Measures of frequency and Disease Occurrence

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Learning objectives

Measures of …..

….frequency

- Count
- Ratio
- Proportion
- Rate

…disease occurrence

- Prevalence
- Incidence
  - Cumulative incidence (CI), (Incidence proportion)
  - Incidence density (ID),

1. Measures of frequency

- **Count**
- **Ratios**
- **Proportions**
- **Rates**

1. Counts

- Common descriptive measure
- First step in calculating rates
- Essential for service delivery, planning
- Formula:-

Count= Number of Occurrences

Counts

TABLE I. Summary of provisional cases of selected notifiable diseases, United States, cumulative, week ending December 31, 2005 (52nd Week)*

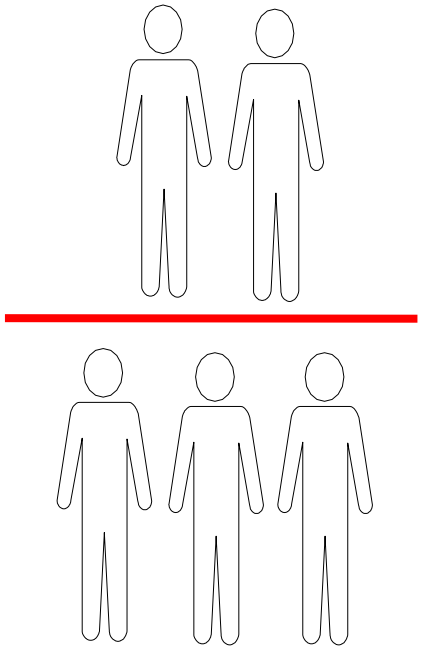
Disease	Cum. 2005	Cum. 2004	Disease	Cum. 2005	Cum. 2004
Anthrax	—	—	Hemolytic uremic syndrome, postdiarrheal†	187	200
Botulism:			HIV infection, pediatric†¶	255	369
foodborne	15	16	Influenza-associated pediatric mortality†**	49	—
infant	80	87	Measles	62††	37§§
other (wound & unspecified)	29	28	Mumps	265	258
Brucellosis	107	115	Plague	7	3
Chancroid	25	30	Poliomyelitis, paralytic	1	—
Cholera	6	5	Psittacosis†	21	12
Cyclosporiasis†	733	208	Q fever†	141	72
Diphtheria	—	—	Rabies, human	2	7
Domestic arboviral diseases			Rubella	16	10
(neuroinvasive & non-neuroinvasive):	—	—	Rubella, congenital syndrome	1	—
California serogroup†§	65	116	SARS† **	—	—
eastern equine†§	21	6	Smallpox†	—	—
Powassan†§	—	1	*Staphylococcus aureus*:		
St. Louis†§	9	13	Vancomycin-intermediate (VISA)†	1	—
western equine†§	—	—	Vancomycin-resistant (VRSA)†	—	1
Ehrlichiosis:	—	—	Streptococcal toxic-shock syndrome†	104	132
human granulocytic (HGE)†	700	538	Tetanus	20	34
human monocytic (HME)†	471	345	Toxic-shock syndrome	96	98
human, other and unspecified †	113	70	Trichinellosis¶¶	17	6
Hansen disease†	89	105	Tularemia†	133	134
Hantavirus pulmonary syndrome†	22	25	Yellow fever	—	—

Number of Ebola hemorrahagic fever cases by age and sex, Zaire, 1976

Age (years)	Male	Female	Total
< 1	10	14	24
1 - 14	18	25	43
15 - 29	33	60	93
30 - 49	57	52	109
50+	23	26	49
Total	141	177	318

2. Ratio

- A **ratio** is the relative size of two quantities
- **It quantifies the magnitude of one occurrence in relation to another.**
- One number divided by another
- Example: sex ratio



Cont….

- No specific relationship is necessary between the numerator and denominator (numerator NOT necessarily included in the denominator)

- Either the numerator or denominator is usually set to 1.

