Principles of Epidemiology

Objectives:

1-Understand the history, principles, and concepts of epidemiology.
2-Define and calculate prevalence and incidence.
3-Recognize and explain the role, strengths and challenges of the epidemiologic approach in contributing to our understanding of health and illness
4- Assess whether observed associations are likely to be causal or non-causal.
5- Identify the difference between internal and external validity and their role in critically appraising epidemiologic research.
6-Understand and apply epidemiological concepts as they relate to specialized fields of epidemiology, including infectious disease epidemiology, disease prevention and screening.

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- Doctor notes
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- Important
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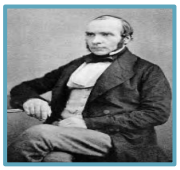
History of epidemiology

English physician considered one of the founders of modern Epidemiology



John snow
"The father of epidemiology"

Tracing the source of a cholera outbreak in Soho, London,in 1854
- Fundamental changes in the water and waste systems of London.
- Significant improvement in general public health around the world.

Principles of epidemiology

Definition : Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.

(Study itself is not enough,because it has to be applied to prevent diseases and promote health and that is the role of public health.)

1 Study:

Epidemiology is a scientific discipline with sound methods of scientific inquiry at its foundation.(where you know how to ask and answer questions related to diseases or health events) Epidemiology is data-driven and relies on a systematic and unbiased approach to the collection, analysis, and interpretation of data(methodology and collecting the data in the right way is very important to reach a result and take an action). However, epidemiology is not just a research activity(its about using research to prevent diseases and promote health) but an integral component of public health, providing the foundation for directing practical and appropriate public health action based on this science and causal reasoning.

2 Distribution:

Frequency refers not only to the number of health events such as the number of cases of meningitis or diabetes in a population, but also to the **relationship of that number to the size of the population.** The resulting **rate** allows epidemiologists to compare disease occurrence across different populations.Pattern refers to the occurrence of health-related events by time, place, and person.(this is called descriptive epidemiology)
Characterizing health events by time, place, and person are activities of descriptive epidemiology,

3 Determinants

Epidemiology is also used to search for determinants, which are the causes and other factors that influence the occurrence of disease and other health-related events.ex:marital,education status,social status etc these are health determinants
-Epidemiologists assume that illness does not occur randomly in a population(epidemiology looks for factors or causes to help understand diseases therefore prevent them accordingly), but happens only when the right accumulation of risk factors or determinants exists in an individual. To search for these determinants, epidemiologists use analytic epidemiology or epidemiologic studies to provide the "Why" and "How" of such events.

4 Health-related states or events:

The term health- **related** states or events may be seen as anything that affects the well-being of a population.
(ex;Traffic accidents,bullying,natural disasters,screening,so it is not necessarily a disease)
(Anything that can affect health in the long run)

5 Specified populations:

Although epidemiologists and direct health-care providers (clinicians) are both concerned with occurrence and control of disease, they differ greatly in how they view "the patient."
(Doctor:treats the patient,while epidemiologists look for causes of diseases and ways to prevent it.)

6 Application:

Epidemiology is not just "the study of" health in a population; it also involves applying the knowledge gained by the studies to community-based practice.
(Ex:screening for colorectal cancer for men>50,pap smear,breast cancer screening)
(Any application is evidence based,and it has to be beneficial and cost effective)

Concept of epidemiology

Epidemiology is based on two fundamental assumptions.

- **1)** the occurrence of disease is not random (i.e., various factors influence the likelihood of developing disease)
(so we have to study and investigate the causes and association between variables)

- **2)** the study of populations enables the identification of the causes and preventive factors associated with disease. To investigate disease in populations, epidemiologists rely on models and definitions of disease occurrence and employ various tools, the most basic of which are rates.(we have to have to be specific in the definition)

