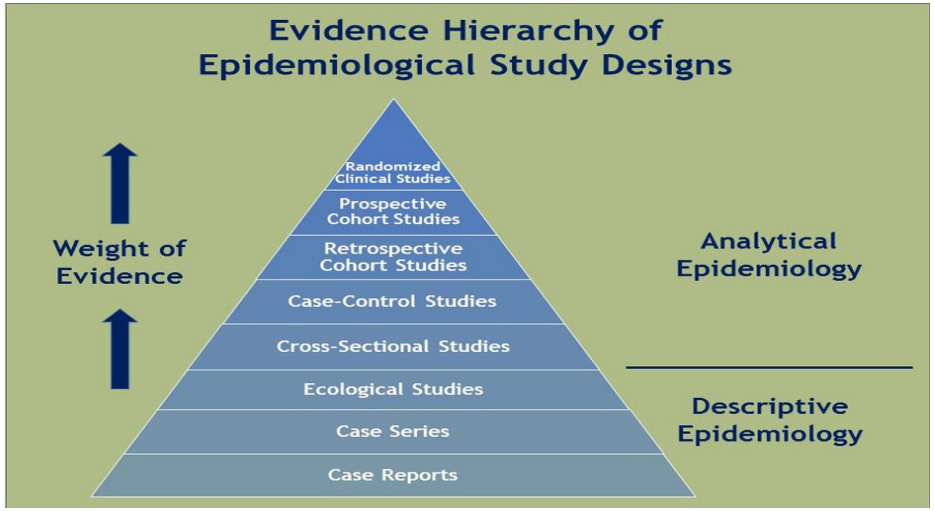
Unit III: Epidemiological Methods/Study Designs… 16 hours



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Methods of Measuring occurrence and distribution health problems

- Measuring occurrence of health problems: Descriptive cross-sectional and ecological studies, measuring occurrence of diseases, Hypothesis generation
- Measuring distributions of disease: Descriptive Cross-sectional study, ecological study, cohort study, quantifying disease distribution, Hypothesis generation
- Geographical Information System (GIS) and Epidemiology

Measuring occurrence of health problems

- Epidemiological research is based on the ability to quantify the occurrence of disease (or any other health-related event) in populations.

- To do this, the following must be clearly defined:
  1. What is meant by a case, i.e., an individual in a population who has the disease, or undergoes the event of interest (e.g., death).
  2. The population from which the cases originate.
  3. The period over which the data were collected.

For the measurement of occurrence of events, descriptive cross-sectional and ecological studies are indicated/conducted.

DESCRIPTIVE STUDY

Descriptive study is the basis of other epidemiological studies. Some times this study is required to find out the hypothesis of analytic and experimental studies.

Prior to the start of the study/investigation of an occurrence, some logical questions arise. These questions are ;

1. When it occurs ?
2. Where is occurs ?
3. Who are affected ?

Objectives of Descriptive Epidemiology

- To permit evaluation of trends in health and disease and comparison among various groups and subgroups
- To provide a basis for planning, implementation and evaluation of health services
- To identify problems to be studied by analytic methods and to suggest area that may be fruitful for investigation.

Steps of Descriptive study

1. Defining the population to be studied
2. Defining the occurrence/disease under study
3. Describing the occurrence/disease by ;
   - Time
   - Place
   - Person
4. Measurement of the occurrence/disease
5. Comparing with known indices
6. Formulation of hypothesis

1. Defining the population

The first step of the study is to define the population under study (population at risk), in terms of ;

- Total number
- Age
- Sex
- Occupation
- Culture, etc.

2. Defining the disease under study

- The next step is to define or specify the disease being studied / investigated.
- The researcher must identify the disease/occurrence in question and he must spell out clearly the criteria by which the disease can be measured (operational definition).

3. Describing the disease

The primary objective of descriptive study is:

- To describe the occurrence and distribution of the disease by (a) time, (b) place and (c) person

- To identify those characteristics associated with the presence and absence of the disease among the population under study. This involves the systematic collection and analysis of data.

(a) Time distribution

The pattern of disease may be described by the time of it's occurrence i.e., by weeks, months, years, the day of the week, hour of the onset, etc. There are three types of time trend ;

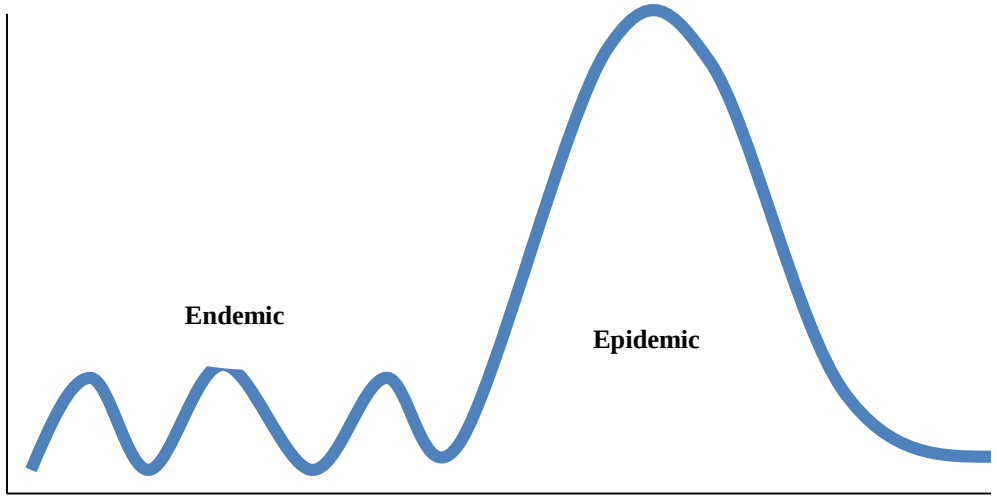
1. Short term fluctuations
2. Periodic fluctuations
3. Long term or secular trend

Short term fluctuations

The best example of short term fluctuation is an Epidemic.

Epidemic

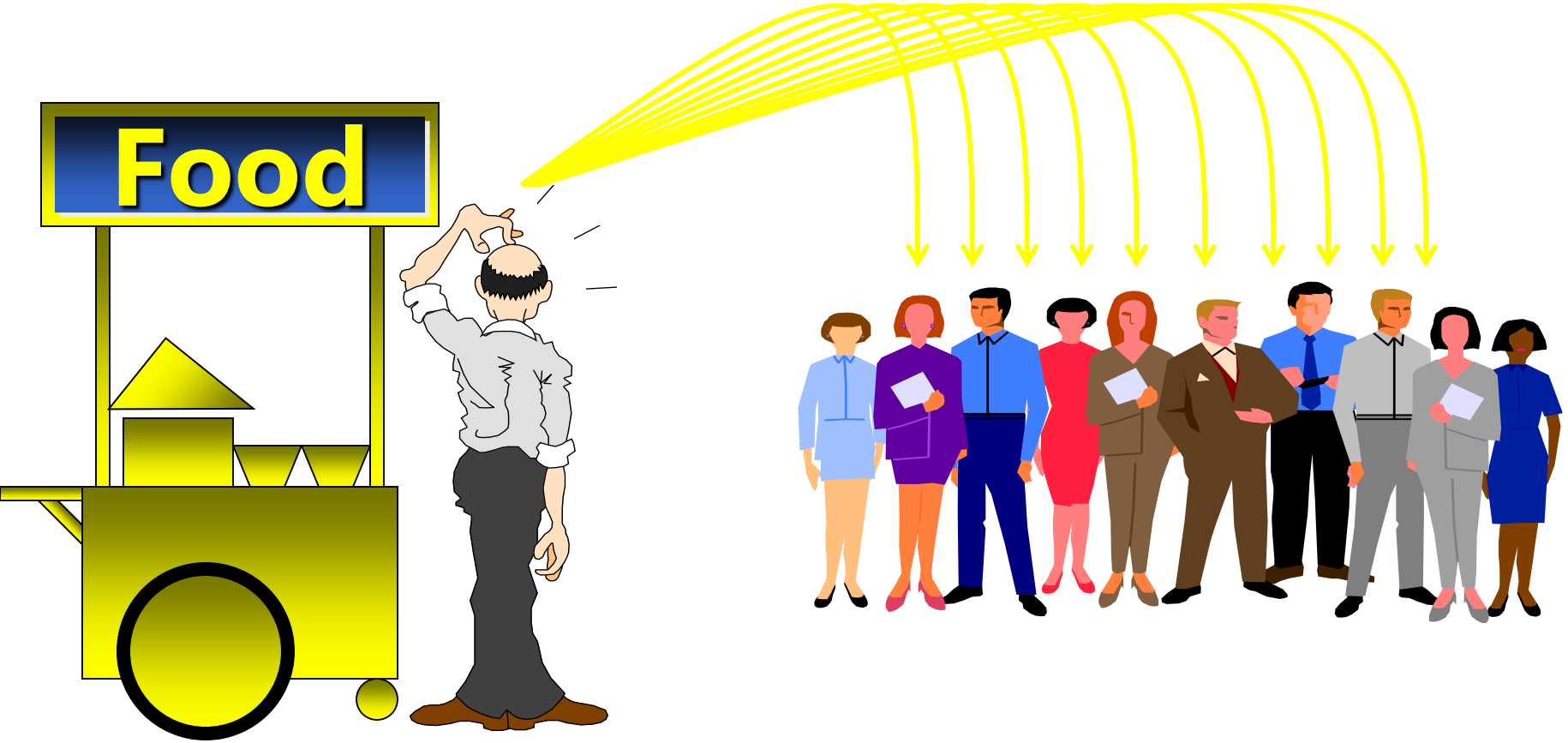
Epidemic may be defined as the number of occurrence of any health related event in a population, clearly in excess of it's normal expectancy.



