Dept. of Public Health Dentistry

EPIDEMIOLOGY OF PERIODONTAL DISEASE

By. Dr. Janki Shah


New Cairo 2
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Definition of epidemiology

- The study of distribution & determinants of health related states or events in specified populations,& the application of this study to the control of health problems

Definition of epidemiology

Study:

- Observations in health practice
- Hypothesis testing of observational studies
- Experiments such as random trials

Distribution:

- Time sequences, places, persons affected

Determinants:

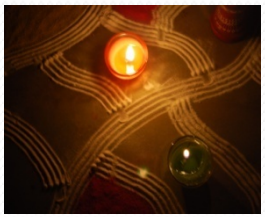
- Physical, biological & behavioral factors
- Health related states/events: death, injuries, behavior e.g. smoking
- Specified populations: identifiable characteristics in defined Nos.

Aims of Epidemiology

- Collection & analysis of vital records
- "Collection & analysis" of morbidity data from hospitals, etc.
- Surveillance of levels of disease
- Implementation of investigations for controlling & preventing epidemics & health problems
- Design & implement clinical research studies & health surveys
- Screening of disease
- Evaluate effectiveness of treatment methods
- For description of clinical course & h/o disease
- Identify population at risk
- Identify links of etiology
- Evaluate health problems
- Provide data for health planning/decision making by administrators

Objectives of epidemiology

- To collect & analyze all data relating to roles of agents, host & environment
- To further analyze & describe occurrence, distribution & nature of diseases according to variables such as age, sex, occupation etc.
- Research to find casual factors
- To help administrators to lay down priorities, appraise action & evaluate periodically



Uses of epidemiology

- To study historically rise & fall of disease in populations
- Community diagnosis
- Planning & evaluation
- Evaluation of individuals risk & chances
- To help in identification of syndromes
- Completing the natural history of the disease
- Search for causes & risk factors

Principles of epidemiology

- Exact observation :accurate & precise
- Correct interpretation: free from error
- Rationale explanation: intelligent, sensible
- Scientific construction: by expert knowledge & technical skill

Steps in epidemiological study

- Acquire basic knowledge about disease
- Define the problem [clinically]
- Collect data & formulate hypothesis
- Analyze data; interpret; present report
- Use sampling techniques for valid conclusions
- Arrange for special investigations like lab. investigations, expert consultations

Components of epidemiology

- Disease frequency: Rate / Ratio, Comparison
- Distribution of disease: Time, place, person
- Determinants of disease: etiological hypothesis, risk factors

Tools of measurement

- Rate: occurrence of particular event in a population during given time period.
- Ratio: relation in size between 2 random quantities e.g. x:y ; x/y
- Proportion: ratio which indicates the relation in magnitude of a part of the whole. Usually expressed as a %

Rate

- Rate is the frequency of a disease or characteristic expressed per unit of size of the population or group in which it is observed.
- Rate measures the occurrence of some particular event in a population during a given time period.
- Rate consists of a numerator, a denominator, the time factor & the multiplier
- Rate=no. of events in a specified period/ population at risk of experiencing the event or disease X 10^n
- Numerator forms a part of the denominator.

Categories of Rate

- Crude Rates: actual observed rates such as birth and death rates
- Specific rates: actual observed rates of diseases due to specific causes or diseases occurring in specific groups or diseases during specific time periods
- Standardized rates: obtained by direct or indirect method of standardization or adjustment like the age & sex standardized rates.

Ratio

- Ratio denotes the relation in size between 2 random quantities.
- The numerator is NOT a part of the denominator.
- Formula A:B or A/B

Proportion

- It is a ratio which expresses the relation in magnitude of a part of the whole.
- The numerator is ALWAYS a part of the denominator.
- It is usually expressed as a %

Incidence & Prevalence

- **Incidence** : The no. of new cases occurring in a defined population ratio during a specific period of time.

- **Uses**: to control disease, For research into etiology and pathogenesis, distribution of disease and efficacy of preventive and therapeutic measure.

- **Prevalence**: It refers to all current cases (Old and new) existing at a given point and time or over a period of time in a given population
  i) point ii) period

- Prevalence = Incidence × Duration
- **Uses**: To estimate the magnitude of disease problem , and identify high risk population
- In administrative and planning purposes.

Definitions

- Mid year population: population estimated to be present as on the 1st July every year (commonly chose as a denominator)
- Population at risk: all those in the particular population to whom an event or disease could have happened, whether it affected them or not.

