Measures of Disease Frequency

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Types of Epidemiologic Measures

1. Measures of disease frequency
2. Measures of association
3. Measures of potential impact

Measures of Disease Frequency

- Measures of disease frequency in mathematical quantity
  - Counts
  - Proportion (percentage)
  - Rate
  - Ratio
- Measures of disease frequency in epidemiology
  - Prevalence
  - Incidence

Importance of Denominator

$\frac{a}{b}$ → Numerator

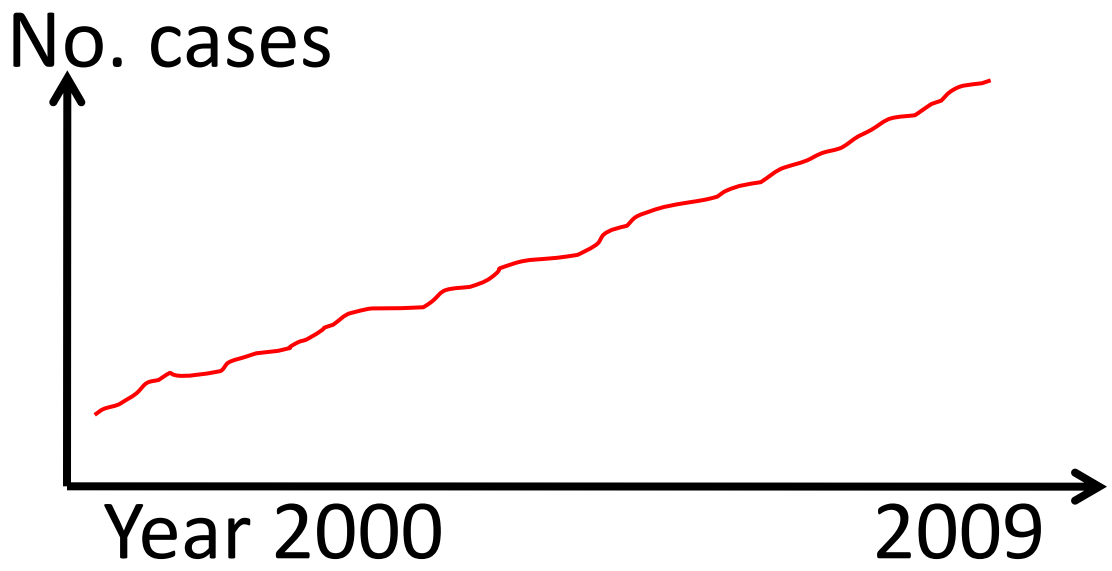
→ Denominator

Example 1:

- 250 cases of dengue fever in Vientiane
- 120 cases of dengue fever in Phongsaly

  Which one is more infected?
- Vientiane: 250/800,000 = 0.3/1,000
- Phongsaly: 120/300,000 = 0.4/1,000

Example 2: Dengue outbreak in Savannakhet



Is the situation worse?

Answer: depends on population size, difference in reporting method (more sensible), definition of case !!!

Counts

- Simplest & most basic measure - absolute number of persons who have disease or characteristic of interest

- Example: 123 severe acute diarrhea cases reported in Kaleum village in the past 3 days

- Useful for health planners & administrators: for allocation of resources (e.g. quantity of ORS needed by diarrheal cases

- Count of No. cases of a disease, is used for surveillance of infectious disease for early detection of outbreaks

Limited values of counts

- Number of persons with characteristic, e.g., cases of dengue hemorrhagic fever, depends on the size of the population at risk of the disease in an area.

  The bigger this group, the higher is the expected number of cases.

- The duration of observation also affects the frequency of cases; the longer the observation period, the more cases can occur.

  → **Count does not contain these elements !**

Proportion (percentage, frequency)

- **Proportion:** + a included in the denominator

$$\frac{a}{a+b}$$

+ No measurement unit; > 0 to $\leq$ 1

+ Often expressed as %

Example: From 7,999 females aged 16 – 45 y, 2,496 use modern contraceptive methods.