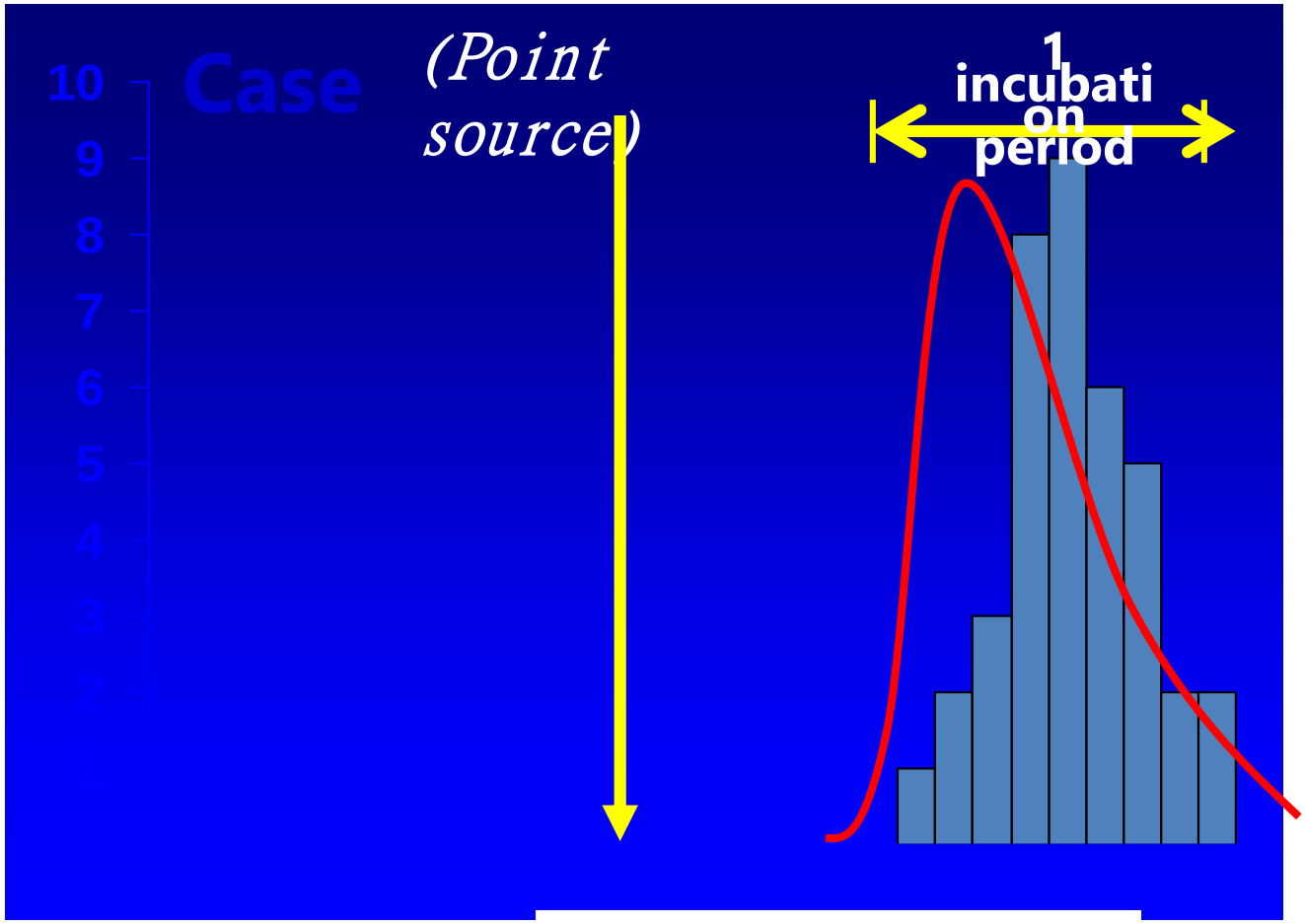
Epidemic

1. **Common source epidemic**
   - **Single exposure epidemic (Food poisoning)**
   - **Multiple exposure epidemic (VD from prostitute)**

Common source outbreak



Epidemic curve of common source outbreak



Point source

- All cases occur in 1 incubation period
- Steep upslope
- More gradual down slope
- Able to predict exposure period

Important features of single exposure epidemic

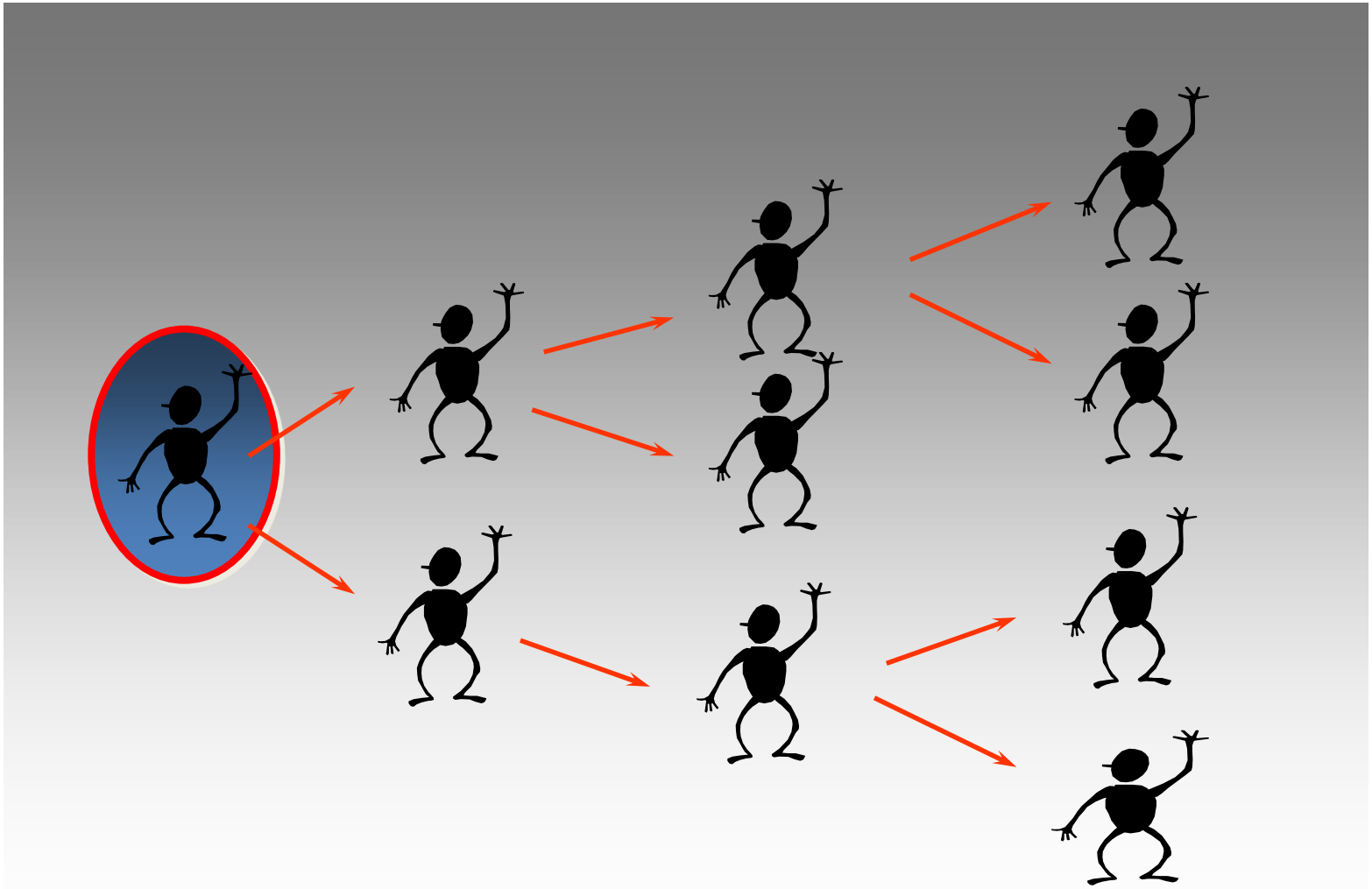
- There is sudden rise and fall in the case load with no secondary waves.
- Epidemics are explosive in nature
- Clustering of cases takes place within a narrow interval of time.
- Cases appear within a single incubation period of time.