Measurement of mortality

- Crude death rate =

$$\frac{\text{no. of deaths during the year in a population}}{\text{mid year population}} \times 1000$$

- Specific death rate =

$$\frac{\text{No. of death rate from oral cancer during an year}}{\text{Mid year population}} \times 1000$$

Measurement of morbidity

- Morbidity: any departure, subjective or objective from a state of physiological well being
- Impairment: any loss or abnormality of psychological, physiological or anatomical structure or function
- Disability: any restriction or lack of ability to perform an activity in the manner or within the age considered normal

Factors affecting mortality rate

- Birth rate
- Density of population
- Geographical
- Season
- Epidemic experience
- Secular variation

Definitions

- Epidemic: it is the outbreak of infections/ disease in a region or a community from a common source with increased virulence
- Endemic: diseases that are constantly present in a particular area.
- Pandemic: intercontinental spread of disease
- Sporadic: the cases occur irregularly haphazardly from time to time
- Zoonosis: infections transmitted from vertebrate animals to man
- Epizootic: epidemic among the lower animals

Epidemiological Triad

AGENT:

- Organism , substance or force the presence or lack of which may initiate a disease process or may cause it to continue.
- Living or biological agents: bacteria, virus
- Nonliving agents: nutrient agents, [protein, fats] chemical agents [Pb, As, ketone bodies in diabetes, urea in renal failure]
- Physical agents: Temperature, atmospheric pressure

Epidemiological Triad

HOST:

- Person/ animal that affords lodgment to an infectious agent under natural conditions
- Demographic Characteristics: Age, sex
- Biological Characteristics: Genetic background, nutritional and immune status
- Socioeconomic characteristics: Religion, education, social class, marital status
- Lifestyle: Living habits, food habits

Epidemiological Triad

ENVIRONMENT:

- Source or reservoir of agents of disease
- Internal environment: Organs & systems of human body
- External environment: External to human
- Physical: gases, liquids, solids
- Biological: Animal, plants e.g. rats, mosquitoes, bacteria, fungi
- Social: social and economical factors