The proportion of those who use modern contraceptive methods = 2,496 / 7,999 x 100 = 31.2%

Rate

Definition: **Frequency of events, that occur in a defined time period, divided by the average population of risk.**

$$\text{Rate} = \frac{\text{Numerator}}{\text{Denominator}} \times \text{Constant multiplier}$$

$$\text{Crude death rate} = \frac{\text{Number of deaths (defined place and time period)}}{\text{Mid-period population (same place and population)}} \times 1000$$

Ratio

- **Ratio:** A fraction in which the numerator is not part of the denominator.

$$\frac{a}{b}$$

- a and b are two mutually exclusive frequency

- Example:

- Number of hospital beds per 100,000
- Male and female dengue infection ratio = 70/35 or 2 males to one female (2 : 1)

Measures of Disease Frequency

2 important measures of disease frequency in epidemiology:

- **Prevalence**
- **Incidence**

Prevalence

- Number of existing cases of disease
- Proportion of individuals in a population with disease or condition at a specific point of time

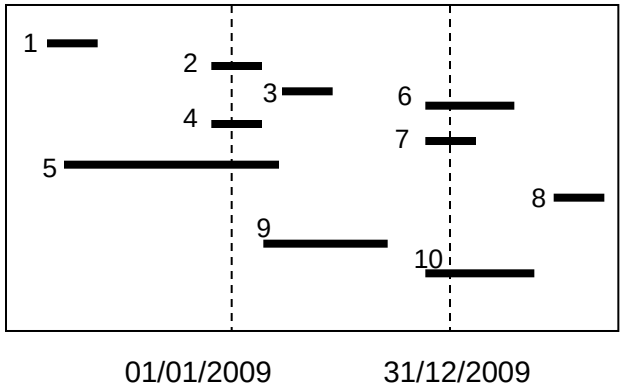
$$\text{Prevalence} = \frac{\text{No. of cases observed at time } t}{\text{Total No. of individuals at time } t}$$

Example of Prevalence

- The prevalence of hypertension (diastolic BP $\geq$ 95 mmHg) on May 1-2, 2009 in Lao men aged 30-69 years in Xienglairkhok village was:

$$\frac{\text{276 persons with systolic BP} \geq \text{95 mmHg}}{\text{1,853 Lao men aged 30-69 years at the time of survey}} \times 100 = 15\%$$

Prevalence divided into two types:



*** Point prevalence**

- **01/01/2009: case No. 2, 4, 5**
- **31/12/2009: case No. 6, 7, 10**

*** Period prevalence between 01/01-31/12/2009:**

Case No. 2, 3, 4, 5, 6, 7, 9, 10

Incidence

- Measures of **new cases** of disease that develop in a population during a specified period of time

- 2 types of incidence

1. Cumulative incidence (incidence)
2. Incidence rate = incidence density

Cumulative Incidence (CI) = Incidence

$$CI = \frac{\text{No. of individuals who get the disease during a certain period}}{\text{No. of individuals in the population at the beginning of the period}}$$

- A proportion
- Has no dimension
- Varies between 0 and 1

Example of Cumulative Incidence

- The population statistic of Lab Lair District in 2001 revealed that there were 5,572 women aged 20-39 years who were sex workers. Based on the record of CHAS, among those women, 45 were HIV +ve during 2002-2005.