(Note: NCDs also occur in epidemic form,
Even a single case of new disease appears, it constitutes epidemic)

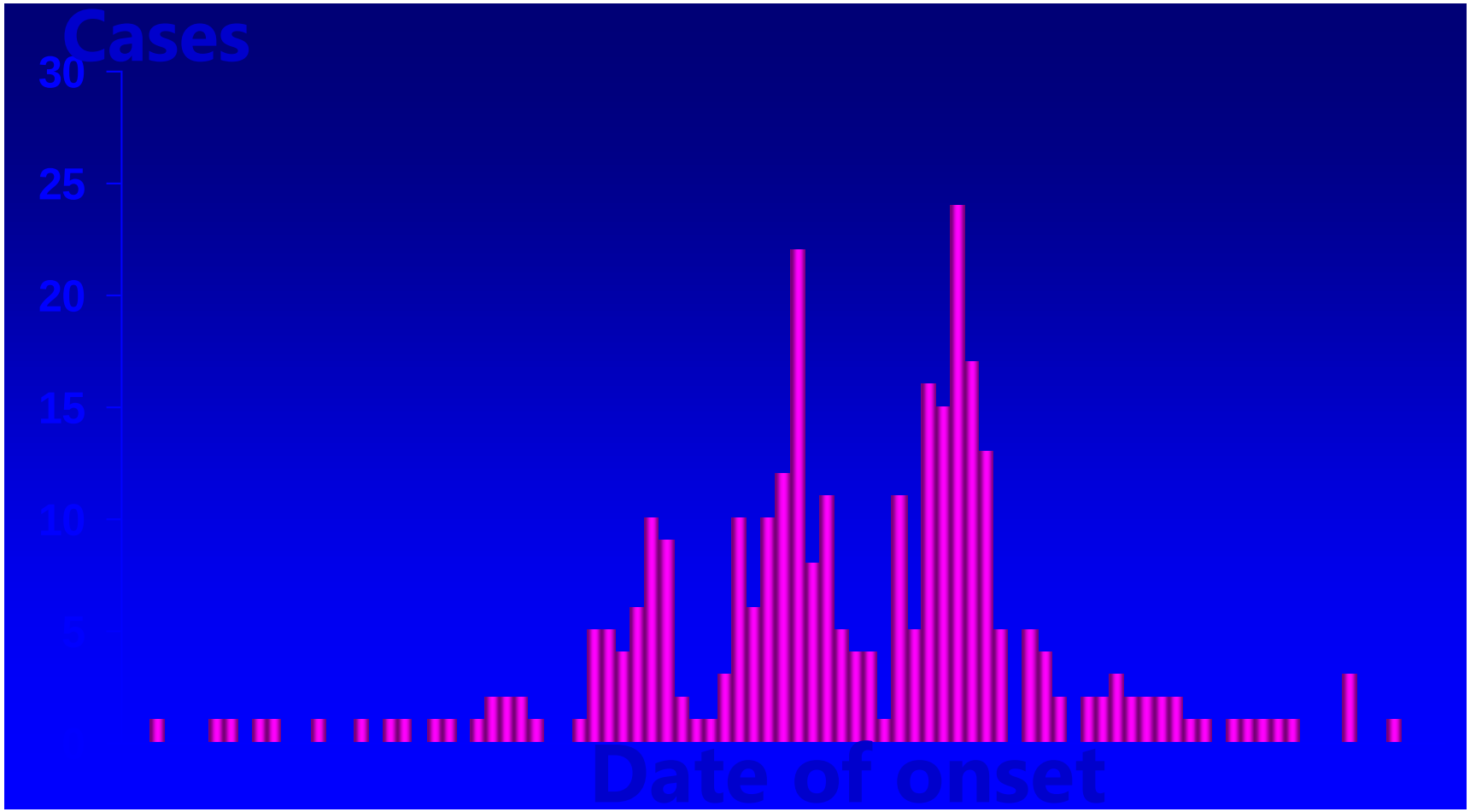
2. **Propagated epidemic**
    - **Person to person/Direct contact (Polio)**
    - **Vector borne (Malaria)**

3. **Modern epidemic or slow epidemic**

Propagated source outbreak



Epidemic curve of propagated source outbreak



Epidemic

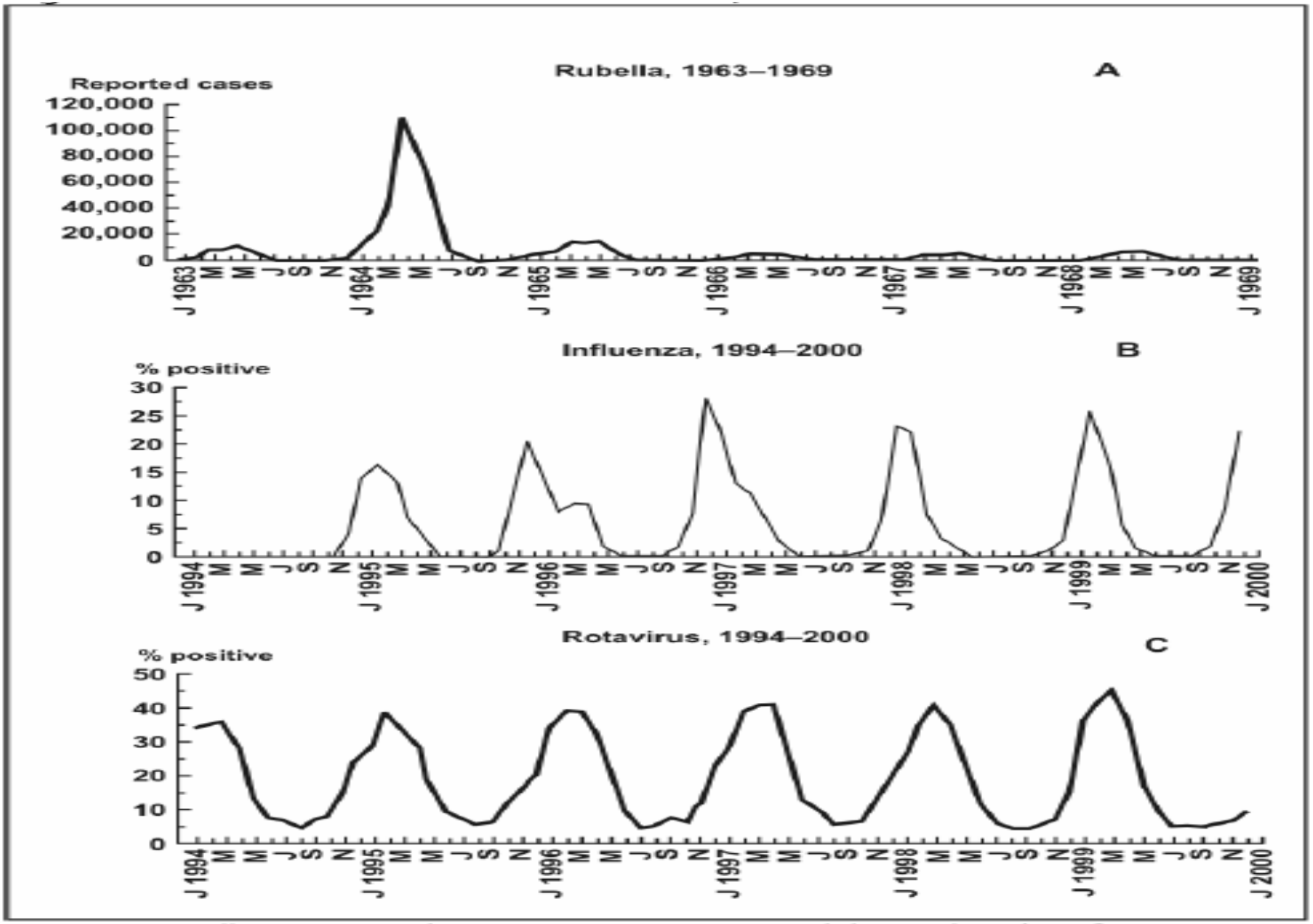
Periodic fluctuations or seasonal variation

For example;

(a) Early spring – Measles, Chickenpox, etc.

