

**Measures  
of disease Frequency  
&  
Measures of association**



**Part II**

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## **In this session**

**We are going to introduce:**

- a. Basic measures of disease frequency**
- b. How they are calculated**

## Objectives

**The measures of disease in epidemiology fall into two broad categories:**

**Prevalence**

**and incidence.**

## Objectives

**There are there specific types of incidence measures,**

**Cumulative incidence or risk,**  
**odds,**

**and incidence rate or density.**

# Prevalence (point prevalence)

No. of existing cases of disease at a **specific time**

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Total population of interest at that time

Proportion of a population affected by a disease  
at a **given time.**

Expressed as a percentage

Ex:

Population	350,000
Cases	96,200
Prevalence	27.6%

**Cumulative  
incidence or  
risk**

# RISK

- **Non-technical definition**
  - Vague, culture-dependent
  - Unexpected, unusual, dangerous/negative events
- **Epidemiologic definition**
  - **Probability** that an event will occur
  - Estimated by:
    - **Observing events among a population during a specified time**

# Cumulative Incidence (CI)

number of **new cases** of a disease during a given **period** of time

$$CI = \frac{\text{number of new cases of a disease during a given period of time}}{\text{Total population at risk (free of disease) at the beginning of the period}}$$

# Example: Cumulative Incidence (CI)

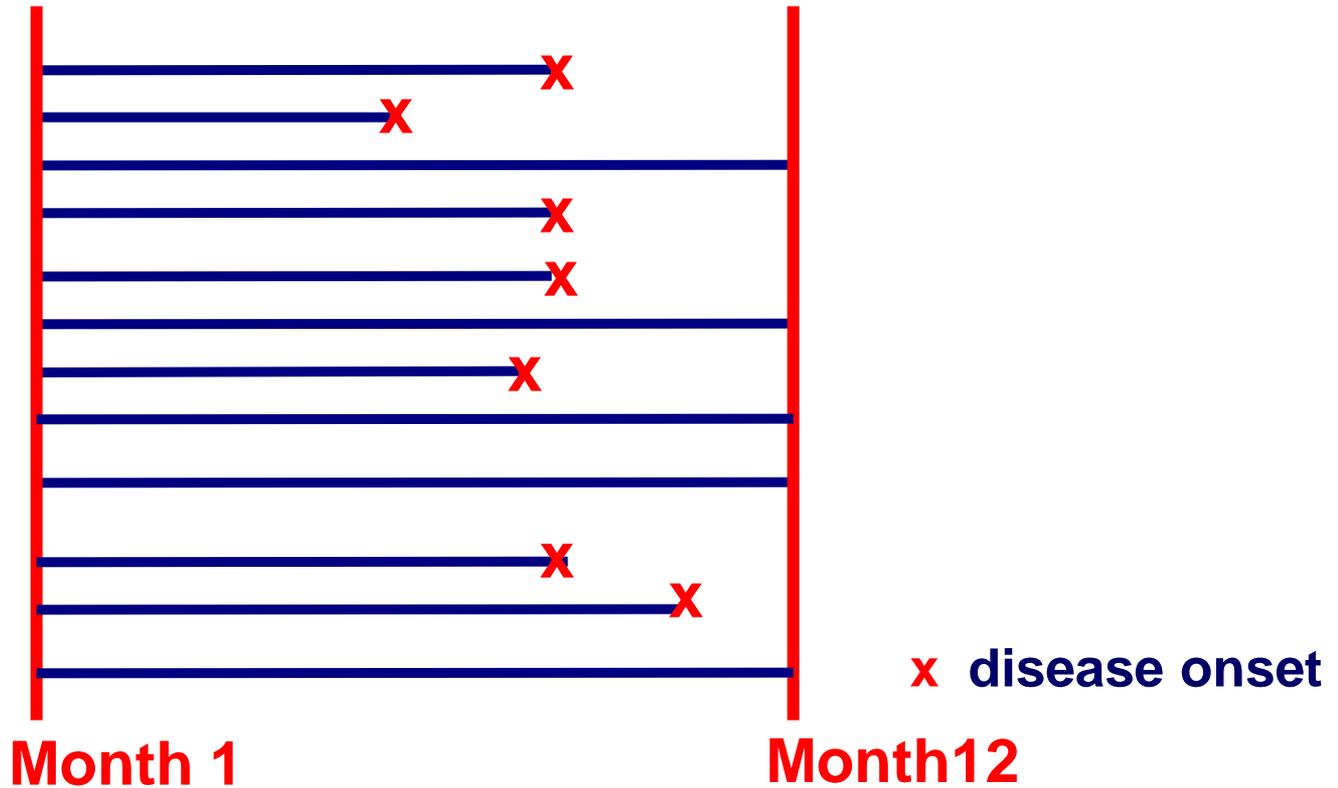
**Ex:**

**Population**                      **350,000**

**New cases**                      **1,250**

**Cumulative incidence = 0.0036 per year**  
**= 0.36 % per year**  
**= 3.6 new cases / 1000 during a**  
**year**

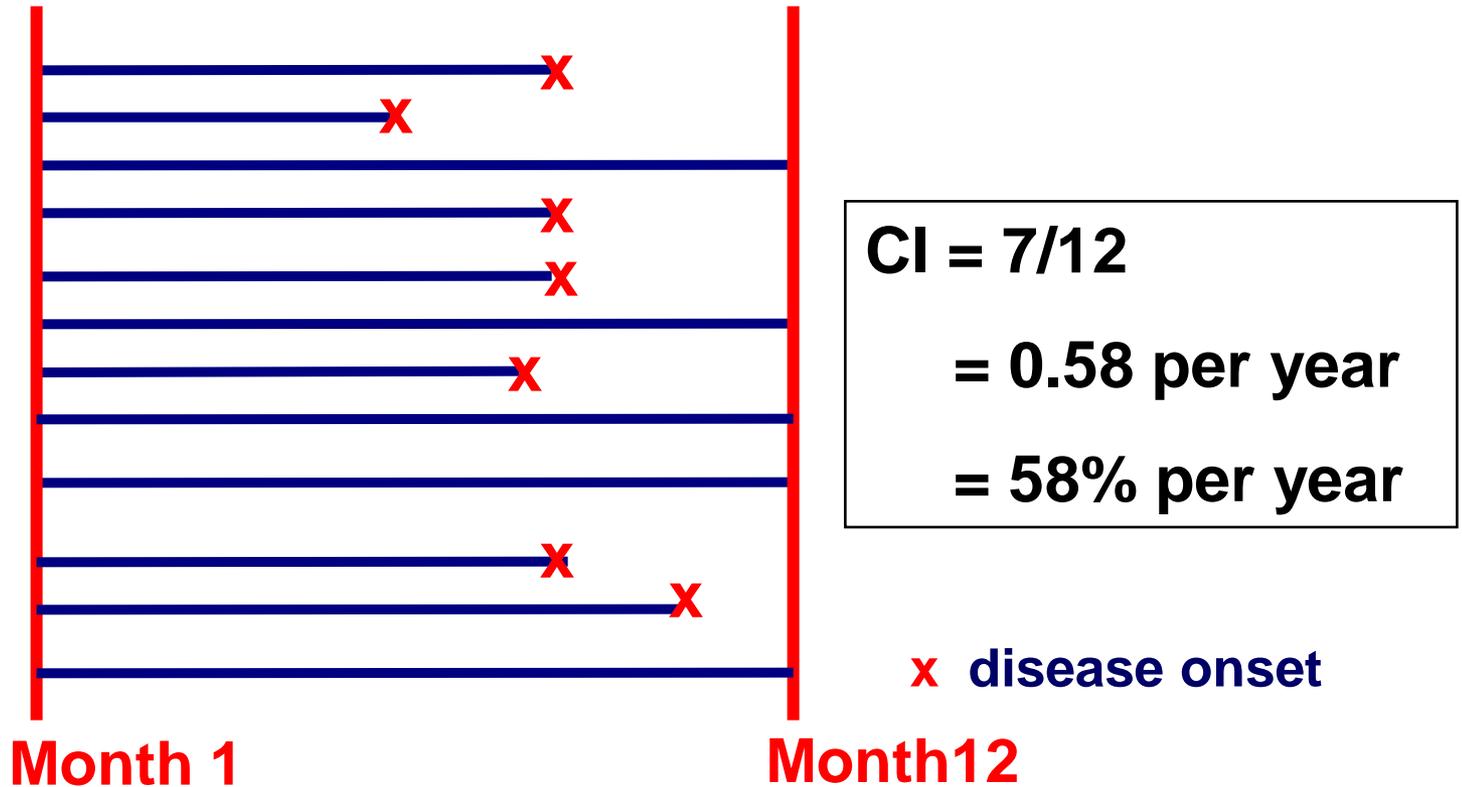
# Cumulative Incidence



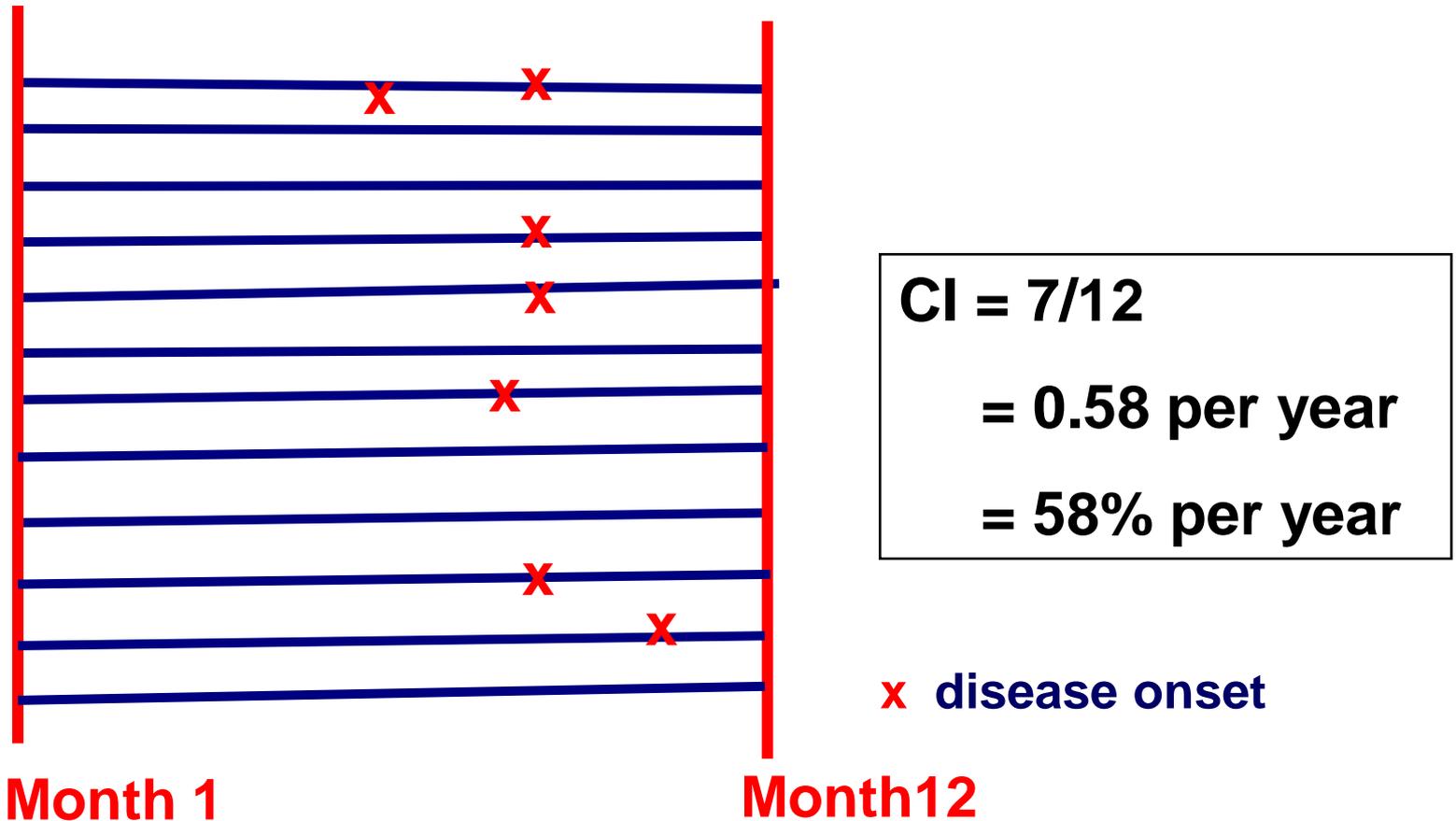
Population = 12

Diseased = 7

# Cumulative Incidence



# Cumulative Incidence



**CI** assumes that the entire population at risk is followed up for the same time period

## **Attack Rate (AR)**

**special type of cumulative incidence  
during an outbreak**

**Expressed for the **entire  
epidemic period**, from the first  
to the last case**

## Attack Rate (cont...)

**Ex: Outbreak of cholera in country X in summer 2011**

- Number of cases            490**
- Population                    18,600**
- Attack rate                    2.6%**

# Attack Rate during an outbreak

FOOD	FOOD EATEN			FOOD NOT EATEN		
	Cases	Total	AR (%)	Cases	Total	AR (%)
1_استیک	45	78	58	6	11	55
2_همبرگر	30	50	60	21	39	54
3_پوره	22	38	58	29	51	57
4_سوسیس	26	48	54	25	41	61
5_ماهی دودی	5	10	50	46	79	58

# Odds

## Odds (plural)

**Probability** that an event will happen

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**Probability** that an event will not happen