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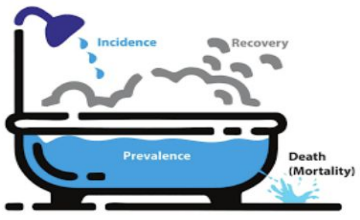
Q: Define and calculate prevalence and incidence. (disease frequency)	
Incidence	**Prevalence**
The number of **new** cases of disease that develop over time.	The amount of a disease in one **particular point in time** (the proportion of people who have the disease)
Ex:a side effect of a surgery is hemorrhage,how do we calculate the incidence?nominator:number of patients who got hemorrhage post op.Denominator:number of patients who underwent surgery"at risk") 1 proportion(people at risk): $\frac{\text{number of new cases of disease}}{\text{population without disease at baseline}} \times 100\%$ 2 rate(time is involved): The approach to look for prevalence: cross sectional study $\frac{\text{number of new cases of disease}}{\text{person-time at risk}}$	$\frac{\text{number of people with disease}}{\text{number of people in the population}} \times 100\%$



Bathtub Analogy

Increase in prevalence is based on increase in incidents.

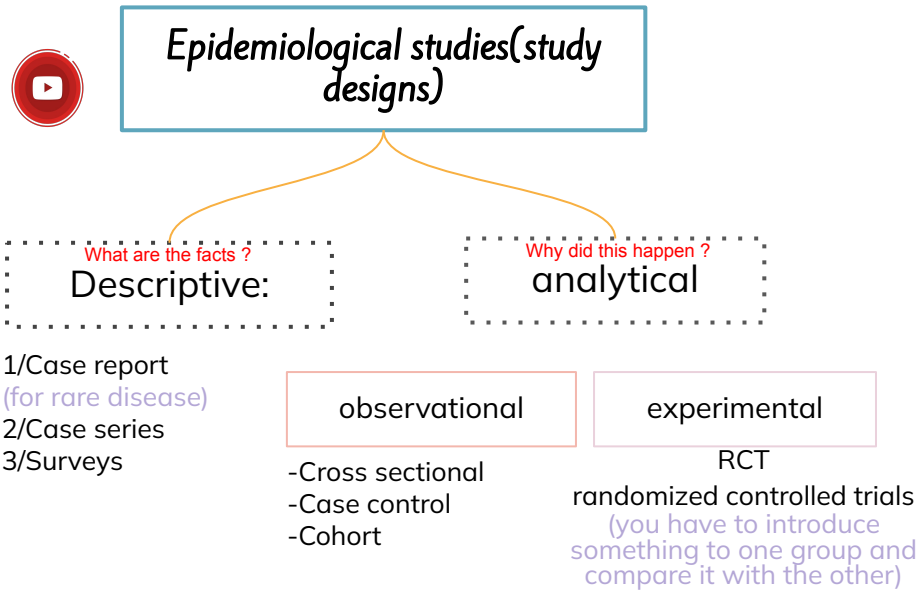
Epidemiologic approach

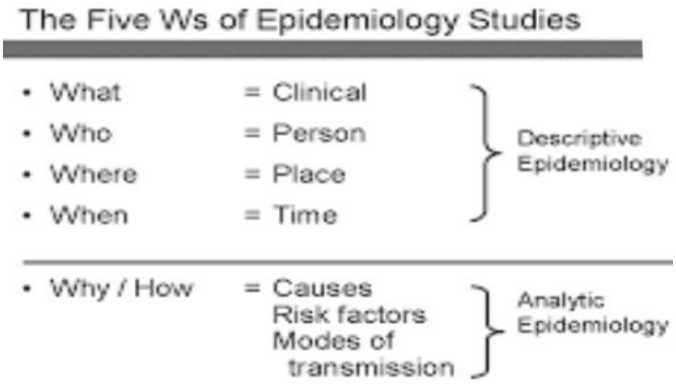
• Epidemiology offers powerful tools to quantify the degree to which risk factor and humanitarian interventions affect population health.

•Asking questions: related to events or related to health actions Place, person, time, case definition (what), cause (why).

• Making comparisons: to find out differences in the agent, host and environment conditions between two groups

• A measure of association quantifies the relationship between exposure and disease among the two groups. Is a popular restaurant?Or was there a factor to the outbreak?





Case report/series

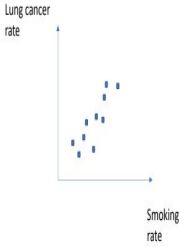
Descriptive or explanatory analysis of **one or a few cases**
Report:single case
Series:multiple cases

- Usually very clinical
- Good for new or rare diseases

Lung cancer...describe...aim?