(b) Winter – URTI, Frostbite, etc.

(c) Summer – GIT infections, Sun strokes, snake bite, etc.



Source: Dowell SF. Seasonal Variation in Host Susceptibility and Cycles of Certain Infectious Diseases. Emerg Infect Dis. 2001;5:369-74.

Epidemic

Long term or secular trend

It is the change of occurrence of diseases (increase or decrease) over a long period of time, e.g., IHD, Lung cancer, Diabetes mellitus are on increase in our country.

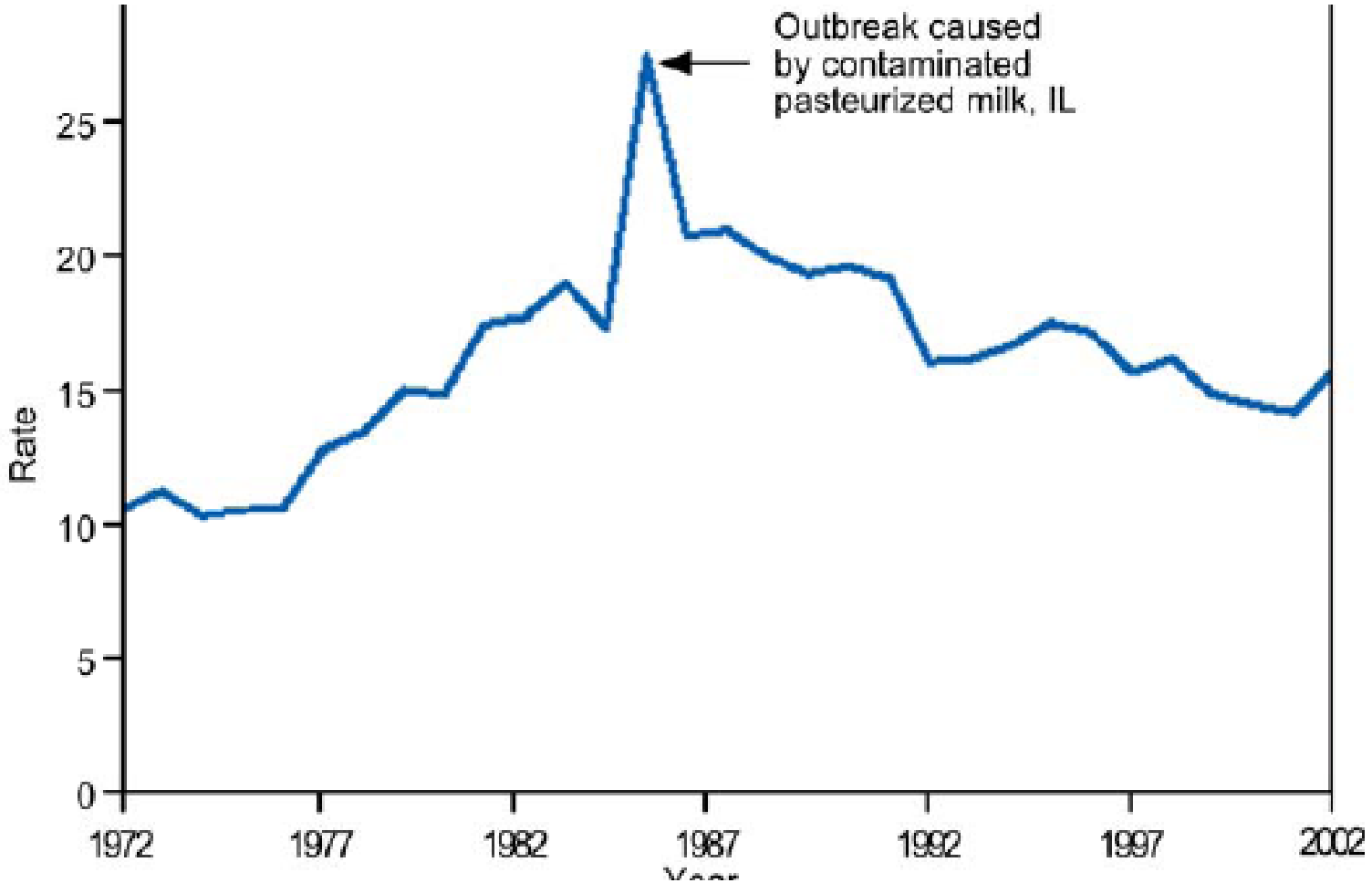


Figure: Secular trend in the Occurrence of Salmonelosis in USA (1972-2002)

(b) Place distribution
(Geographic variation)

It provides an important source of clues about the causes of diseases or events. Geographic variation may be classified as

a. **International variation**
b. **National variation**
c. **Rural-Urban variation**
d. **Local variation**

(b) Place distribution

International variation

The pattern of diseases is not the same everywhere in the world. e.g.

1. **Cancer stomach is very common in Japan but unusual in US.**

2. **Cancer cervix is common in Indo-Pak-Bangla sub-continent but uncommon in industrialized countries.**

3. **Breast cancer is more prevalent in western countries but less prevalent in Japan.**

C. Person distribution

Defining the persons who develop the diseases is the most important factor in descriptive study. These are Age, Sex, Occupation, Marital status, Habits, Social class, Religion, culture, custom, etc.

Person distribution…

AGE

Age is an important factor for variation of disease prevalence.

For example;

- **Measles is more common in children.**
- **Cancer in middle ages and Atherosclerosis in old ages.**

Person distribution

SEX

Diabetes, Hypertension, is more common and lung cancer, coronary heart diseases are less common in females.

Person distribution

MARITAL STATUS

Mortality rate is lower in married than un-married persons of the same age and sex.

Person distribution

OCCUPATION

Coal miners suffer from Silicosis sedentary workers from IHD and farmers from tetanus and hook worm.

Person distribution…

SOCIAL CLASS

People of upper social class suffer more from IHD, Hypertension, Obesity, etc. on the other hand people of lower social class suffer from deficiency diseases, infectious diseases, etc.

Person distribution…

BEHAVIOUR

Change of behavior affects the individual for causation of some specific diseases, like Smoking causes lung cancer, heart diseases, Drug abuse causes HIV/AIDS, HBV infection and over eating causes obesity, etc.

4. Measurement of Disease

- Mandatory to measure the clear disease load
- Information should be in terms of mortality, morbidity and disability
- Morbidity can be expressed in terms of incidence and prevalence

5. Comparing with known indices

- Essence of epidemiology is to make comparison and asking questions
- Comparison between different population and other subgroups of population will permit to draw inferences

6. Formulation of hypothesis

- Hypothesis cab be formulated from descriptive study
- Epidemiological hypothesis must specify :
  - The population : characteristics
  - Specific causes
  - The expected outcomes
  - Dose response relationship
  - Time response relationship

Uses of Descriptive Study findings

Results of descriptive study provide ;

1. Information on the magnitude of the problem/disease in the community.
2. Information on the type of disease/problem in the community in terms of morbidity and mortality rates and ratios.
3. Clues to disease etiology and helps in the formulation of hypothesis.
4. Background information/data for planning, organizing, and evaluating preventive and curative services.
5. Basic data (base line information) for future research.

THANK YOU

1. Cross - sectional Studies

Cross-Sectional Studies……

- Simple form of an observational study.
- Based on a single examination of a cross section of population at one point in time.
- The measurements of exposure and outcome are made at the same time.
- The key questions asked in this study is whether the exposure followed outcome or vice versa.

