>
<th>Incidence</th>
<th>Average Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>High SES</td>
<td>100</td>
<td>4/year</td>
<td>25 years</td>
</tr>
<tr>
<td>Low SES</td>
<td>60</td>
<td>20/year</td>
<td>3 years</td>
</tr>
</tbody>
</table>
Review Questions

- What is the difference between **incidence** and **prevalence**?
- How are they related?
Section B

Sources of Morbidity Data
The Natural History of Disease and Sources of Data

Healthy → Disease Onset → Symptoms → Seek Care → Diagnosis → Treatment

Gene testing

Biomarkers

Interviews

Some Sources of Data

M.D. records

Hospital records
Examples of Sources of Morbidity Statistics

- Hospitals and clinics
- Disease/cancer registries
- Surveillance systems, such as communicable disease reporting
Examples of Sources of Morbidity Statistics

- Hospitals and clinics
- Disease/cancer registries
- Surveillance systems, such as communicable disease reporting
- Surveys, such as NHANES, NHCS, NHIS
- Insurance and prepaid medical plans
- Tax-financed medical plans
- Industry
- Records of military personnel
Problems with Incidence and Prevalence Measurements

- Problems with numerators
  - Definition
  - Data collection methods
  - Sources
- Problems with denominators
  - Definition
  - Appropriateness
Different Definitions of Rheumatoid Arthritis

- The percent of the population with a diagnosis of rheumatoid arthritis—New York criteria vs. American Rheumatism Association criteria

Problems with Numerators

- Different definitions and lack of uniform criteria for reporting
  - Not until 1990 was there a uniform criteria for reporting cases to CDC
    - "Case Definitions for Public Health Surveillance" document
- Different uses of confirmatory lab tests or epidemiologic criteria
  - Example: the inclusion of exposure to a point source of infection in the definition
- Use of International Classification of Diseases, Clinical Modification (ICD-9-CM) to code morbidity data may underestimate disease incidence due to its use for insurance billing purpose
Problems with Numerators

- Different methods are used to gather data (questionnaires, telephone interview, direct examinations, hospital record abstraction, etc.)
- Hospital records are incomplete, illegible, and not intended for use in research
### Different Sources of Data

Comparison of Patients' Statements with Examination Findings Concerning Circumcision, Roswell Park Medical Institute, Buffalo, N.Y.

<table>
<thead>
<tr>
<th>Patients’ Statements</th>
<th>Circumcised</th>
<th>Not circumcised</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination finding</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Circumcised</td>
<td>37</td>
<td>47</td>
<td>84</td>
</tr>
<tr>
<td>Not circumcised</td>
<td>19</td>
<td>89</td>
<td>108</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>29.2</td>
<td>136</td>
</tr>
</tbody>
</table>

Self-reported status was correct in $37/56 = 66\%$ and $89/136 = 65\%$

Source: Lilienfeld et al, 1958
Different Sources of Data

Comparison of Patients' Statements with Examination Findings Concerning Circumcision, HPV Studies, Several Countries, 2002

<table>
<thead>
<tr>
<th>Patients’ Statements</th>
<th>Circumcised</th>
<th>Not circumcised</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination finding</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Circumcised</td>
<td>282</td>
<td>37</td>
<td>319</td>
</tr>
<tr>
<td>Not circumcised</td>
<td>5</td>
<td>466</td>
<td>471</td>
</tr>
<tr>
<td>Total</td>
<td>287</td>
<td>36.3</td>
<td>503</td>
</tr>
</tbody>
</table>

Self-reported status was correct in 282/287=98% and 466/503=93%

Source: NEJM 346:1105-1112, 2002
Problems with Denominators

- Variable geographic boundary of population at risk
  - Hospital referral area
- Selection of appropriate denominators for study question
  - Example: study of accident and cell phone use while operating a motor vehicle
  - Denominator = ?
    - Number of cars, number of drivers, number of trips, number of miles, number of minutes
- Definition of characteristics, such as ethnicity
- Inclusion of people who are not at risk in the denominator
### Estimated Spanish Ancestry Population in New Mexico, Based on a 1970 U.S. Census (According to Which Census Definition Is Used)