Ecological study

- A group of people is used as **one unit** or single observation in the analysis
(ex:in this society,smoking increases lung cancer(it's very general)



- It ignores individual differences

Descriptive study

Describe features of **a population**

- Very similar to case studies, except for **larger samples**

- Describe the features of lung cancer patients. Do we think smoking is related to lung cancer.

Cross-sectional study

Data collected at single **point in time**
(can show association between variables)

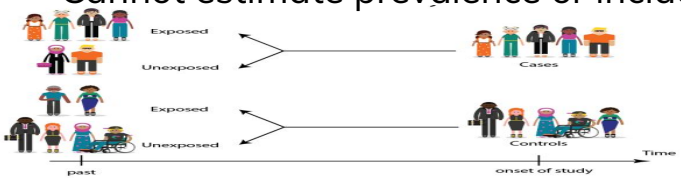
- Relatively quick and cheap. Do you smoke? Do you have lung cancer?..maybe frequency

- Lack temporality (time component). **What came first?**

Case-control study

(imp. diff. Between case control and retrospective cohort)
Subjects are selected based on the **outcome** or disease (y variable)

- We take people with LC and without LC and ask about their smoking habits.
- Good for **rare** disease
- Quick and inexpensive. We don't have to wait till someone gets LC
- Lack temporality (time component). What came first?
- Recall bias
- Cannot estimate prevalence or incidence

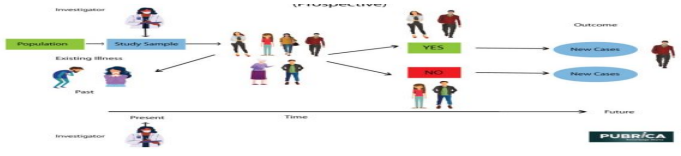


Cohort *(mostly prospective)*

Subjects are selected based on **exposure** (x variable)

- Subjects are followed **over time** to see the outcome (y variable)
- Does x (smoking) cause y (LC)?(causation relation)
- It has temporality(you can know what happened first)
- Takes a long time
- Expensive
- Loss to follow-up issues(because follow up is for years)

Retrospective cohort:2 groups where one has the exposure(smoking) while the other doesn't and then look for people with LC))(in case control its 2groups one has the outcome(disease and the other doesn't)

