Chapter 2

Epidemiology

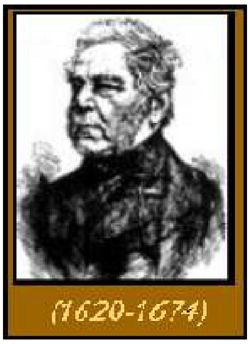
2.1. The basic theoretical science of epidemiology
- 2.1.1 Brief history of epidemiology
- 2.1.2. Definition of epidemiology
- 2.1.3. Epidemiology and public health/preventive medicine
- 2.1.4. Social epidemiology
- 2.1.5. The differences between individual and population based approach

2.1. The basic theoretical science of epidemiology

2.1.1 Brief history of epidemiology

The Greek physician Hippocrates (i.e. 460-375) was the very first epidemiologist. He has examined the relationships between the occurrence of disease and environmental influences. Hippocrates believed sickness of the human body to be caused by an imbalance of the four humors. The cure to the sickness was to remove or add the humor in question to balance the body. He coined the terms endemic (for diseases usually found in some places but not in others) and epidemic (for diseases that are seen at some times but not others).

John Graunt (1620-1674) in the 17th century analyzed the mortality rolls in London, presented one of the first life tables giving probabilities of survival to each age, and report time trends for many diseases, new and old. He provided statistical evidence for many theories on disease, and also refuted some widespread ideas on them. Graunt, along with William Petty, developed early human statistical and census methods that later provided a framework for modern demography. Graunt is also considered as one of the first experts in epidemiology, since his famous book was concerned mostly with public health statistics.



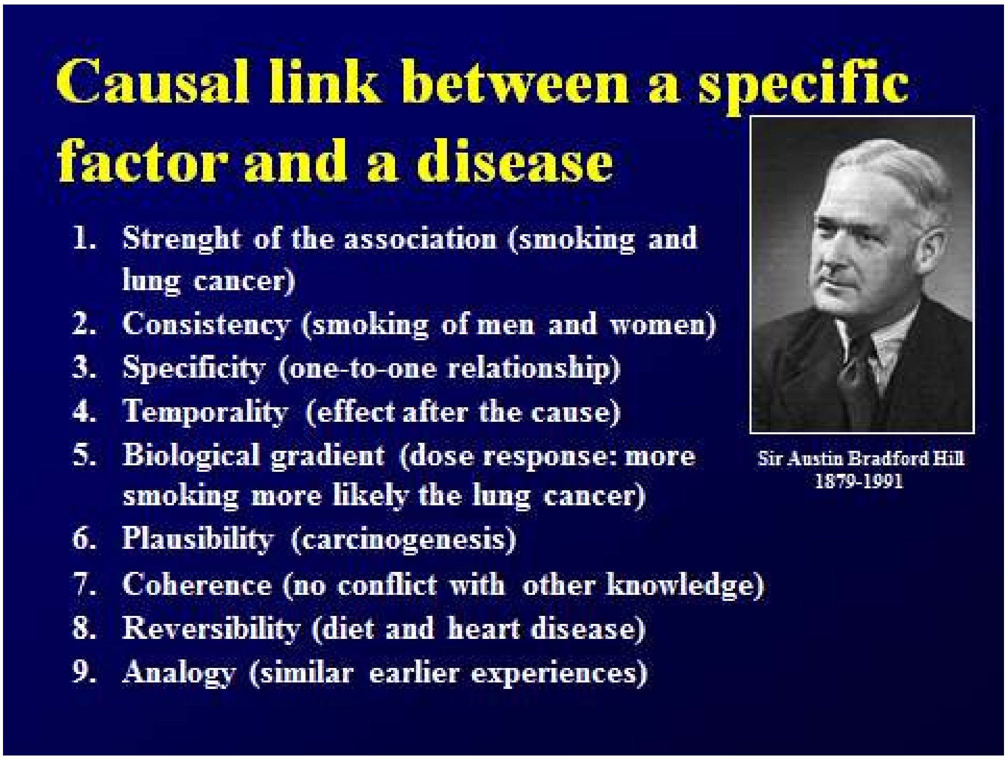
Dr. John Snow (1813-1858) is famous for his investigations into the causes of the 19th century cholera epidemics, and is also known as the father of modern epidemiology. He began with noticing the significantly higher death rates in two areas supplied by water by Southwark Company. His identification of the Broad Street pump as the cause of the Soho epidemic is considered the classic example of epidemiology. He used chlorine in an attempt to clean the water and had the handle removed, thus ending the outbreak. This has been perceived as a major event in the history of public health and regarded as the founding event of the science of epidemiology, having helped shape public health policies around the world.

