Introduction to epidemiology
lecture 1

Epidemiology It is derived from the Greek word epidemic (epi= upon ; demos= people; logos= study).

Epidemiology began with Adam and Eve, both trying to investigate the qualities of the "forbidden tree".

Although epidemiological thinking has been traced to the time of Hippocrates, who lived around 5th century B.C., the discipline did not flourish until 1940s
Hippocrates displayed an extraordinary awareness of the impact of environment and behavior on personal well–being.
There were many other scientists who contributed to the development of epidemiology. One of them was John Snow. In 1849, John Snow, an English physician, formulated and tested a hypothesis concerning the origin of an epidemic of cholera in London. Finally, Snow concluded that the source of cholera outbreak was contaminated water

Why does a disease develop in some people and not in others?

Diseases, and ill health are not randomly distributed in human populations. Rather, each of us has certain characteristics that predispose us to, or protect us against, a variety of different diseases. These characteristics may be primarily genetic in origin or may be the result of exposure to certain environmental hazards. Perhaps most often, we are dealing with an interaction of genetic and environmental factors in the development of disease.

Epidemiology is defined as :

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

—John M Last

Epidemiology is thus concerned with three aspects of health related problems: the frequency (how many), the distribution (when and where) and the determinants (risk factors and causes of disease).

Health related conditions: are conditions which directly or indirectly affect or influence health. These may be injuries, births, health related behaviors like smoking, unemployment, poverty etc.

Uses of epidemiology

1. To describe magnitudes of disease
2. To know causation of disease
3. To know natural history of a disease
4. Description of health status in population
5. Health planning and identifying priorities
6. Evaluation of intervention

Sources of epidemiological information

1. Population census is collection of data from every member of a population; theoretically it should provide the most reliable data.
2. Registration of vital events—Birth, death and marriage.
3. Hospital/health center records.
4. Disease registers, i.e. The Revised National Tuberculosis Control Program maintains a Tuberculosis Register in each DOTS center.
5. Epidemiologic studies.
6. Publications, Electronic sources

Risk: A probability that an individual will become ill or die within a specified period of time or age. It is used to denote incidence rate

Risk factors: An attribute or exposure that is significantly associated with development of a disease.

They are only suggestive and not absolute proof of disease occurrence. Also, they must be identified prior to disease occurrence. Risk factors are suspected from descriptive epidemiologic studies and established by analytic studies

Relative risk (RR): is a measure of strength of association between an exposure and an outcome.

Its value is an indicator of the significance of the exposure in the etiology of the outcome.

The relative risk is calculated by relating the incidence rate (IR) of the disease among those exposed to the risk factor to the incidence rate of the disease among those not exposed.

$$\text{Relative risk (RR)} = \frac{\text{Incidence rate among exposed}}{\text{Incidence rate among non exposed}}$$

Interpreting Relative Risk (RR) of a Disease

If RR = 1 Risk in exposed equal to risk in nonexposed (no association)
If RR > 1 Risk in exposed greater than risk in nonexposed (positive association; possibly causal)
If RR < 1 Risk in exposed less than risk in nonexposed (negative association; possibly protective)

Association: A statistical (quantitative) dependence between two or more variables. Variables are said to be associated if they tend to occur together more frequently than could be explained by chance. The degree of association is determined by statistical tests

Types of statistical association

1- Non causal when the apparent association is due to confounding process, when a third factor is related both to the risk factor (the cause) and the outcome or effect (the disease).
2- Causal association

TYPES OF CAUSAL RELATIONSHIPS

A causal pathway can be either direct or indirect
In case of *direct causation*, a factor directly causes a disease without any intermediate step. In the case of *indirect* causation, a factor causes a disease, but only through an intermediate step or steps.
In human biology, intermediate steps are virtually always present in any causal process.