<table>
<thead>
<tr>
<th>Definition Used</th>
<th>Estimated Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth and parentage</td>
<td>40,173</td>
</tr>
<tr>
<td>Spanish language</td>
<td>379,723</td>
</tr>
<tr>
<td>Spanish surname</td>
<td>324,248</td>
</tr>
<tr>
<td>Spanish origin</td>
<td>308,340</td>
</tr>
<tr>
<td>Spanish heritage</td>
<td>407,286</td>
</tr>
</tbody>
</table>
From the Short Form of the U.S. 2000 Census

7. Is Person 1 Spanish/Hispanic/Latino? Mark \(\xmark\) the “No” box if not Spanish/Hispanic/Latino.
   - No, not Spanish/Hispanic/Latino
   - Yes, Puerto Rican
   - Yes, Mexican, Mexican Am., Chicano
   - Yes, Cuban
   - Yes, other Spanish/Hispanic/Latino — Print group.

8. What is Person 1’s race? Mark \(\xmark\) one or more races to indicate what this person considers himself/herself to be.
   - White
   - Black, African Am., or Negro
   - American Indian or Alaska Native — Print name of enrolled or principal tribe.
   - Asian Indian
   - Japanese
   - Native Hawaiian
   - Chinese
   - Korean
   - Guamanian or Chamorro
   - Filipino
   - Vietnamese
   - Samoan
   - Other Asian — Print race.
   - Other Pacific Islander — Print race.
   - Some other race — Print race.
Age-adjusted uterine cancer incidence rates, Alameda County – Corrected and uncorrected—by hysterectomy status

Hysterectomy = removal of uterus

Source: Lyon and Gardner
Section C

Indices of Mortality
About Mortality

- Death is the foundation of all vital statistics
- The early work on vital statistics was done by John Graunt (1620–1674), a British demographer
  - His work on the Bills of Mortality led to development of statistical methods to analyze mortality data
- In most countries, laws require registration of deaths
- In the U.S., physicians, coroners, or medical examiners must certify all deaths and provide diagnosis for causes of death
  - All deaths are recorded and reported to local and state health departments—and finally to the National Center for Health Statistics (NCHS)
  - NCHS developed a **Standard Certificate of Death** to be used by all states
    - It followed the format recommended by WHO
Example of a Death Certificate