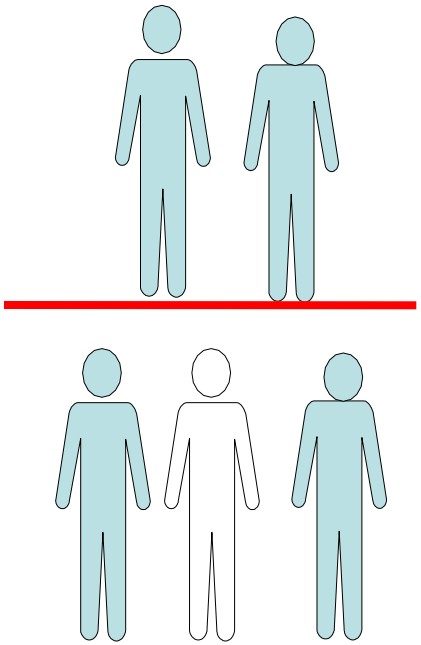
- n:y or n/n: y/n or 1 to y/n

Example

- # beds per doctor
  - 120 beds/10 doctors
  - 120/10 : 10/10
  - 12 beds for a doctor
- # students per facilitator
- # inhabitants per latrine
- Sex ratio
- Odds ratio
- Rate ratio

3. Proportion

- It is comparison of a part to the whole population in which these occurrences take place
- Numerator MUST BE INCLUDED in the denominator
- Its result ranges between 0 and 1 or (0–100%)
- Percentage = Proportion x 100



Example---1

AIDS cases:

4000 male cases

2000 female cases

Q:

What is the proportion of male cases among all the cases?

Female cases among all the cases?

Cont….

Population

3500 women

6500 men

Proportion of men

= 6500 / (3500 + 6500) = 0.65 or 65 %

Male to female ratio

= 6500 / 6500 = 3500/6500 = 0.54

1.00 to

1 male for 0.54 females

Example--3

- A survey of school district found that 65 out of 300 students reported having asthma
- what is the proportion of asthma in this students?

Solutions:-

Proportion=65/300 =0.217

Proportion=21.7%

The proportion of Asthma in this student population is 21.7%

Example---3

- A study of a certain community found that 45 out of 200 individuals had Diabetes
- What is the proportion of Diabetes in this populations?

Proportion — Summary

- Common descriptive measure
- Numerator must be included in the denominator
- Can be expressed as a fraction, decimal, or percentage

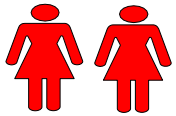
4. Rate

- **It is a measure of 2 numbers**

- **It also adds speed of occurrence of an event over time**

1. Numerator

- **number of EVENTS observed in a given time**

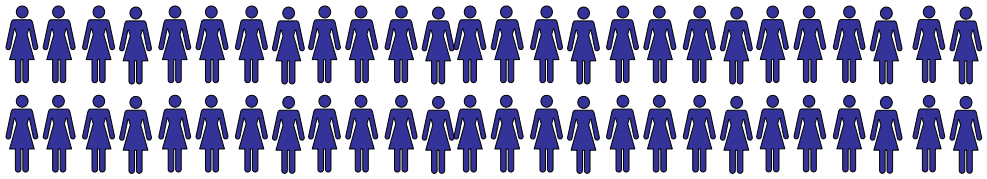
 **Observed in 2006**

Cont…

2. Denominator

- **Population in which the events occur (Population at risk)**

- **includes time dimension**



Population in 2006

Cont....



Observed in 2006

$$\frac{2}{100} = 0.02 \text{ / year}$$

Rate

- It is a measure of frequency with which event occurs in defined population over specified period of time
- Rate = how quickly disease occurs in a population in a given time.
- Risk = proportion of population that develops disease during defined time
- used to describe the incidence or mortality of disease in a populations

Formula and Example

- Rate=No of events/Total popn at risk xK where K can be 100, 1,000, 10,000, 100,000----)
- Rate may be expressed in any power of 10 (10^0, 10^1, 10^2, 10^3, 10^n)
- If there are 750 cases of a disease in a population of 10,000 people over a period of one year, the incidence rate of the disease will be:
- Rate=750/10,000 x1000 = 75

2. Measures of disease occurence

Two types of measures :

1. Prevalence

Which measures a population's disease status

(two forms)

1. Point Prevalence 2. Period prevalence

2. Incidence

Assesses frequency of disease onset

(two forms)

2. Cumulative incidence/ incidence proportion
3. Incidence density or incidence rate

1. Prevalence

Number of cases of a disease at a specific time

Mid-year population at risk at that time

It is proportion of a population affected by a disease
at a given time.