Considerations for causation

Statistical association is likely to be causal if the following criteria are fulfilled:

A-Epidemiological criteria(Bradford Hill criteria)

1- Temporal relation :Does the cause precede the effect? (essential)
2- Plausibility: The association agrees with currently accepted understanding of pathological processes**.** Is the association consistent with other knowledge? (mechanism of action; evidence from experimental animals)
3- Consistency : Have similar results been shown in other studies?
4- Strength :What is the strength of the association between the cause and the effect? (relative risk)
5- Dose–response relationship : Is increased exposure to the possible cause associated with increased effect?
6- Reversibility : Does the removal of a possible cause lead to reduction of disease risk?
7- Study design: Is the evidence based on a strong study design?
8- Judging the evidence How many lines of evidence lead to the conclusion?

B-Biological criteria (Koch's Postulates).

Koch stated that four postulates should be met before a causal relationship can be accepted between a particular bacterial parasite (or disease agent) and the disease in question. These are:

1. The agent must be shown to be present in every case of the disease by isolation in pure culture.
2. The agent must not be found in cases of other disease.
3. Once isolated, the agent must be capable of reproducing the disease in experimental animals.
4. The agent must be recovered from the experimental disease produced.

The likelihood of a causal association is heightened when many different types of evidence lead to the same conclusion.

Evidence from well-designed studies is particularly important, especially if they are conducted in a variety of locations.

The most important use of information about causation of diseases and injuries may be in the area of prevention.

The Epidemiologic Triangle

The epidemiologic triangle, is a model that scientists have developed describe the relationship among three key factors (vertices) in the occurrence of disease or injury: **agent, environment,** and **host.**

The mission of an epidemiologist is to break at least one of the sides of the Triangle, disrupting the connection between the environment, the host, and the agent, and stopping the continuation of disease.

The Epidemiological Triangle has three vertices(elements).

- **Agent, (the "what" of the Triangle)**

The **agent** is the cause of the disease

As a general rule, the agent must be present for the disease to occur. However, the mere presence of the agent is not always sufficient for the disease to occur.

Agents Can be: Bacteria, Virus, Parasite, Fungus, Protozoa, helminthes. Chemicals (solvents), Radiation, Heat, Natural toxins (snake or spider venom).

Host, (the “who” of the Triangle)

"Host" refers to the organism (e.g. human) capable of being infected by a specific agent. There are intrinsic factors that influence an individual's exposure, susceptibility or response to a causative agent. These factors include socio-economic status, lifestyle, behaviours, and psychological characteristics.

e.g Smoking for example is an important contributor in the aetiology of lung cancer and ischaemic heart diseases.

Environment, (the “where” of the Triangle)

The **environment** is the favorable surroundings and conditions external to the human or animal that cause or allow the disease or allow disease transmission.

They can be physical factors (e.g. climate), biological factors (e.g. insects) or socio-economic factors (e.g. sanitation, access to health services).

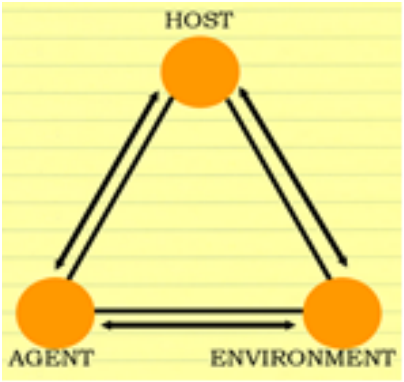
Example:

With the help of the triangle we were asked to discuss the cholera outbreak in Basra city. The findings included:

- Agent = Cholera
- Host= humans living in the region
- Environment = the water systems within the city

To break the cycle is environment –> host.

This is because if the governments were able to clean up the water supply in the country than the spread of the disease would no longer be possible



Quiz

1- Define epidemiology. 2- What are the uses of epidemiology

3- What are the sources of epidemiological information

4- Biological criteria (Koch's Postulates).

5-Epidemiological criteria (Bradford Hill criteria) Considerations for causation

6- Write about the elements of the epidemiological triangle.

7- With the help of the triangle we were asked to discuss the following diseases measles, chicken pox.