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Decedent's legal name (Include AKA's if any) (First, Middle, Last)</td>
</tr>
<tr>
<td>2.</td>
<td>Sex</td>
</tr>
<tr>
<td>3.</td>
<td>Social security number</td>
</tr>
<tr>
<td>4a.</td>
<td>Age: Last birthday (Years)</td>
</tr>
<tr>
<td>4b.</td>
<td>Under 1 year</td>
</tr>
<tr>
<td>4c.</td>
<td>Under 1 day</td>
</tr>
<tr>
<td>5.</td>
<td>Date of birth (Mo/Day/yr)</td>
</tr>
<tr>
<td>6.</td>
<td>Birthplace (City and state of foreign country)</td>
</tr>
<tr>
<td>7a.</td>
<td>Residence-state</td>
</tr>
<tr>
<td>7b.</td>
<td>County</td>
</tr>
<tr>
<td>7c.</td>
<td>City or town</td>
</tr>
<tr>
<td>8.</td>
<td>Street and number</td>
</tr>
<tr>
<td>7d.</td>
<td>APT. NO.</td>
</tr>
<tr>
<td>7e.</td>
<td>ZIP code</td>
</tr>
<tr>
<td>9.</td>
<td>Ever in US armed forces? Yes No</td>
</tr>
<tr>
<td>10.</td>
<td>Marital status at time of death: Married, Married, but separated, Widowed, Divorced, Never Married, Unknown</td>
</tr>
<tr>
<td>11.</td>
<td>Father's name (First, Middle, Last)</td>
</tr>
<tr>
<td>12.</td>
<td>Mother's name prior to first marriage (First, Middle, Last)</td>
</tr>
<tr>
<td>13a.</td>
<td>Informant's name</td>
</tr>
<tr>
<td>13b.</td>
<td>Relationship to decedent</td>
</tr>
<tr>
<td>13c.</td>
<td>Mailing address (Street and number, city, state, zip code)</td>
</tr>
<tr>
<td>14.</td>
<td>Place of death (Check only one; see instructions)</td>
</tr>
<tr>
<td>15.</td>
<td>Facility name (If not institution, give street &amp; number)</td>
</tr>
<tr>
<td>16.</td>
<td>City, town, state, and zip code</td>
</tr>
<tr>
<td>17.</td>
<td>County of death</td>
</tr>
<tr>
<td>18.</td>
<td>Method of disposition: Burial, Cremation, Donation, Removal from State, Other (Specify)</td>
</tr>
<tr>
<td>19.</td>
<td>Place of disposition (Name of cemetery, crematory, other place)</td>
</tr>
<tr>
<td>20.</td>
<td>Location: City, town, and state</td>
</tr>
<tr>
<td>21.</td>
<td>Name and complete address of funeral facility</td>
</tr>
<tr>
<td>22.</td>
<td>Signature of funeral service licensee or other agent</td>
</tr>
<tr>
<td>23.</td>
<td>License number (of licensee)</td>
</tr>
<tr>
<td>24.</td>
<td>Date pronounced dead (Mo/Day/yr)</td>
</tr>
<tr>
<td>25.</td>
<td>Time pronounced dead</td>
</tr>
<tr>
<td>26.</td>
<td>Signature of person pronouncing death (Only when applicable)</td>
</tr>
<tr>
<td>27.</td>
<td>License number</td>
</tr>
<tr>
<td>28.</td>
<td>Date signed (Mo/Day/yr)</td>
</tr>
<tr>
<td>29.</td>
<td>Actual or presumed date of death (Mo/Day/yr) (Specify month)</td>
</tr>
<tr>
<td>30.</td>
<td>Actual or presumed time of death</td>
</tr>
<tr>
<td>31.</td>
<td>Was medical examiner or coroner contacted? Yes No</td>
</tr>
<tr>
<td>32.</td>
<td>Cause of death (See instructions and examples)</td>
</tr>
</tbody>
</table>

**CAUSE OF DEATH (See instructions and examples)**

- **Part I:** Enter the chain of events—diseases, injuries, or complications—that directly caused the death. Do not enter terminal events such as cardiac arrest, respiratory arrest, or withdrawal without showing the etiology. Do not abbreviate. Enter only one cause on a line. Add additional lines if necessary.
- **Immediate cause:** (Final disease or condition resulting in death)
Section on Causes of Death

Immediate cause of death

Underlying cause of death
Causes of Death on Death Certificate

- The immediate cause of death and the underlying cause of death are found on a death certificate
  - The underlying cause of death is the disease or injury that initiated the set of events leading to death
- Causes of death are coded according to the rules set forth in the International Classification of Diseases (ICD)
  - ICD-9 first used in 1979
  - ICD-10 first used in 1999
- Rules for selection of the underlying cause of death can be found in ICD
- Nosologists, MICAR (Mortality Medical Indexing, Classification, and Retrieval), SuperMICAR, ACME (Automated Classification of Medical Entities)
Death was caused by
  Immediate cause       A) Cerebral hemorrhage
  Due to               B) Nephritis
  Due to               C) Cirrhosis of liver

Cirrhosis of liver is the underlying cause of death
  It is coded as 571.5

Source: Israel and Klebra, 1964
The 10 Leading Causes of Death in 1996: ICD-9 and -10