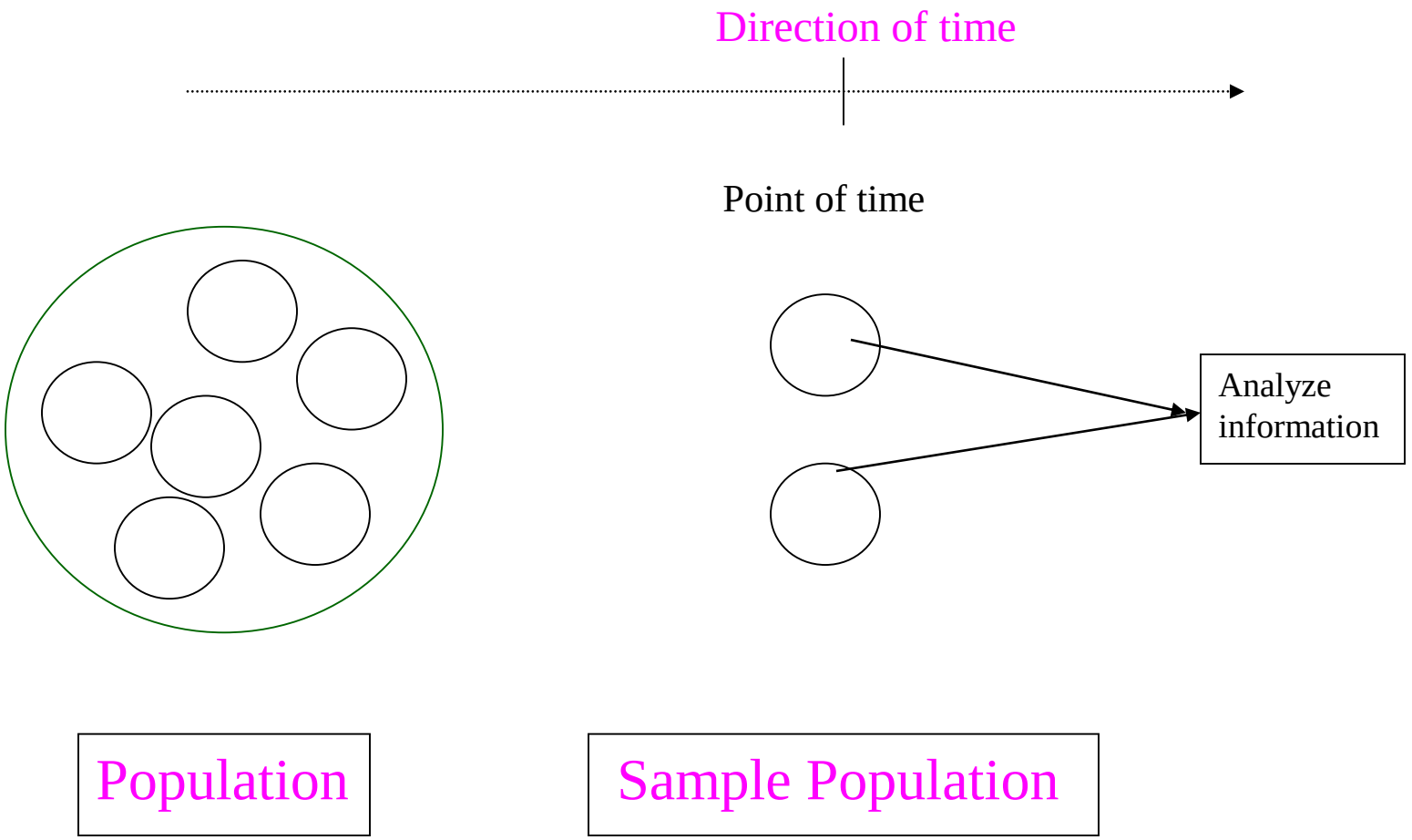


Fig: Schematic diagram of C/S study

Types

1. **Descriptive cross sectional study:**

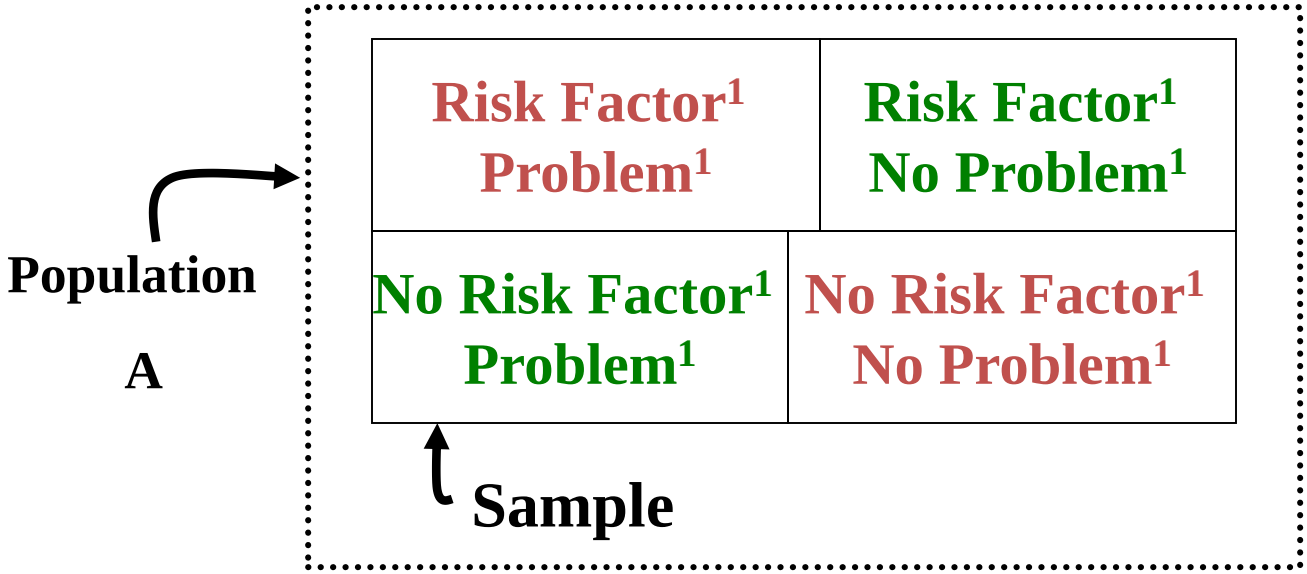
- It is also known as prevalence study.
- It describes the current existing situation or events at a particular point in time.

Cross-Sectional Studies……

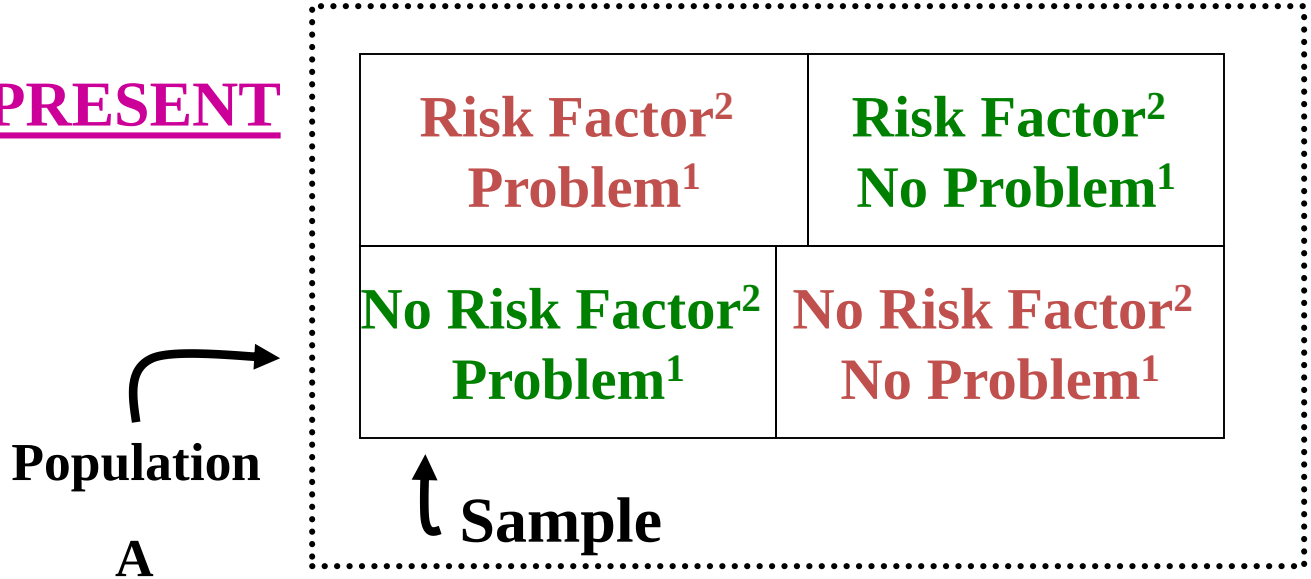
- A *snapshot* of the experience of a defined single population
- Simultaneous determination of variety of exposures and outcome status
- What is about the situation of ?
  - Various Exposures *(Availability of health service providers, essential medicines, important laboratory facilities, resources (fund), refrigerator/freezer, power supply system, communication system, toilet facility,…etc.)*
  - Outcomes *(service coverage, number of out patient visitors, number of patient consulted with health care practitioner in time, consultation time, waiting time for patients, patients receives medicine in time, providing laboratory test result in time, timely distribution of maternity incentive for Institutional delivery cases, client access to toilet, …… etc.)*