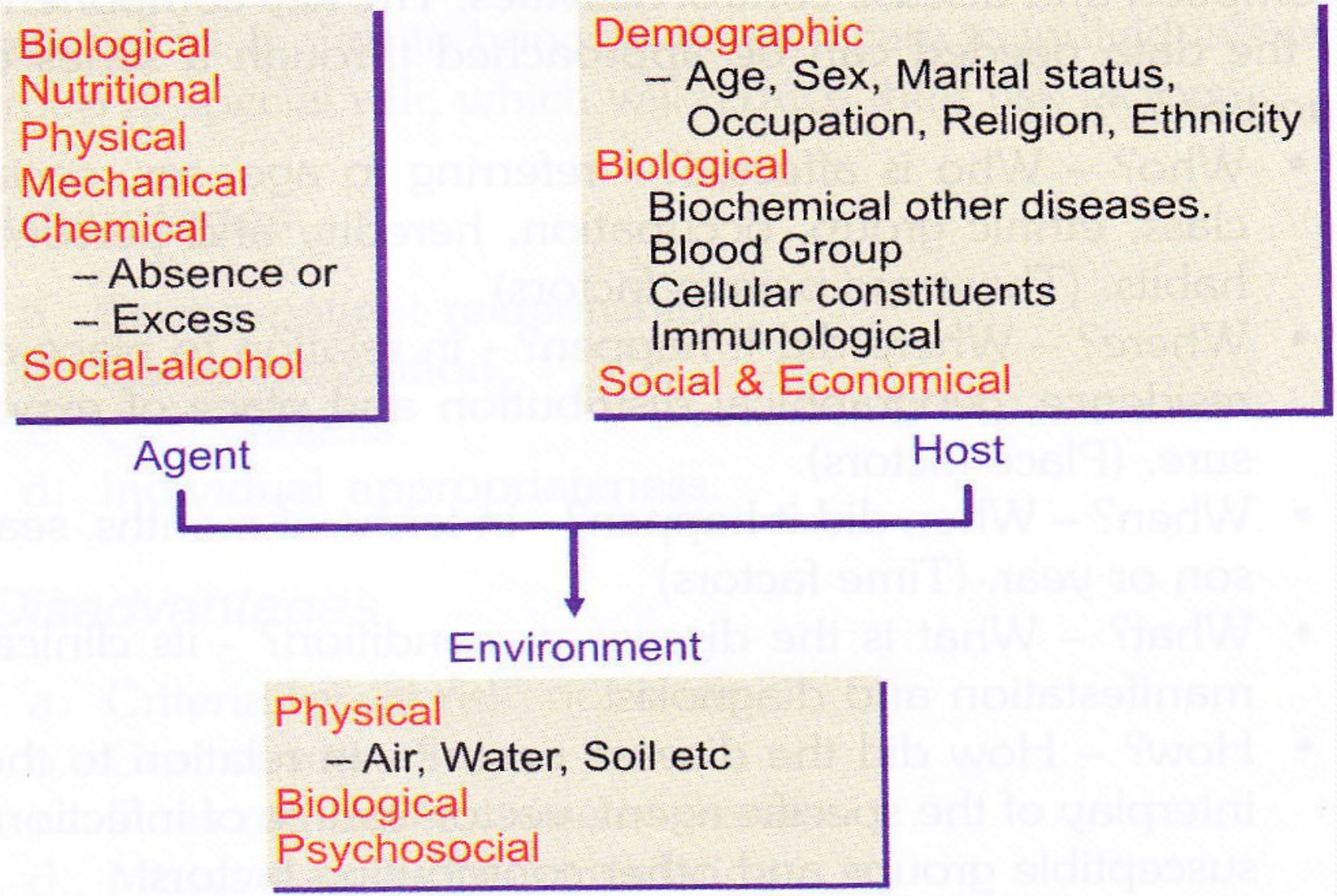


Fig. 2.1: Epidemiological triad and their interaction

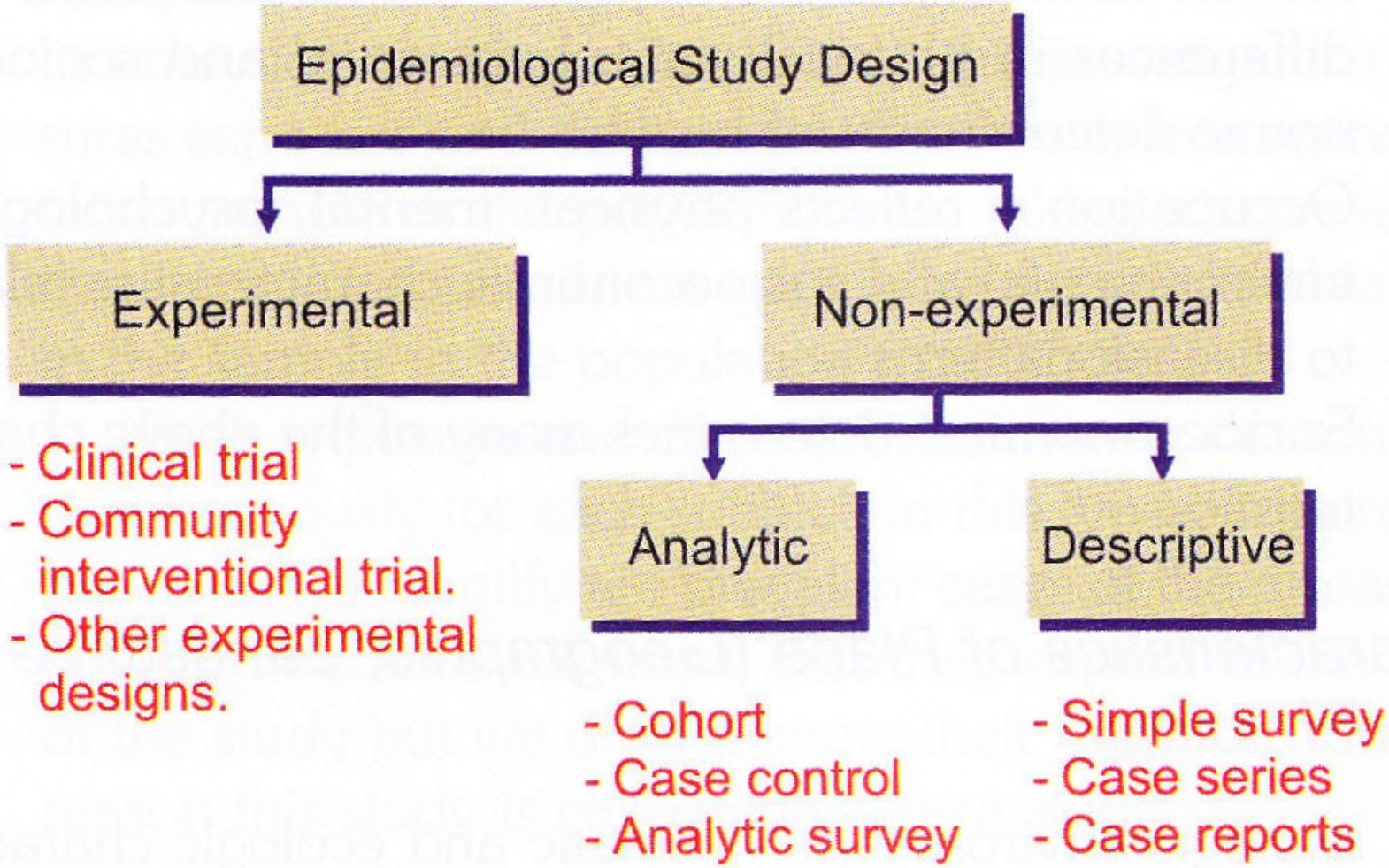


Fig. 2.3: Classification of epidemiological studies

Types of Epidemiology

1.Observational studies

(a) Descriptive Studies

(b) Analytical Studies

(i) Case Control

(ii) Cohort Studies

2. Experimental Studies

i) Randomized control trials or clinical trials

ii) Field Trials or Community intervention Studies

iii) Community Trials

Epidemiological approach

- ASKING QUESTIONS:
- What is the event: to identify disease
- What is its magnitude: identify severity
- Where did it happen: identify place/ area
- When did it happen: identify time of occurrence of disease
- Who are affected: identify persons affected
- Why did it happen: identify possible reasons for appearance of the problem
- MAKING COMPARISONS: between study & control groups