Other pioneers include Hungarian physician Ignác Philipp Semmelweis (1818-1865), who in 1847 discovered the background of maternal death using a “case-control” study and brought down mortality at a Vienna hospital by instituting a disinfection procedure.
Semmelweis introduced as a disinfection procedure hand-washing standards after discovering that the occurrence of puerperal fever could be prevented by practicing hand disinfection in obstetrical clinics. He believed that microbes causing infection were readily transferred from patients to patients, medical staff to patients and vice versa. Thus, he suggested the use of chlorinated lime solution for hand-washing to prevent the infectious disease from spreading. For this

successful yet such simple and cost effective method, he is rightfully considered to be the savior of mothers.
Read more: Semmelweis' Germ Theory - The Introduction of Hand Washing

Another breakthrough was the 1954 publication of the results of a British Doctors Study, led by Richard Doll and Austin Bradford Hill (1879-1991), which lent very strong statistical support to the suspicion that tobacco smoking was linked to lung cancer.

As a result of this study was a general concept of the so-called Bradford Hill criteria:



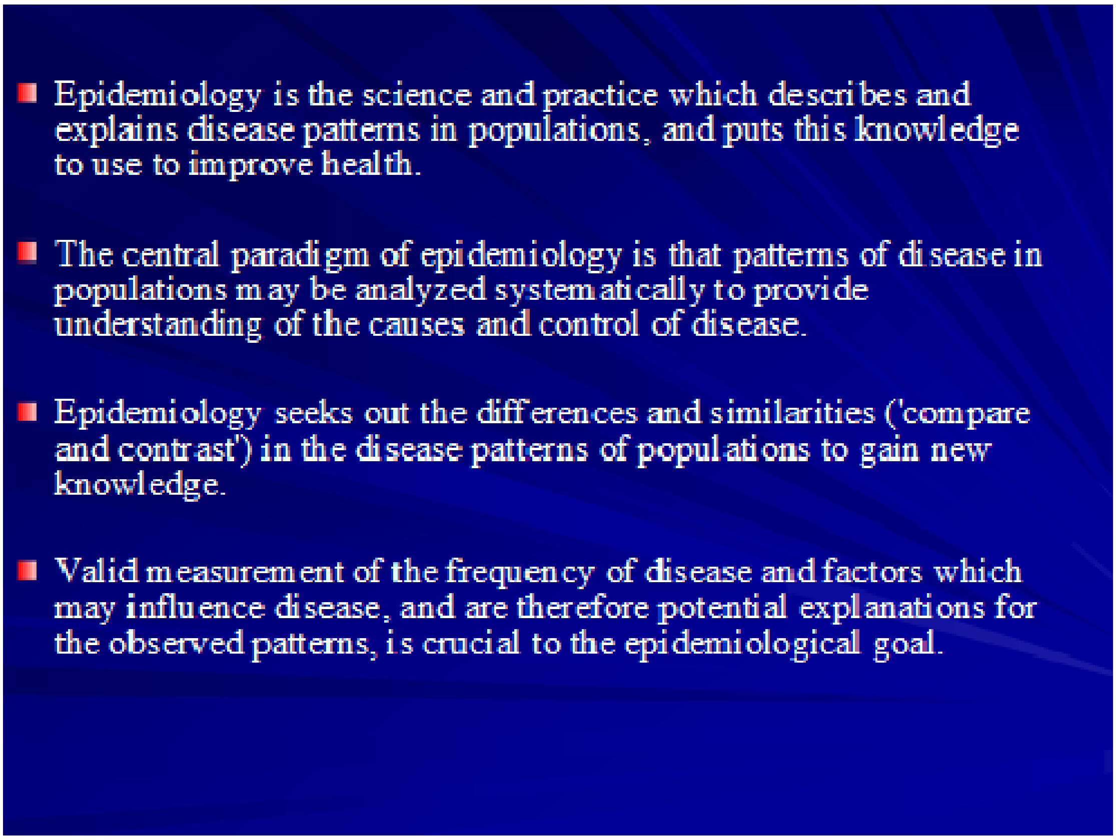
In the 20th century epidemiology has broadened and specialised: there are sub-disciplines like infectious disease and chronic disease epidemiology, health care epidemiology, genetic epidemiology etc.

2.1.2. Definition of epidemiology

In one sentence: epidemiology is the study of how often diseases occur in different groups of people and why. Epidemiological information is used to plan and evaluate strategies to prevent illness and as a guide to the management of patients in whom disease has already developed. Like the clinical findings and pathology, the epidemiology of a disease is an integral part of its basic description. This chapter aims to provide a brief description of the epidemiological approach, its terminology and its theory.

The word epidemiology consists of the Greek words epi = among, demos = people, and logos = doctrine, and thus means the doctrine of what is among or happening to people. Epidemiology may be viewed as based on two fundamental assumptions:

- first, that human disease does not occur at random, and
- second, that human disease has causal and preventive factors that can be identified through systematic investigation of different populations or subgroups of individuals within a population on different places or at different times.