Cross-sectional Descriptive Study

THE PRESENT

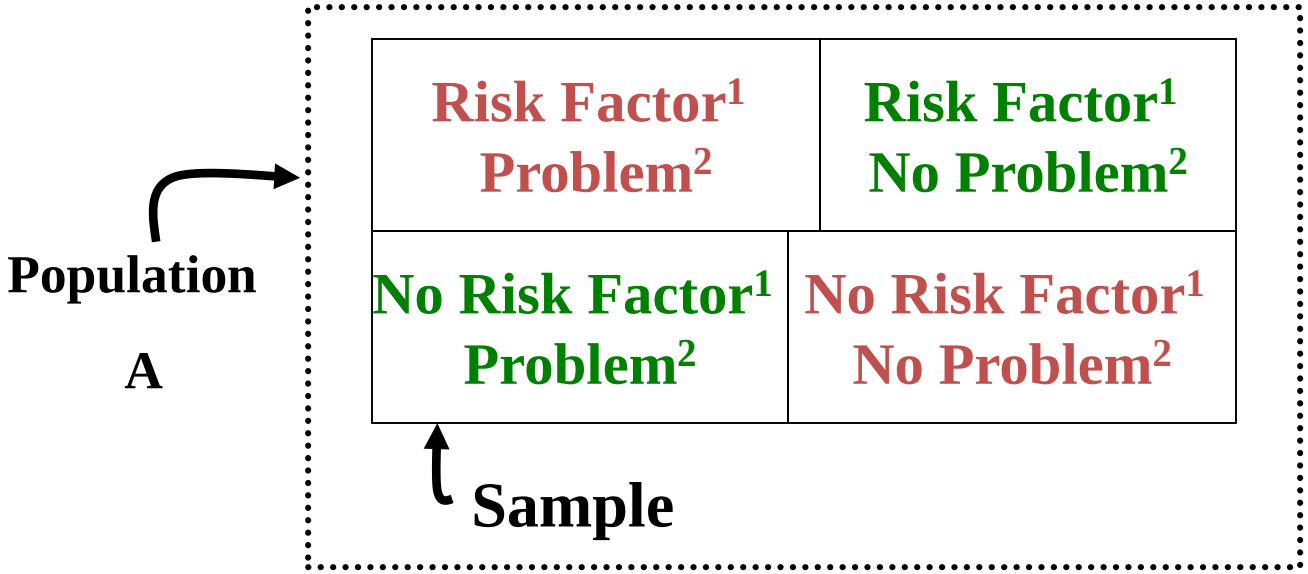


THE PRESENT



Cross-sectional Descriptive Study

THE PRESENT



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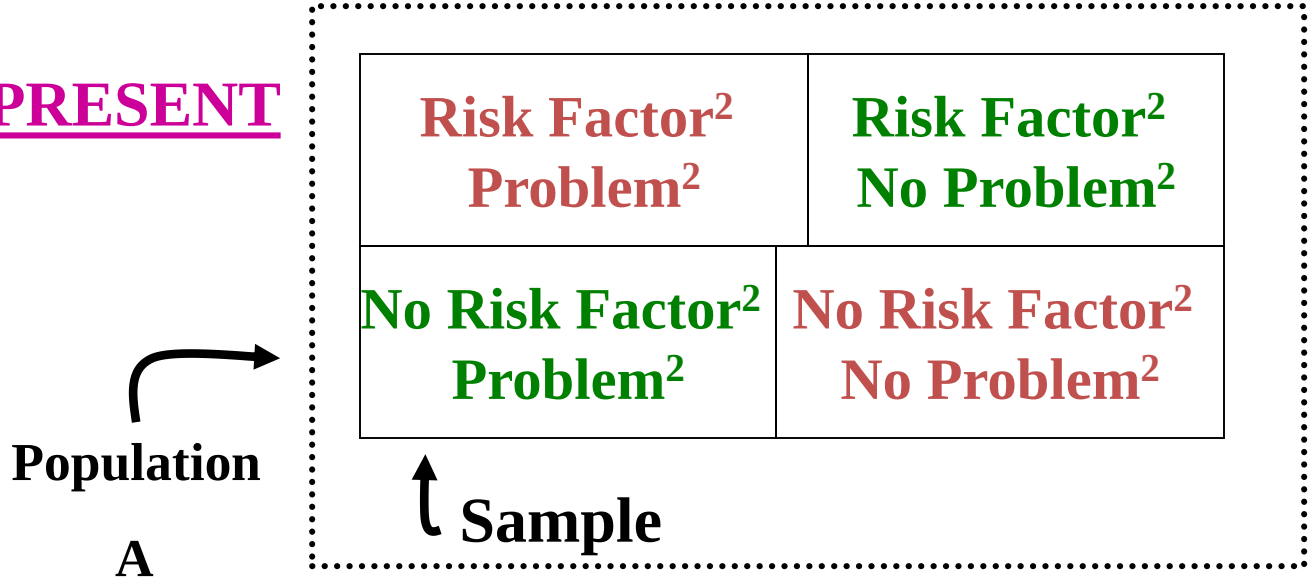


Contd…

2. Analytical Cross Sectional Study:

- In analytical cross sectional study, the data collection on both exposure and outcome takes simultaneously.

- When the prevalence of outcome is compared with the exposed and non exposed group, it is possible to identify the potential exposures on particular time.

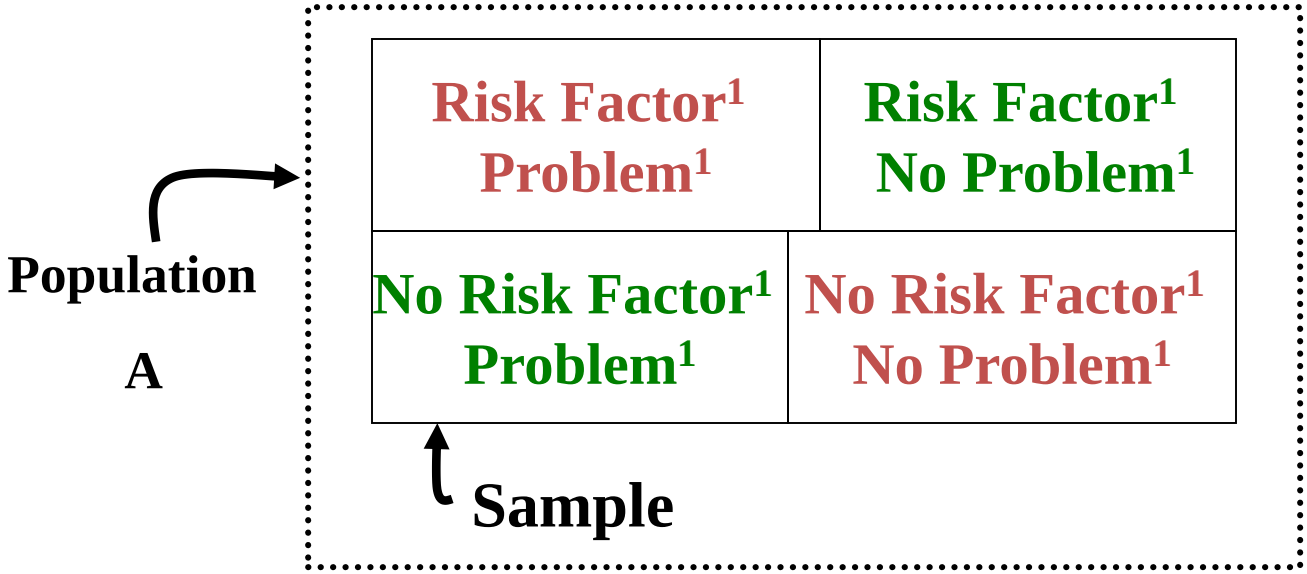
- Analytical cross sectional studies are useful for defining the health needs of a population at a particular point in time and for investigating common exposures and common outcomes.