Descriptive Epidemiology

First phase of investigation

- Questions Asked

i) When is the disease is occurring? (time distribution)

ii) Where is it occurring? (Place distribution)

iii) Who is getting the disease? (person distribution)

- Procedures:

i) Define the population to be studied

ii) Define the disease under study

iii) Describe the disease by time, place, person

iv) Measurement of disease :cross sectional studies & Longitudinal studies

v) Comparing with known indices

vi) Formulation of etiological hypothesis

Characteristics frequently examined in descriptive studies

Time	Place	Person	
Year, season	Climatic zones	Age	Birth order
Month, week	Country, region	Sex	Family size
Day, hours of Onset,	Urban/rural Local community	Marital State	Height Weight
Duration	Towns Cities Institutions	Occupation Social status Education	Blood pressure Blood cholesterol Personal habits

Descriptive epidemiology

- TIME DISTRIBUTION:
- Short term fluctuations: epidemics
- Periodic fluctuations: seasonal trends, cyclic trends
- Long term /secular trends: changes that occur over a long period of time e.g. coronary heart disease, lung cancer, diabetes upward trend; T.B. ,typhoid, polio downward trend

Descriptive epidemiology

- PLACE DISTRIBUTION:
  - International variations
  - National variations
  - Rural-urban variations
  - Local distributions

Descriptive epidemiology

- PERSON DISTRIBUTION:
- Age
- Sex
- Ethnic group/ ethnicity
- Occupation
- Socioeconomic status
- Marital status
- Behavior

Measurement of disease

- Incidence can be obtained by longitudinal studies
- Prevalence can be obtained by cross sectional studies

Comparing with known indices

- Make comparisons between 2 populations & subgroups to arrive at clues to disease etiology
- Helps to identify risk factors for diseases

Formulation of hypothesis

- It is a supposition arrived from observation or reflection
- It should specify the following:
- A] population
- B] specific cause
- C]expected outcome –disease
- D] dose – response relationship (amt- incidence)
- E] time – response relationship

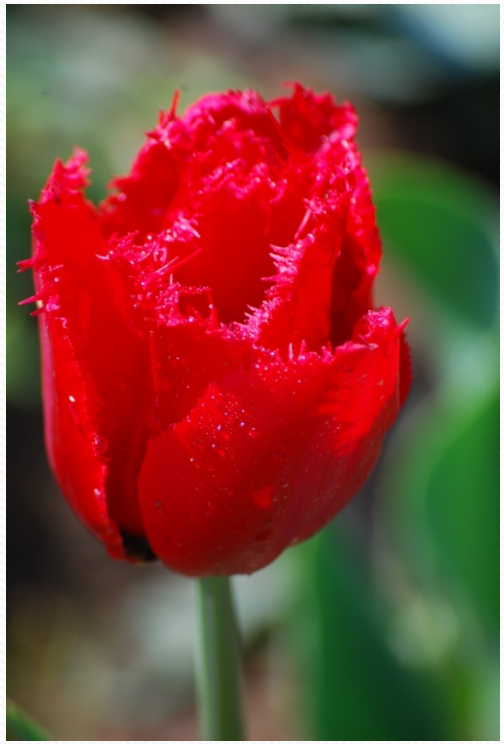
Uses of Descriptive Epidemiology

1. Providing data with regards to type of disease problem and their magnitude in community.
2. Provides information on etiology of the disease, and formulation of an etiological hypothesis.
3. Provides data required for planning , organizing and evaluating preventive and curative services.
4. Leads path for further research.