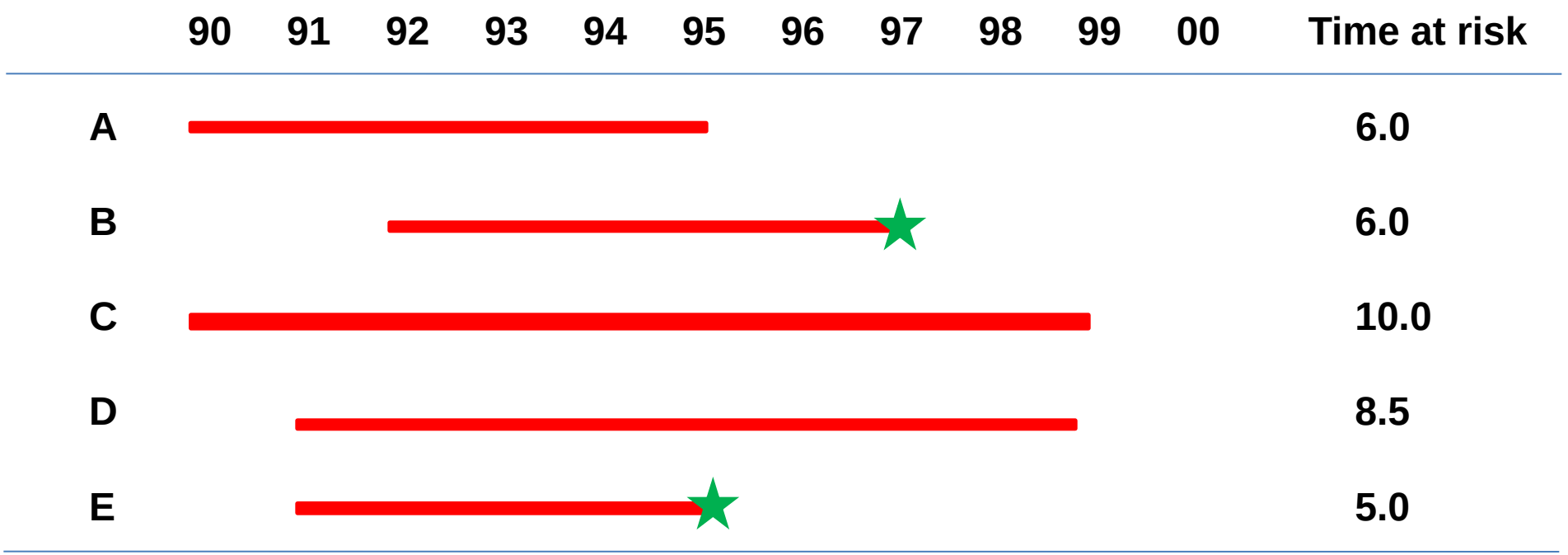
- What is the cumulative incidence of HIV +ve among those women during a period of 4 years?
- Cumulative incidence = 45 / 5,572 = 0.008 or 0.8%

Incidence Rate or Density (ID)

$$ID = \frac{\text{No. of new cases that occur during a calendar period}}{\text{Amount of person-time contributed by the observed candidate person during that period (time at risk)}}$$

- Not a proportion
- Has dimension (unit of ID is time)
- Varies between 0 to infinity