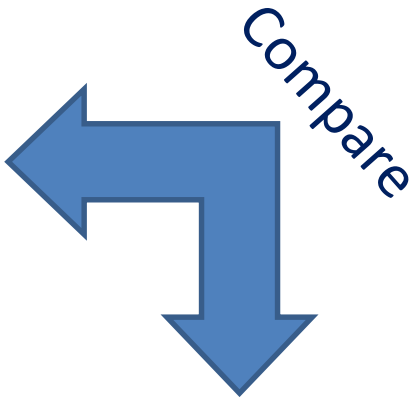
Cross-sectional Analytical Studies

- A *snapshot* of the experience from two or more population
- Simultaneous determination of variety of exposures and outcomes status among two or more population
- **Research Hypothesis:** There is a difference in various outcomes and various exposures among population A and B
  - Various Exposures *(Availability of health service providers, essential medicines, important laboratory facilities, resources (fund), refrigerator/freezer, power supply system, communication system, toilet facility,…etc.)*
  - Outcomes *(service coverage, number of out patient visitors, number of patient consulted with health care practitioner in time, consultation time, waiting time for patients, patients receives medicine in time, providing laboratory test result in time, Timely distribution of Maternity incentive for Institutional delivery cases, client access to toilet, …… etc.)*

Cross-sectional Analytical Study

THE PRESENT





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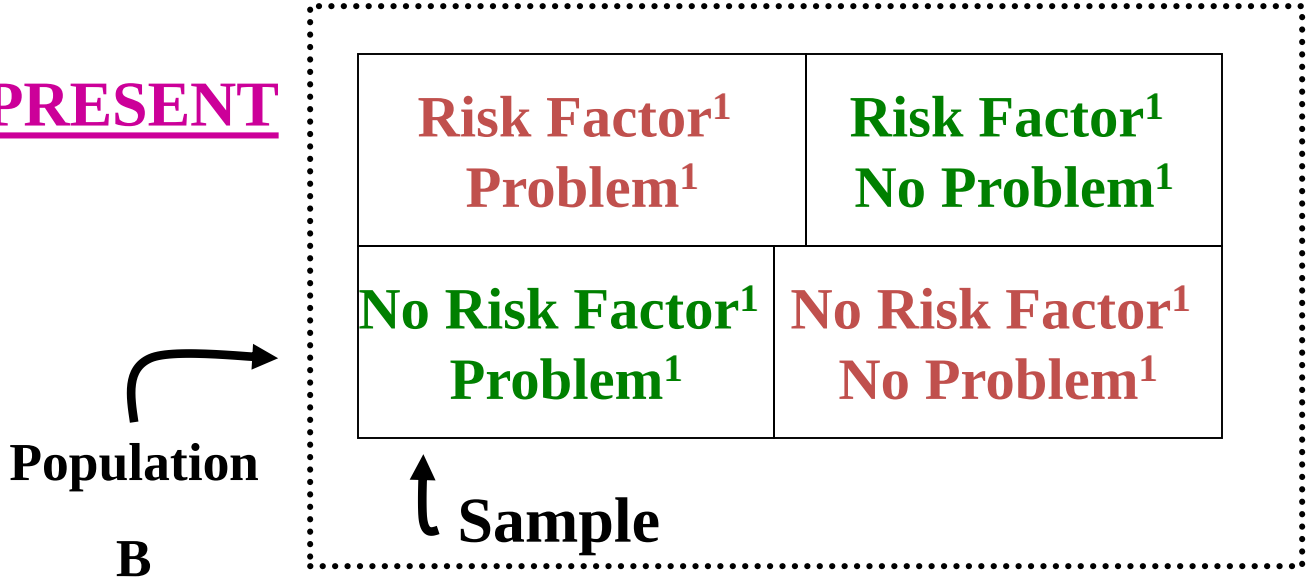


Cross-sectional Analytical Study

THE PRESENT

Population A

Risk Factor[2] Problem[1]	Risk Factor[2] No Problem[1]
No Risk Factor[2] Problem[1]	No Risk Factor[2] No Problem[1]

Sample

Compare

THE PRESENT

Population B

Risk Factor[2] Problem[1]	Risk Factor[2] No Problem[1]
No Risk Factor[2] Problem[1]	No Risk Factor[2] No Problem[1]

Sample

Advantages of Cross sectional studies

- Easy to perform
- Useful to measure current situation of health and disease problem
- Helps to measure the magnitude of health problem at one time
- identifies the risk factors or etiology of disease

Disadvantages

- No temporality can be maintained
- Not useful for the study of disease with short period of illness
- Prone to bias especially recall bias.
- Does not give clues on incidence of diseases

Ecological studies

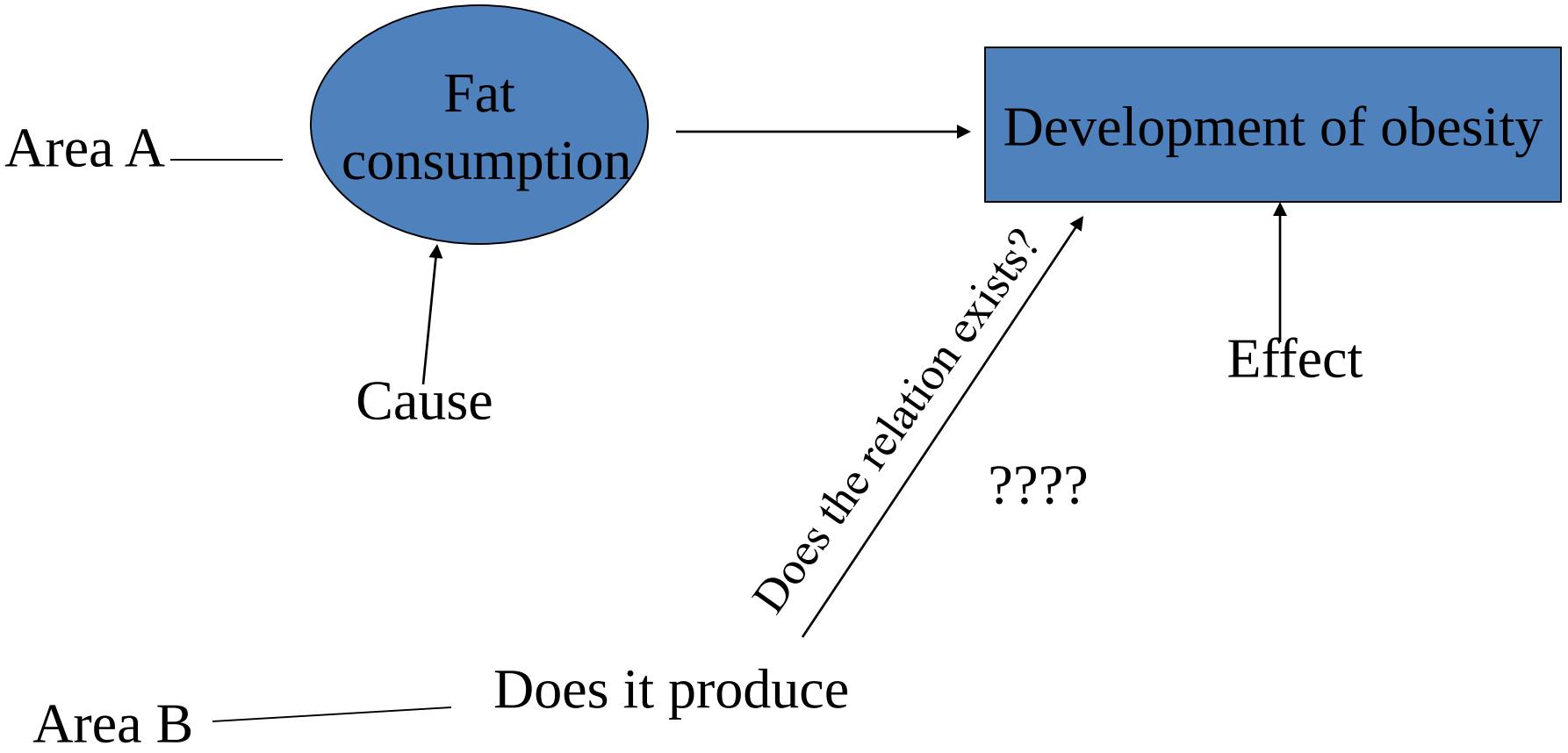
Contd..