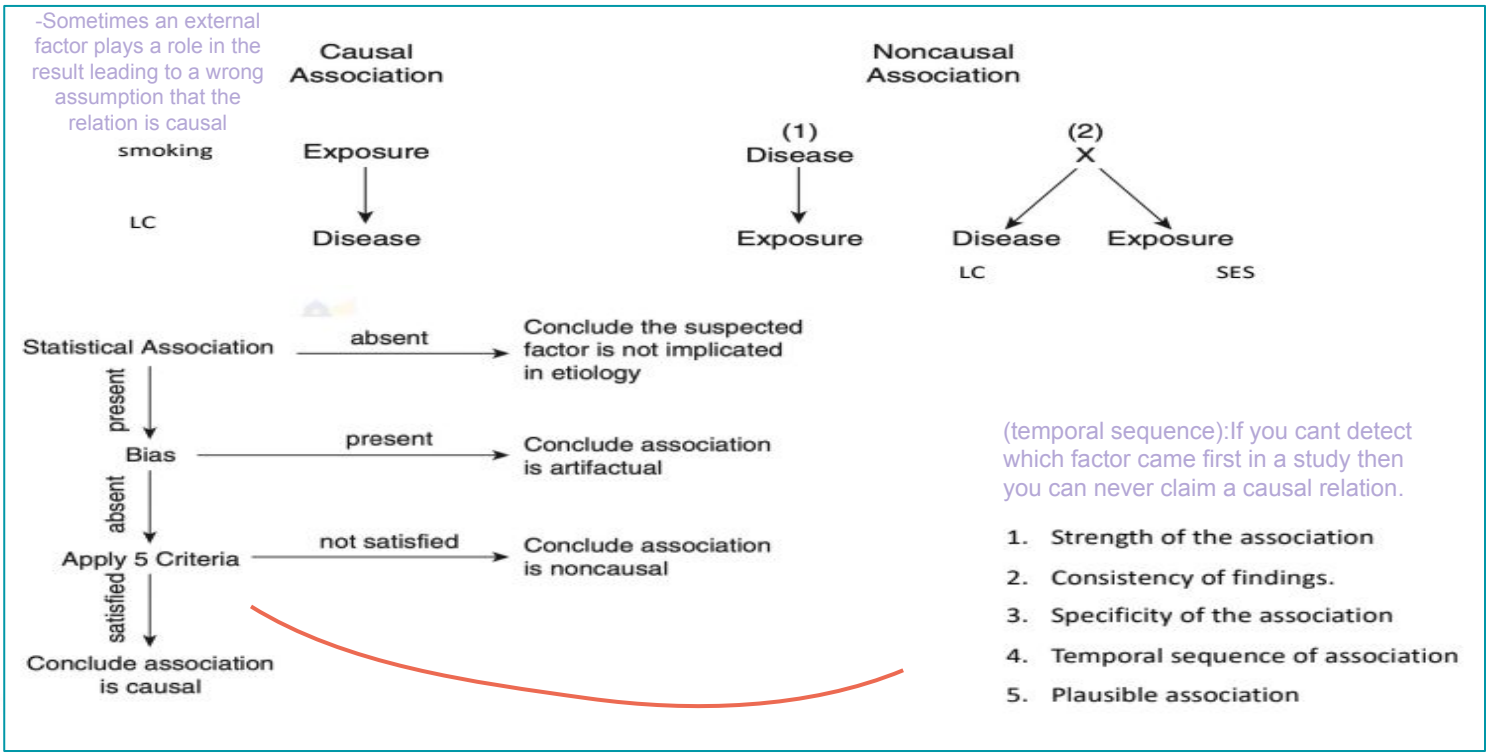


RCT

(Expose them to a specific variable intentionally)
Similar to cohort but the difference is that people are **randomly assigned** to exposure/treatment

- Balance out confounders
- Long and expensive
- Ethical issues

causal or non-causal ?



Internal validity

• The extent to which the observed results **represent** the truth in the population **we are studying** and, thus, are not due to methodological errors

• The internal validity of a study can be threatened by many factors, including errors in **measurement** or in the **selection of participants** in the study, and researchers should think about and avoid these errors.

Validity

• The validity of a research study refers to how well the results among the study participants **represent true findings** among similar individuals outside the study. This concept of validity applies to all types of clinical studies, including those about prevalence,associations, interventions, and diagnosis.

(ex:if I weigh 60 but the scale shows 70 then its not valid,but if it shows 70 every single time then its reliable)

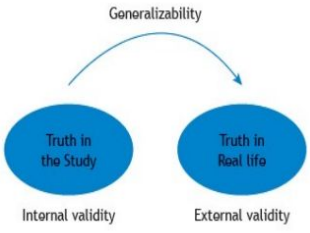
External validity

• Once the internal validity of the study is established, the researcher can proceed to make a judgment regarding its external validity by asking whether the study results **apply to similar patients in a different setting** or not

• External validity refers to the extent to which the results of a study are **generalizable** to patients in our daily practice, especially for the population that the sample is thought to represent.

• Lack of internal validity implies that the results of the study deviate from the truth, and, therefore, **we cannot draw any conclusions**;hence, if the results of a trial are not internally valid, external validity **is irrelevant**

• Lack of external validity implies that the results of the trial may not apply to patients who differ from the study population and, consequently, could lead to **low adoption** of the treatment tested in the trial by other clinicians



Epidemiological concepts as they relate to specialized fields:

• Epidemiological studies are conducted to determine why an infectious disease occurs endemically or epidemically and what causes differences in the occurrence of infections among populations and within populations

• When a disease occurs in a population, epidemiologists help us to understand where the disease is coming from, and who it is most likely to impact. **The information gathered can then be used to control the spread of the disease and prevent future outbreaks**

• Screening is a public health intervention intended to improve the health of a precisely defined target population. Within this population are individuals considered at risk of the effects of a condition, and screening is **justified by the awareness of that condition as an important public health problem.**

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