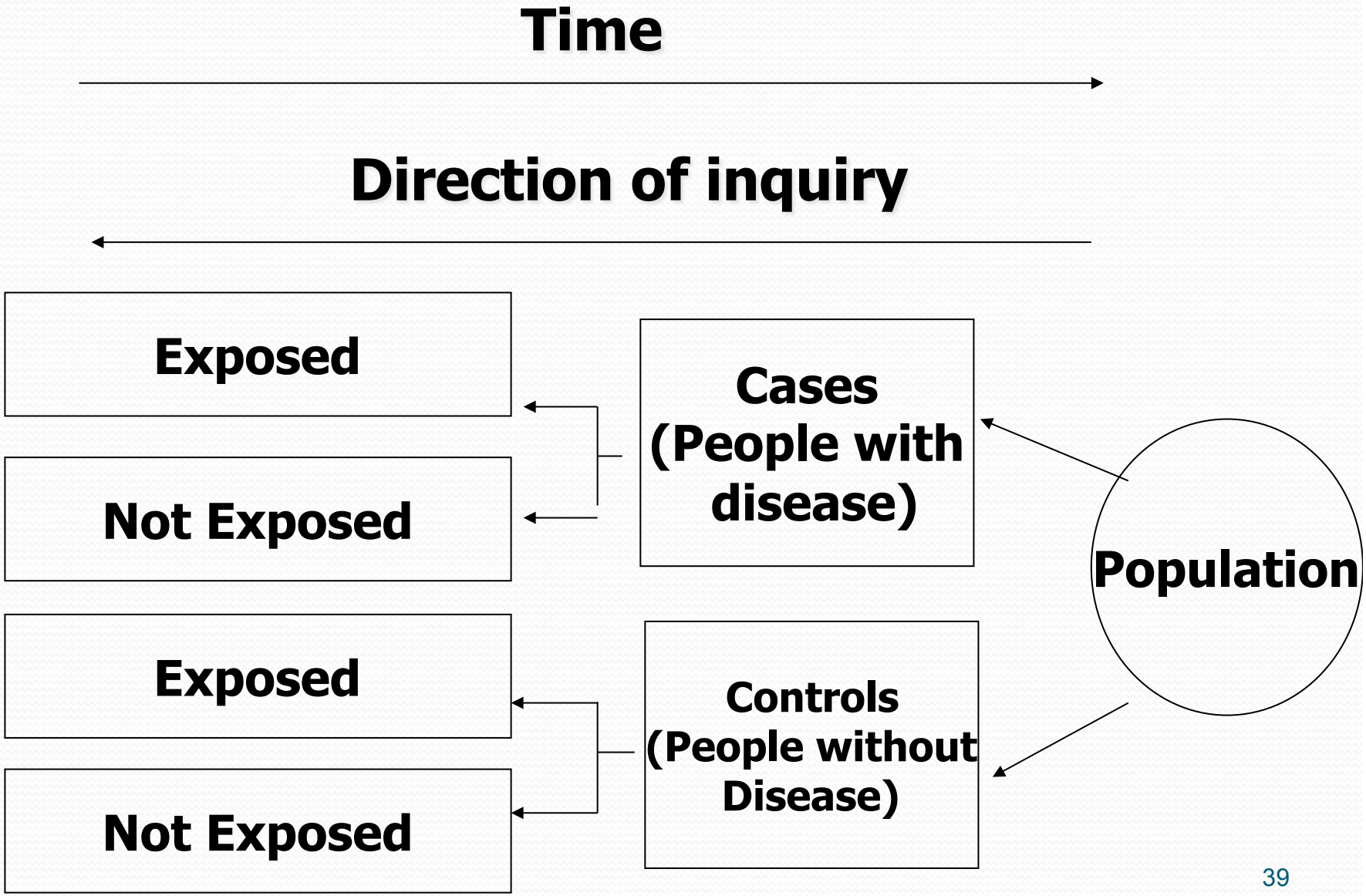
Analytical Epidemiology

A) Case control study (Retrospective Study)
B) Cohort Study (Prospective Study)

A) Case control study
i) Selection of cases and controls
ii) Matching
iii) Measurement of the exposure
iv) Analysis and interpretation



Design of a case control study



Identification of case

- Define disease criteria accurately (diagnostic and eligibility criteria)

Locate cases from

- medical records (hospitals, registries, wards)
- -community
- workplaces

Selection of controls

- Generally from equal ratio
- Match characteristics such as age, sex, economic status)
- Can be derived from medical facilities, communities, or neighborhood of cases,

  relatives

Number of controls: multiple groups

Matching

- Match acc to age ,sex, occupation, social status etc.....to ensure comparability between case & control
- Def: the process by which we select controls in such a way that they arte similar to cases with regards to certain pertinent selected variables eg age which are known to influence the outcome of disease and which if not adequately matched for comparability, could distort or confound the results.
- Confounding factor: one which is associated both with exposure and disease, and is distributed unequally in study & control groups

Matching

- Select a parallel group for matching i.e. frequency matching such that control group too has similar variables like age, sex etc.
- Pair wise matching: for each case selected, one of similar attribute of control is selected
- Unmatched controls: random

Exposure rates

- Self reported
- Hospital records
- Detect using special investigations

Analysis & interpretation

- Exposure rate among cases & controls to suspected factor

- Estimation of disease risk associated with exposure (odds ratio)

Analysis

- Estimate **relative risk** called the odds ratio

e.g. association between chewing tobacco & development of Oral Cancer

Relative risk=incidence amg exposed/incidence among non exposed

a/a+c >b/b+d.....exists

Odds ratio=axd/bxc

=80x50/10x40

=10 i.e. Cases were 10 times more likely than controls to have chewed tobacco in the past

Risk factor	Cases of cancer	controls
present	80(a)	40(b)
absent	10 ©	50 (d)

Case control study of smoking & Oral cancer

	Cases with lung cancer	Controls (without lung cancer)
Smokers	33 (a)	55 (b)
Non smokers	2 ©	27 (d)
Total	35 (a +c)	82 (b +d)

Cases=a/a+c=
33/35=94.2%

Controls=b/b+d=
55/82=67%

Relative risk=incidence amg exposed/incidence among non exposed =a/a+c /b/b+d

Exposure Rates

Frequency rate of cancer is definitely higher among smokers than non smokers

Biases

It is any systematic error in the determination of the association between the exposure and disease.