Person-time



Total years at risk **35.5**

-- time followed

x disease onset

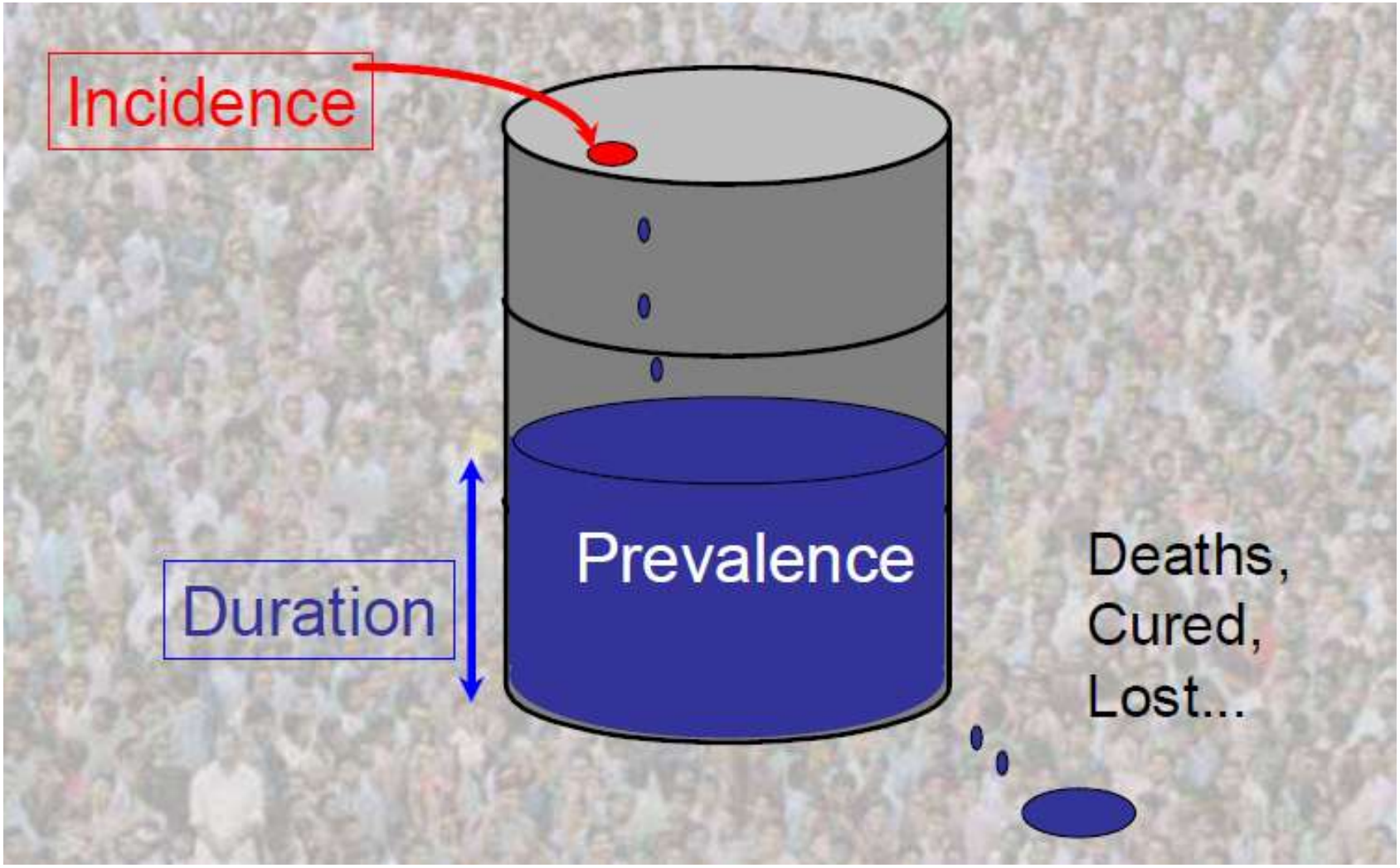
Incidence rate/density = 2 / 35.5 person- years
= 0.056 / person-year

Example of Incidence Density

- In 2003, the number of new cases of STI was 29 among the men aged 40-44 years in Lab Leu District. The person-years was 41,532 among that group of people.

- What is the incidence density or incidence rate of STI +ve among those people?
- Incidence density = 29 / 41,532 person-years = 0.0007/person-year

Prevalence vs Incidence



Morbidity

$$\text{Morbidity} = \frac{\text{No. of persons with disease}}{\text{No. persons in population at risk}}$$

Example: morbidity of dengue in a community is ~ 2 / 1,000

Mortality, Fatality, Death

- **Mortality rate:** Death of a particular disease/event in the total population (e.g., maternal mortality)

$$\frac{\text{Number of pregnancy – related death (defined place and time period)}}{\text{Number of live birth (same place and time period)}} \times 100{,}000$$

Maternal mortality rate in Laos in 2000 ~ 530/100,000

- **Fatality rate:** Mortality among cases of a particular disease
- **Death rate:** Mortality of all diseases among the total population

Commonly Used Rates for Population Study

Age-specific death rate = $\dfrac{\text{Number of death in a particular age group (defined place and time period)}}{\text{Mid-period population (same age group, place and time period)}}$ x 1,000

Cause specific death rate = $\dfrac{\text{Number of death due to a particular cause (defined place and time period)}}{\text{Mid-period population (same place and time period)}}$ x 1,000

Infant mortality rate = $\frac{\text{Number of death to infants <1 year of age (defined place and time period)}}{\text{Number of live births (same place and time period)}}$ x 1,000

Infant mortality rate in Laos in 2005 ~ 70 / 1,000

Peri-natal mortality rate =

$$\frac{\text{Number of stillbirth (defined place and time period)} + \text{Number of deaths to infants <7 days of age (same place and time period}}{\text{Number of stillbirth (same place and time period)} + \text{Number of live births (same place and time period)}} \times 1{,}000$$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