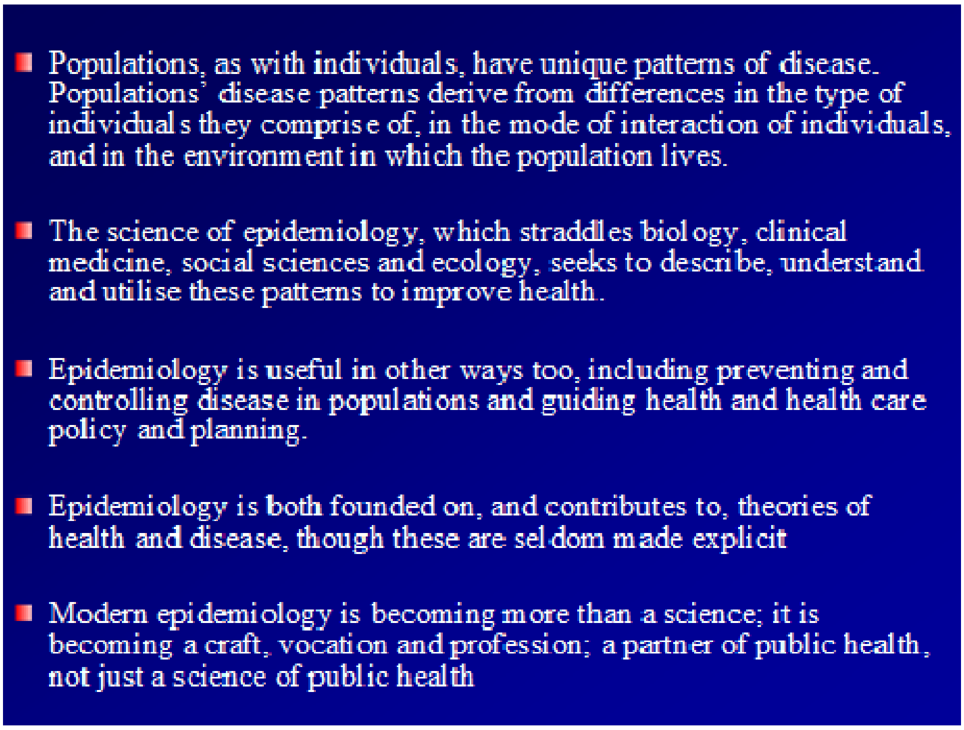
This leads directly to a useful and comprehensive definition of epidemiology. Epidemiology is "the study of the distribution and determinants of disease frequency" in human population (or in the group of population). These three closely interrelated components encompass all epidemiological principles and methods. The measurement of disease frequency involves quantification of the existence or occurrence of disease. The availability of such data is a prerequisite for any systematic investigation of patterns of disease occurrence in human populations. The distribution of the disease considers such questions as who is getting disease within a population, where and when the disease is occurring. Such questions may involve comparisons between

- different populations at a given time,
- subgroups of a population, or
- various periods of observations.

Knowledge of such distributions is essential to describe patterns of disease as well as to formulate hypotheses concerning possible causal or preventive factors. The determinants of disease, which can be derived from the knowledge of frequency and distribution of the disease, are necessary to test the epidemiological hypotheses. Epidemiology is concerned with disease in populations. Populations exist in a physical environment which is a dominant force in determining health. The study of life in relation to the environment is ecology, so epidemiology is, in addition, the science of the ecology of disease. The science of epidemiology, therefore, combines elements of biology, social sciences and ecology - a bio-social-environmental science focusing on disease in populations.

2.1.3. Epidemiology and public health/preventive medicine

Epidemiology is often referred to as the science of public health. The idea of epidemiologic theory is about explaining the people's health, life and death, biology and society, ecology and economy. It is about essential knowledge critical for improving the people's health and minimizing inequitable burdens of disease, disability, and death. Health policies and plans, and clinical care can be enriched by understanding of disease patterns in populations. Outlining an ecosocial theory of disease distribution that situates both population health and epidemiologic theory in societal and ecologic context, it offers a more holistic picture of how we embody the human experience. Viewed as the study of the distribution and societal determinants of the health status of populations, epidemiology is the basic-science foundation of public health.