- Selection of cases
- In investigating controls
- Confounding bias: distortion of study effect mixed with another effect
- Over matching
- Bias in analysis

COHORT

- Def: group of people who share a common characteristic or experience within a defined time period. [e.g. age, environment, economic status.]
- Indications: 1)When there is good evidence of assoc between exposure & disease. 2)rare exposure but the incidence of disease is high among exposed . 3)when ample funds available; easy follow up, cooperative, stable & easily available cohort

B) COHORT STUDY

I) **Prospective Cohort Study**

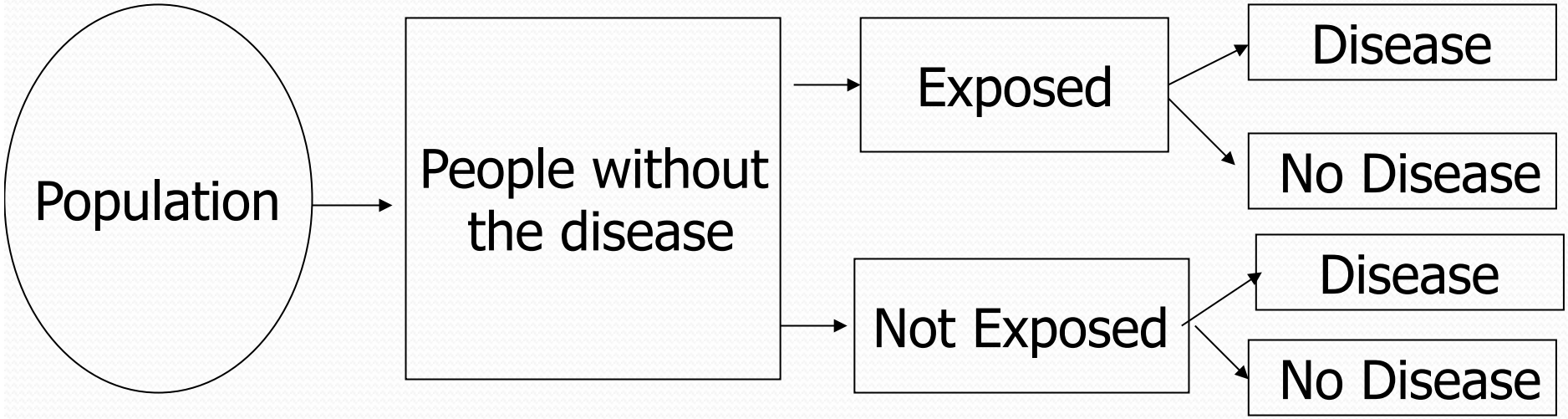
II) **Retrospective Cohort Study**

III) **Combination of Retrospective & Prospective Study**

Cohort study

- Selection of study subjects: general public / group of population
- Obtain data: personal interview/mailed questionnaires
- Selection of comparison groups: internal/ external
- Follow up
- Analysis & interpretation

DESIGN OF A COHORT STUDY



Selection of study cohorts

- Identify a ‘special exposure group’ defined because of

(a) Unusual exposure to a suspected causative/ etiological factor

(b) Unusual lifestyle/ experience

- Using a ‘general population sample in which there is heterogeneity of exposure to the suspected etiological factor

Obtaining data on exposure

- Collect data from sources: records/ individual members, medical examination/special tests/ evaluation of environment

Selection of comparison groups

- Internal: a single cohort entering the study & its members then classified into exposure categories
- Comparison cohort: having similar demographic characteristics to exposed group but not exposed to risk factor
- Multiple comparisons

Follow up

- Periodic medical examination
- Reviewing physician and medical records
- Routine surveillance of death records
- Mailed questionnaires

- 95% follow up

Analysis

- Incidence rates among exposed and non exposed
- Relative risk/ risk ratio

Rate of disease among chewers = 4.5/1000; among non chewers=0.5/1000

relative risk=4.5/0.5=9 i.e. 9 times higher risk

Risk factor(chewing tobacco)	Developed Oral Cancer	Did not develop	total
Present (chewers)	45	9955	10000
Absent (non chewers)	5	9995	10000

Relative risk/ risk ratio

- Ratio of the incidence of the disease among the exposed & the incidence of disease among non exposed
- Relative risk= incidence among exposed

  incidence among non exposed

The longer the relative risk the greater tie strength of association between the suspected factor & the disease.