It is expressed as a percentage

HIV/AIDS in X city in 1999:

Population	**210,000**
Cases	**3,200**
Prevalence	**1.5%**

Mid-year population (denominator)

$$\text{Mid-year population} = \frac{\text{total population at starting} + \text{total population at the end}}{2}$$

1. Point Prevalence

It is proportion of a population that is affected by disease at a given point in time

The amount of disease in a population usually changes constantly

Thus, may not be useful for assessment of diseases with short generation period

PP=No of individual with a condition at a given time points/Total population at population at a given time pt

example

- A study found that out of 1000 individuals, 150 have DM.
- What is the point prevalence of Dm in this Populations?
- **pp=150/1000x100=15%**

2. Period prevalence

Prevalence in a given period of time

If we want to know how much disease is present over a longer period of time, period prevalence would be preferred.

$$\text{Mid-year population} = \frac{\text{total population at starting} + \text{total population at the end}}{2}$$

Example

- In a city of 500,000 people, 10,000 people were Dx with Ca in 2019
- what is the period prevalence of Ca in this City During 2019?
- **Per P=10,000/500,000x100=2%**

2. Incidence

- The number of new events of a disease in a defined population within a specified period of time.

Number of NEW cases of disease during a specific period

Population at risk during such period

1. Cumulative incidence = incidence proportion or risk
2. Incidence density

a. Cumulative Incidence

Used to calculate the proportion of individuals who develop a particular disease over specific period of time in a population at risk

CI= No of new cases of disease/Total Popn at Risk x100

e.g-Suppose there is a population of 10,000 individuals at risk of developing a particular disease, over a period of one year,200 new case of the disease are reported. calculate the cumulative incidence

b. Incidence density (rate)

Number of NEW cases of disease during a period

Rate **Total person-time of observation**

Instantaneous concept of rate (= speed)

Denominator:

- **is a measure of time**
- **the sum of each individual's time at risk and free from disease is counted**

cidence (density) rate---------

- **Incidence rate must take into account**
  - **Number of individuals who become ill in a population**
  - **Time periods experienced by member of the population during which the events occur**

Formula and worked examples

- **Incidence Density(ID) =(No of New cases/Total person-time at risk)x K**

-ID= Incidence Density

-K--a factor to standardized the incidence density rate

-Total person-time at risk--Total time that all individuals in the population were at risk of developing the disease

Example----1

- If we are studying the incidence of lung Ca in a population of **50,000** people over five-years, and during that period there were **200** new cases of lung cancer diagnosed, and the total person time at risk was **225,000** person-years.
- **Calculate the Incidence density and interpret the result?**

Example------

ID=(200/225,000) x100,000

ID=88.9 Per 100,000 person-years

Interpretations-the incidence density of lung cancer in this populations over the five-year period is 88.9 cases per 100,000 person-year