# Example

**The number of hepatitis cases during an outbreak**

	Cases	Non cases	Population
Hepatitis A	30	49,970	50,000

$$\text{Odds of disease} = \frac{30 / 50,000}{49,970 / 50,000} = 0.006$$

**Rate**

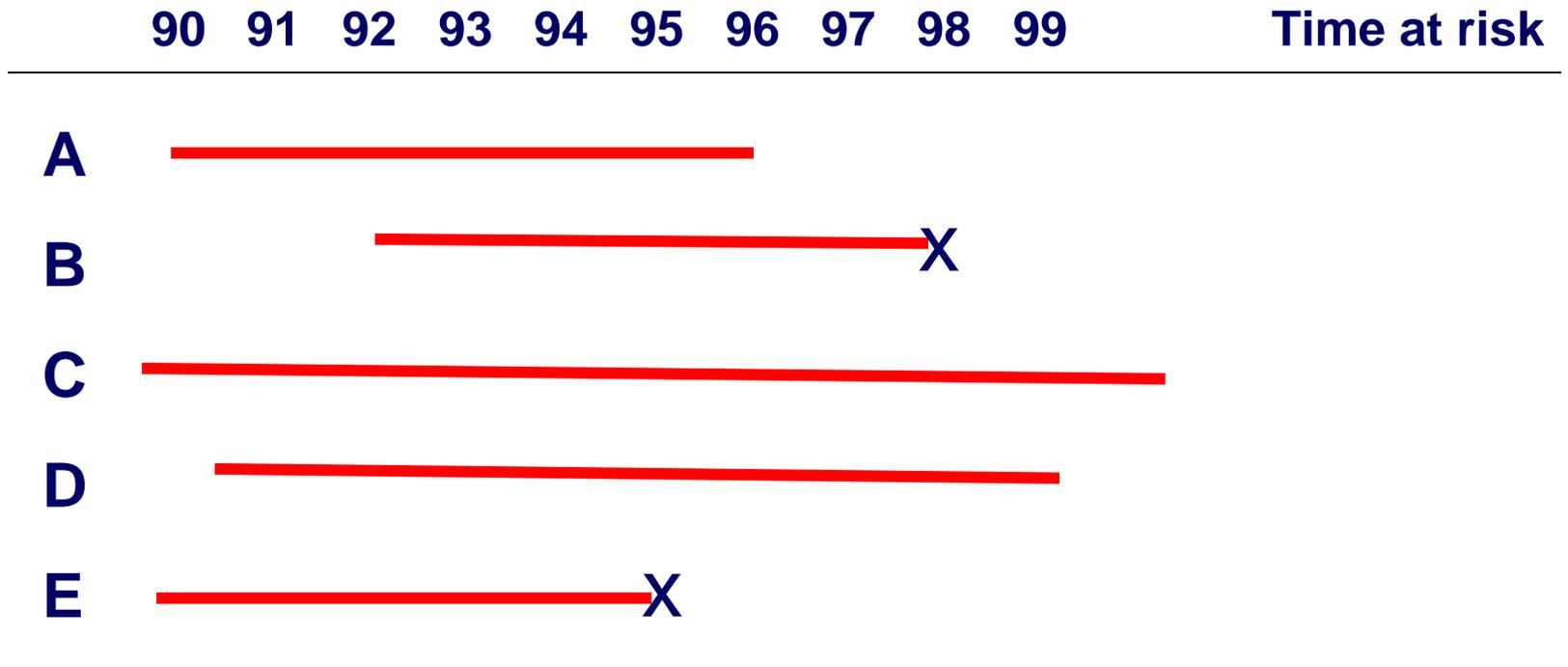
**The length of follow-up, or the time during which the outcome could be observed, will not be uniform for all participants.**

**What will be the approaches to account for these varying time period of follow-up.**

**A more precise estimate of the impact of exposure in a population that utilizes all available information is called the incidence rate (IR), force of morbidity and mortality, or incidence density (ID).**

- **The numerator** of the incidence density is the number of new cases in the population.
- **The denominator**, is the sum of each individuals' time at risk or the sum of the time that each person remained under observation \*and free from disease.

\* person-day, person-month, person-year, etc.



- :time followed

X: disease onset

# Incidence rate

**Number of **New** cases of disease**

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**Total **Person - time** of observation**

# Incidence rate

**Number of **New** cases of disease**

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**Total **Person - time** of observation**

**Denominator:**

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

# Person-time

	90	91	92	93	94	95	96	97	98	99	Time at risk
A											6.0
B											6.0
C											10.0
D											8.5
E											5.0
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Total years at risk											35.5

- :time followed

X : disease onset

# Incidence rate (IR) (Incidence density)

risk

A

B

C

D

E

Total

-- time  
x dis

$$\text{IR} = 2 / 35.5 \text{ person years}$$

$$= 0.056 \text{ cases / person year}$$

$$= 5.6 \text{ cases / 100 person years}$$

$$= 56 \text{ cases / 1000 person years}$$

$$\text{CI} = \frac{\text{number of new cases of a disease during a given period of time}}{\text{Total population at risk at the beginning of the period}}$$

$$\text{Odds} = \frac{\text{number of new cases of a disease during a given period of time}}{\text{Total population who did not become a case during the period}}$$

$$\text{IR} = \frac{\text{number of new cases of a disease during a given period of time}}{\text{Total person-time of observation}}$$

# References

- **Epidemiology, an introduction. Rothman KJ.**
- **Epidemiology in Medicine. Henneckens CH, Buring JE.**
- **Modern infectious disease epidemiology. Giesecke J.**
- **Dictionary of epidemiology. Last J.**

# Thank you



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