Attributable risk

- It is the difference in incidence rates of disease (or death) between an exposed group & non exposed group.
- It is usually expressed as a %
- AR=incidence of disease rate among exposed (70/7000=10 per 1000) minus- incidence of disease rate among non exposed(3/3000=1 per 1000)------

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  incidence rate among exposed
- =10-1/10*100=90%

C smoking	Dev lung Ca	Did nt dev lung Ca	total
yes	70 (a)	6930 (b)	7000(a+b)
No	3©	2997 (d)	3000(c+d)

Case Control Study

1. Proceeds from "effect to cause".
2. Starts with the disease.
3. Tests whether the suspected cause occurs more frequently in those with the disease than among those without the disease.
4. Usually the first approach to the testing of a hypothesis, but also useful for exploratory studies.
5. Involves fewer number of subjects
6. Yields relatively quick results
7. Suitable for the study of rare diseases.
8. Less costly & no dropouts
9. Substantial biases can occur

Cohort Study

1. Proceeds from "cause to effect"
2. Starts with people exposed to risk factor or suspected cause
3. Tests whether disease occurs more frequently in those exposed, than in those not similarly exposed.
4. Reserved for testing of precisely formulated hypothesis
5. Involves larger number of subjects
6. Long follow-up period often needed involving delayed results.
7. Inappropriate when the disease or exposure under investigation is rare.
8. Expensive & dropout ratio higher
9. Biases are generally lower

Experimental Epidemiology

Population is divided into two groups which are identical as much as possible in composition

1. Study group

2. Control group

- Types:
  - Randomized control trials
  - Non randomized on non experimental trials

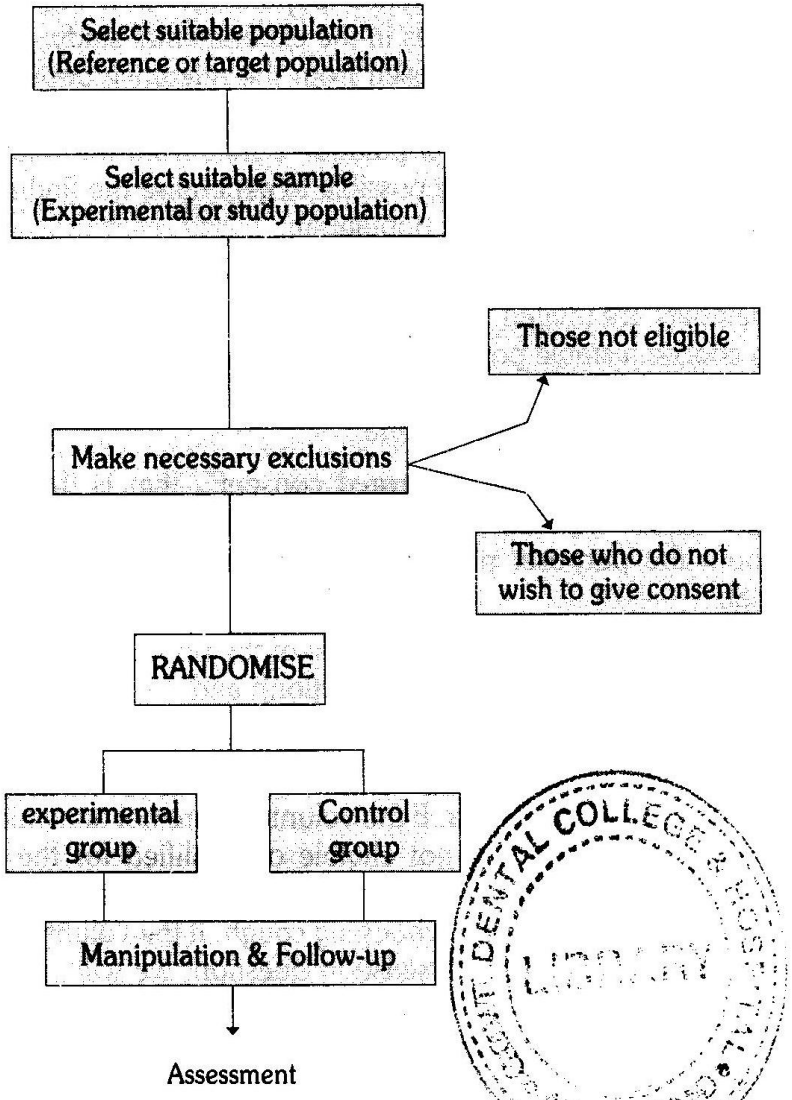


FIG.9

Design of a randomized controlled trial

Randomized control trials

- Drawing a protocol
- Selection of reference and experimental populations
- Randomization
- Manipulation or intervention
- Follow up
- Assessment of outcome

Drawing up a protocol

- Specify aims and objectives
- Criteria for selection of study and control groups
- Size of sample
- Procedure for allocation of subjects into study and control groups
- Treatments to be applied
- Stadardizatiion of working procedures
- Schedule
- Stage of evaluation of outcome of study

Selecting reference and experimental populations

- Reference or target population: mankind/ geographical/age/sex/social groups
- Experimental or study population: actual population that participates ….randomly chosen. Participants must fulfill 3 criteria:
- A] sign informed consent
- Be representative of population
- Qualified/eligible…i.e susceptible to disease

Randomization

- participants divided randomly into study and control groups
- Prevents bias
- Use table of random numbers

manipulation

- Intervene or manipulate the study (experimental) group by deliberate application or withdrawl or reduction of suspected causal factor