Example

1000 HIV negative persons were tested one year later and 50 were found HIV positive.

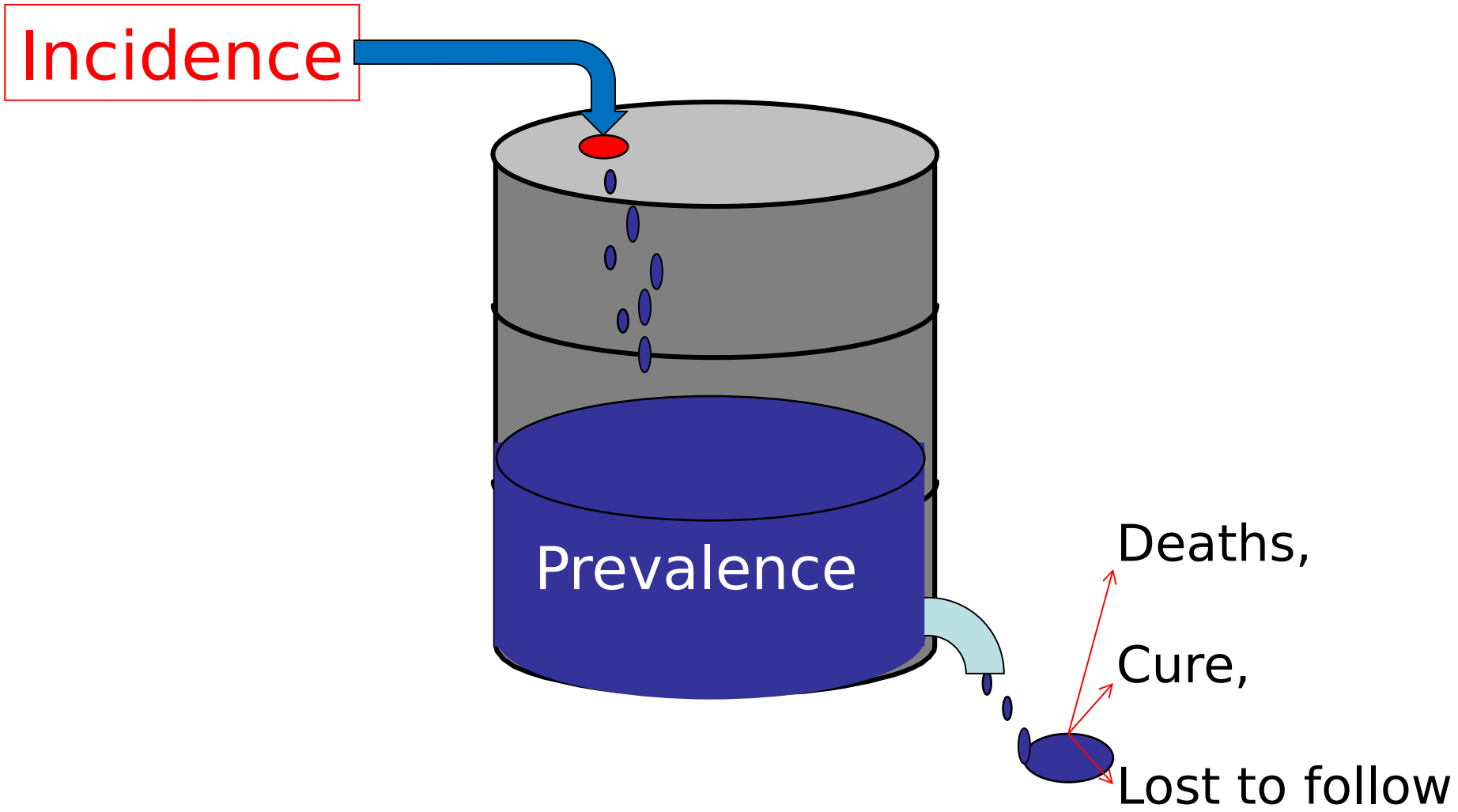
- What is the incidence (cumulative incidence) of HIV infection?

- What is the incidence density (person-time rate) of HIV infection?

Relationship of Incidence to Prevalence

- Prevalence depends on both on incidence rate and duration of disease
- Because prevalence is affected by factors such as migration and duration, incidence is preferred for studying etiology.
- Prevalence = Incidence X Duration
- Both are important measure of disease burden
- **Prevalence-**New case + old case
- **Incidence**-Focus on new cases

Relationship between Incidence, Prevalence and Disease Duration



Factors influencing Prevalence

Increased By

By longer duration of the disease

Prolongation of life of patients without cure

Increase in new cases (increase in incidence)

In-migration of cases

Out-migration of healthy people

In-migration of susceptible people

Improved diagnostic

Decreased By

Shorter duration of the disease

High case fatality

Decrease in new cases (decrease in incidence)

In-migration of health people

Out-migration of cases

Out-migration of susceptible people

Improved cure rate of cases)

Thank you