<table>
<thead>
<tr>
<th>ICD-9</th>
<th>ICD-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heart diseases</td>
<td>1. Heart diseases</td>
</tr>
<tr>
<td>2. Malignant neoplasms</td>
<td>2. Malignant neoplasms</td>
</tr>
<tr>
<td>3. Cerebrovascular diseases</td>
<td>3. Cerebrovascular diseases</td>
</tr>
<tr>
<td>4. COPD</td>
<td>4. Chronic lower respiratory diseases</td>
</tr>
<tr>
<td>5. Accidents</td>
<td>5. Accidents</td>
</tr>
<tr>
<td>6. Pneumonia and influenza</td>
<td>6. Diabetes</td>
</tr>
<tr>
<td>7. Diabetes</td>
<td>7. Influenza and pneumonia</td>
</tr>
<tr>
<td>8. HIV</td>
<td>8. Alzheimer’s disease</td>
</tr>
<tr>
<td>9. Suicide</td>
<td>9. HIV</td>
</tr>
<tr>
<td>10. Chronic liver disease and cirrhosis</td>
<td>10. Intentional self-harm (suicide)</td>
</tr>
</tbody>
</table>
Sources of Mortality Statistics

- National Center for Health Statistics
  - National Death Index (NDI)
- Centers for Disease Control and Prevention (CDC)
  - Morbidity and Mortality Weekly Report
- State vital records
- Tumor registries
Quick Check

- How many deaths occurred in the United States last year?
  A. 25,000
  B. 250,000
  C. 2,500,000
  D. 25,000,000

- How many deaths occurred in your state (or country, if not U.S.) last year?

- Heart diseases are the leading cause of death in the United States
  - What is the leading cause of death in your state (or your country)?

Forecast of Cancer Deaths

Years


0 100000 200000 300000 400000 500000 600000 700000 800000

1900 41000 65000 85000 118000 158000 211000 268000 311000 382000 443000 510000 577000

557000
Mortality Rate

Annual mortality rate from all causes (per 1,000 population) = \frac{\text{Total number of deaths from all causes in one year}}{\text{Number of persons in the population at midyear}} \times 1,000
Calculation of Mortality Rate

- It is usually calculated on an annual basis
- Numerator is the number of deaths
- For vital statistics purpose, the midpoint (midyear) population is used with the assumption that:
  - Addition and subtraction of population occur uniformly throughout the year
  - If the actual person-years of follow-up were calculated for all individuals in a year, the value will be equivalent to the number of population at midyear times one
    - That is, followed for one full year
- The denominator thus becomes person-year, and mortality rate can be considered as a “rate” and not a “proportion”
  - Even though the number of persons at midyear is used in the calculation
Example: Mortality Rate

Annual mortality rate from all causes (per 1,000 population) = \[
\frac{20 \text{ deaths from all causes in one year}}{12,000 \text{ persons in the population at midyear}} \times 1,000
\]

= 1.7 per 1,000
Age-Specific Mortality Rate

Annual mortality rate from all causes for children under age 10 (per 1,000 population) = \frac{\text{Total number of deaths from all causes in one year in children under age 10}}{\text{Number of children in the population under age 10 at midyear}} \times 1,000
**Cause-Specific Mortality Rate**

Annual mortality rate from lung cancer (per 1,000 population) = \[
\frac{\text{Total number of deaths from lung cancer in one year}}{\text{Number of persons in the population at midyear}} \times 1,000
\]
Age- and Cause-Specific Mortality Rate

Annual mortality rate from leukemia for children under age 10 (per 1,000 population) = \frac{\text{Total number of deaths from leukemia in one year in children under age 10}}{\text{Number of children in the population under age 10 at midyear}} \times 1,000

Rate per 100,000

*Age-adjusted to the 2000 U.S. standard population.