Follow up

- Examine both groups at regular intervals of time till final outcome
- Some people drop out due to death/ migration or lack of interest…this is known as attrition

assessment

- A]positive results: reduce incidence or severity of disease
- B] negative results: side effects/ death
- Bias: participant/observer/evaluation bias
- Blinding: Single blind: trial is so planned that the participant is not aware whether he belongs to study group or control group
- Double blind: neither the doctor nor the participant is aware of the group allocation & treatment received
- Triple blind: here the participant, investigator & person analyzing the data, all are blind

Study designs

- Concurrent parallel study design
- Cross over type of study design

Types of randomized control trials

- Clinical trials
- Preventive trials
- Risk factor trials
- Cessation experiments
- Trial of etiological agents
- Evaluation of health services
- Community intervention trials (CITs)

Phases of a clinical trial

Phase 0	**First –in-human trial**	**Single subtherapeutic dose of study drug to 10-15 subjects**	**To gather preliminary data on pharmacodynamics(d-b), pharmacokinetics(b-d)**
Phase 1	20-100 volunteers 1-2 months	Dose ranging	To find best and safest dose
Phase 2	100-300	Effectiveness of drug	How much drug and how well it works
Phase 3	Randomized multicentre trials 300-3000	Regulatory submission from animal & human experiments	Marketed under FDA, if side effect seen, drug withdrawn
Phase 4 Phase 5	Postmarketing surveillance		To detect any rare or long term side effect Integration of new clinical treatment to widespread public health practice

Non randomized trials(quasi experiments)

- Uncontrolled trials
- Natural experiments
- Before and after comparison studies

Evidence based dentistry

- Provides a clinician with strategies & tools to interpret & integrate evidence from published research in his/her patient care.
- Can also inform health policy making, day to day decisions in public health & systems level decision
- All treatment decisions should rest on systematic reviews of methodologically strong randomized controlled trials with consistent results
- This requires precise definition of patient's problem & also information for an effective solution to the problem

Iceberg concept of disease

- Visible portion of iceberg represents the clinical cases seen by the physician.
- The huge submerged portion of iceberg represents the hidden mass of disease, latent, unapparent, presymptomatic & undiagnosed cases & carriers in the community.
- Major deterrent is the absence of method to detect the subclinical state—the bottom of the iceberg.
- Floating tips are what the dentist sees & hidden portion represents unrecognized disease.

Screening for disease

- **Screening**: testing for infection or disease in population or in individuals who do not seek health care. E.g. neonatal screening, AIDS screening
- **Case finding**: use of clinical or lab tests to detect disease in individual seeking health care for other reasons. E.g VDRL for antenatal mothers, TB for chest symptoms
- **Mass screening**: screening of the whole population whether they are at risk at contracting a disease or not
- **Multiphasic screening**: application of 2 or more screening tests in combination to a large no. of people at one time
- **High risk/ selective screening**: application of screening to high risk groups identified based on epidemiological research

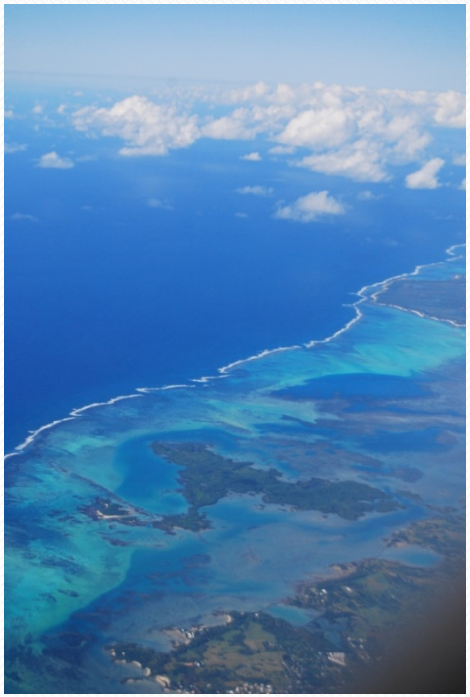
Uses of screening

- Case detection
- Control of spread of infectious diseases
- Research purposes especially for studying chronic nature of the disease
- Educate people

Biases

- Any systematic error in the determination of association between the exposure & the disease.
- Types:

1. Bias to confounding
2. Memory or recall bias
3. Selection bias
4. Berkisonian bias
5. Interviewers bias



Scientific Methods in Dental Epidemiology

1. Establishing the objectives
2. Designing the investigations
3. Selecting the samples
4. Conducting the examination
5. Analyzing the data
6. Drawing the conclusion
7. Publishing the results

Questions asked

- Define epidemiology. Describe its uses.
- Uses of dental epidemiology
- Descriptive epidemiology
- Analytical epidemiology with examples
- Classify experimental epidemiology. Describe randomized controlled trials in detail.
- Evidence based dentistry
- Iceberg phenomenon
- Screening
- Incidence & prevalence.


THE END