- Also known as correlational studies
- The unit of analysis is population or groups of people rather than individuals.
- The relationship of two variables may be studied by comparing population in different countries at the same time or same population in one country at different times.

Contd…

Example

- In ‘A” country a relationship was demonstrated between average fat consumption and prevalence of obesity and coronary health disease
- What will be in others?


Area A
Fat consumption
Development of obesity
Cause
Effect
Does the relation exists?
????
Area B
Does it produce

Contd..

- Ecological studies are often difficult to interpret
- These studies rely on the data collected for other purpose.
- Since the unit of analysis is population, individual link between exposure and effect can not be made.

Contd…

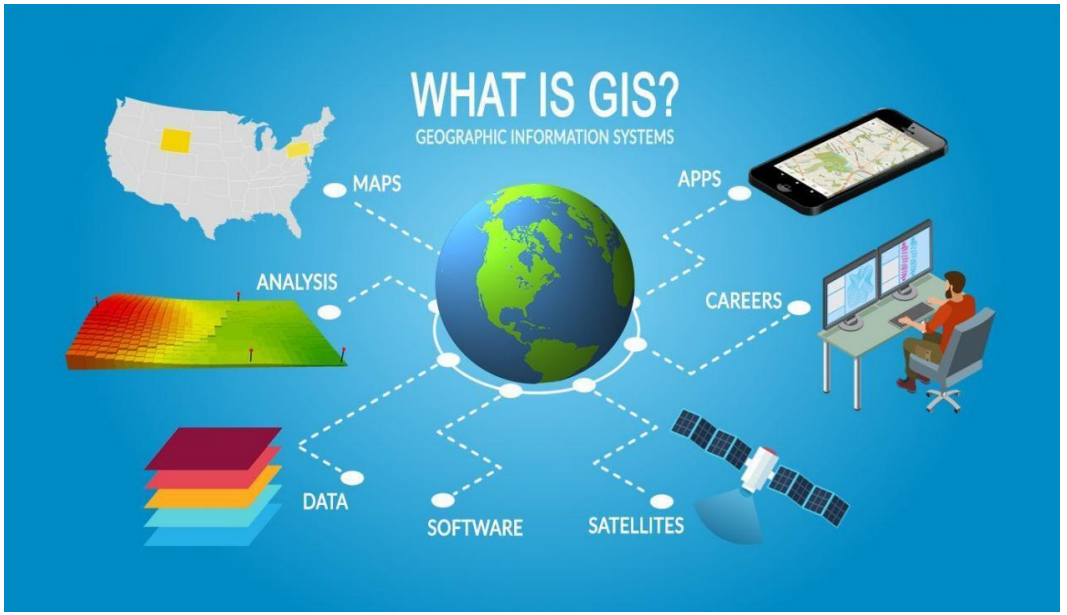
- An ecological fallacy or bias results if inappropriate conclusions are drawn on the basis of ecological data.
- The association that has been exhibited in one place may not exist in other.
- Thus, these are also weak studies.

What is ecological Fallacy?

- An ecological fallacy is the bias that may occur because an association observed between variables on an aggregate level does not necessarily represent the association that exists at individual level.

Geographical Information System (GIS) and Epidemiology

- A geographic information system (GIS) is a system that creates, manages, analyzes, and maps all types of data. GIS connects data to a map, integrating location data with all types of descriptive information (what things are like there).



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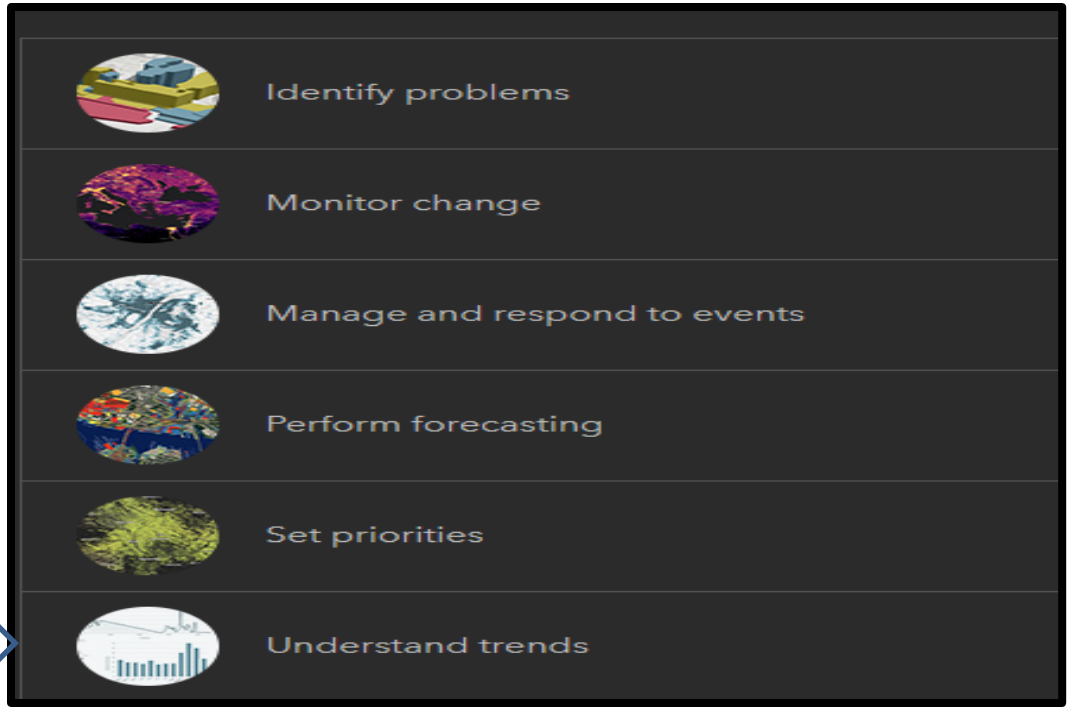
Geographic information system (GIS) technology can be used for scientific investigations, resource management, and development planning.

GIS is used to ----



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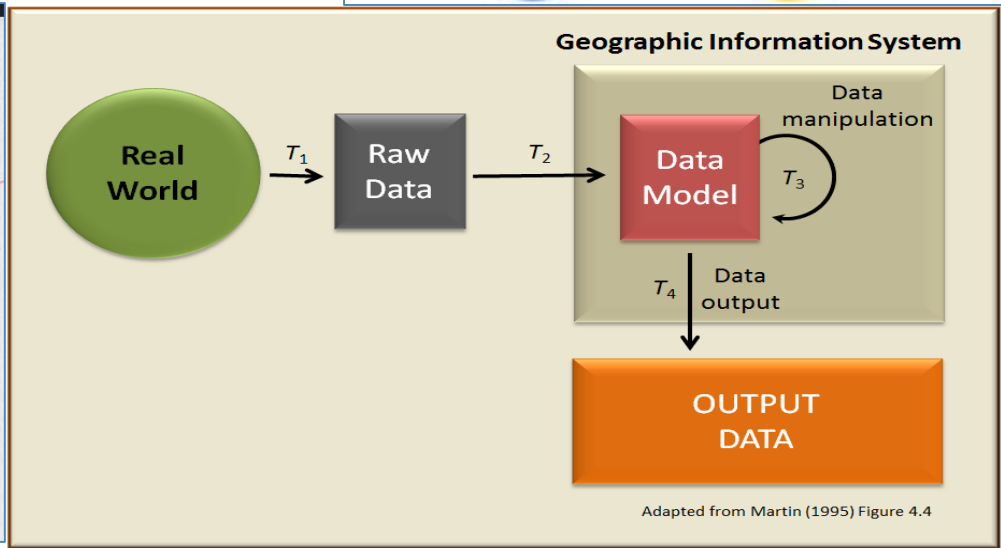
- One of the main applications of epidemiology is to facilitate the identification of geographical areas and population groups that present a greater disease or premature death risk and therefore require more preventive or curative care and health promotion.

- Epidemiology also allows to recognize that the distribution and significance of the factors that lead to the increase of a given risk are not necessarily the same in all population groups.

GIS software

Maptitude	QGIS	gvSIG
ArcGIS	MapInfo Pro	GRASS GIS
Whitebox Geospatial Ana...	Autodesk	GeoDa
ILWIS	CARTO	GeoMedia
Global Mapper	Golden Software	Mapbox
uDig	Transcad Transportation ...	SAGA GIS



Thank you!