*Age-adjusted to the 2000 U.S. standard population.

Case Fatality Rate

Case fatality rate (%) = \frac{\text{Number of individuals dying during a specified period of time after disease onset or diagnosis}}{\text{Number of individuals with the specified disease}} \times 100
Comparison of Mortality Rate and Case Fatality Rate

- Assume a population of 100,000 people
  - 20 are sick with disease “X”
  - In one year, 18 die from disease “X”
- The mortality rate in that year from disease “X”
  \[
  \frac{18}{100,000} = 0.00018 \text{ (or 0.018%)}
  \]
- Case fatality rate from “X”
  \[
  \frac{18}{20} = 0.9 \text{ or 90%}
  \]
Proportionate mortality from cardiovascular diseases in the U.S. in 2000

= Number of deaths from cardiovascular diseases in the U.S. in 2000

Total deaths in the U.S. in 2000
Example of Proportionate Mortality

Deaths from Heart Disease as a Percent of Deaths from All Causes, by Age Group

- All Ages
- <1
- 5–14
- 25–34
- 45–54
- 65–74
- 85+

percent of all deaths

percent of all deaths

Heart Disease

All Other Causes
Deaths from heart disease in two communities, “A” and “B”

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mortality rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from all causes</td>
<td>30/1,000</td>
<td>15/1,000</td>
</tr>
<tr>
<td><strong>Proportionate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mortality from heart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>disease</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Mortality rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from heart disease</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Deaths from heart disease in two communities, “A” and “B”

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality rate from all causes</td>
<td>30/1,000</td>
<td>15/1,000</td>
</tr>
<tr>
<td>Proportionate mortality from heart disease</td>
<td>10%</td>
<td>20%</td>
</tr>
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<td>Mortality rate from heart disease</td>
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## Comparison: Mortality Rate and Proportionate Mortality

- Deaths from heart disease in two communities, “A” and “B”

<table>
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<tr>
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<td>3/1,000</td>
</tr>
</tbody>
</table>
Mortality Rate and Incidence Rate

- When is a mortality rate a good index of an incidence rate?
  - When case fatality rate is high
  - When the duration of disease is short
Years of Potential Life Lost (YPLL)

- **Years of potential life lost** measures the impact of mortality on society.
- It is calculated by summing the years that individuals would have lived had they experienced normal life expectancy and had not died from the particular disease.
- Often, age 65 (or 75) is used in the calculation.
- For example, a person who died at age 30 from heart disease will contribute $65 - 30 = 35$ YPLL.
- YPLL is weighted more by premature deaths, while **crude mortality** is weighted by the larger number of deaths in older people.
- YPLL rate per 100,000 = $\frac{\text{sum (65 – age at death)}}{\text{number of people 65 and younger}} \times 100,000$.
### Comparing First 5 Leading Causes of Death and YPLL

<table>
<thead>
<tr>
<th>Causes of Death (U.S. 1990)</th>
<th>YPLL (U.S. 1990)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heart diseases</td>
<td>1. Unintentional injuries</td>
</tr>
<tr>
<td>2. Malignant neoplasms</td>
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</tr>
<tr>
<td>3. Cerebrovascular diseases</td>
<td>3. Suicide/homicide</td>
</tr>
<tr>
<td>4. Unintentional injuries</td>
<td>4. Heart diseases</td>
</tr>
<tr>
<td>5. COPD</td>
<td>5. Congenital anomalies</td>
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</table>

http://www.cdc.gov/mmwr/preview/mmwrhtml/00016649.htm
City A has 200,000 inhabitants (midpoint population)
  — 400 of them had disease X
  — There were 1,000 deaths in one year
  — Of those 1000 deaths, 25 died from disease X

What is the annual mortality rate?
What is the annual mortality rate from disease X?
What is the case fatality rate of disease X?
What is the proportion of deaths from disease X?
What is the annual prevalence of disease X?