There is also a close connection between epidemiology and preventive medicine. Prevention programs are rarely implemented for an entire population, therefore, prevention programs may be planned to enable studies of the effect of' the intervention on the disease frequency in the population by comparing disease rates among those receiving the preventive program with rates among those who do not. In this way there is usually an opportunity to evaluate preventive measures that have been undertaken, using experimental epidemiology. Epidemiological research has often provided information that has formed the basis for public health decisions long before the basic mechanism of a particular disease was understood. In recent years the value of information about disease distribution for planning the delivery of health care has become more apparent. In several studies disease occurrence has been related to health-care need, demand, and supply. There is also an increasing interest in studying the effectiveness of the health-care system and/or of different treatments. The common basis for these different applications of epidemiology is the study of disease occurrence and its relation to various characteristics of individuals or their environment. Another task of epidemiology is monitoring or surveillance of time trends to show which diseases are increasing or decreasing in incidence and which are changing in their distribution. This information is needed to identify emerging problems and also to assess the effectiveness of measures to control old problems.

2.1.4. Social epidemiology

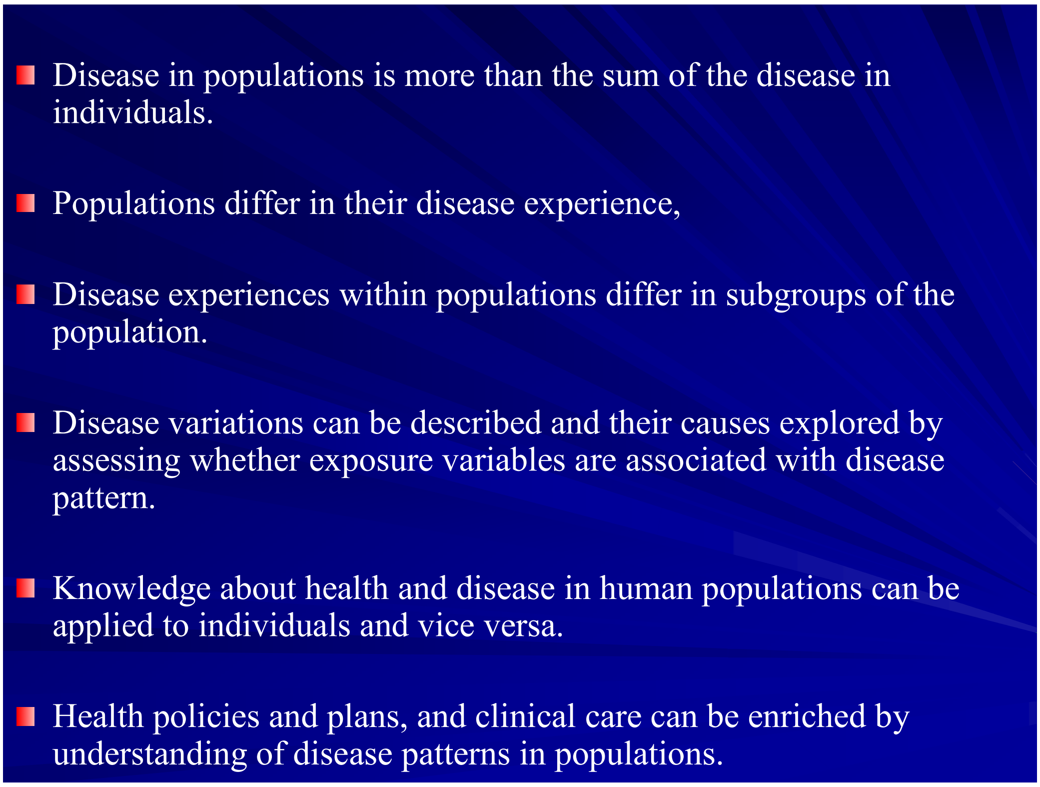
Humans live in societies, where behaviour and attitudes are shaped by interaction among people, which in turn are governed by the conventions and laws. Epidemiology is, therefore not only a bio-science but also a social science.
Social epidemiology is a special branch of epidemiology that focuses particularly on the effects of social-structural factors on states of health. Social epidemiology assumes that the distribution of advantages and disadvantages in a society reflects the distribution of health and disease. It proposes to identify societal characteristics that affect the pattern of disease and health distribution in a society and to understand its mechanisms.
The relationship between social class and health has been a major research field since the beginning of public health history. Many studies have identified the disparities in health among social classes and developed several theories, such as social selection theory and socio-biological translation theory. The central and initial question of social epidemiology to be answered is what effect do social factors have on individual and population health. There are several significant concepts in the field of social epidemiology:

- the bio-psychosocial paradigm,
- the population perspective,
- use of new statistical approaches such as multilevel analysis and significance of theory.

2.1.5. The differences between individual and population based approach

Clinical observations determine decisions about individuals, while epidemiological observations relate primarily to groups of people. This fundamental difference in the purpose of measurements implies different demands on the quality of data. Epidemiological research is based on the systematic collection of observations related to the phenomenon of interest in a defined population. The data from which epidemiology seeks to draw conclusions are nearly always collected by more than one person, often from different regions and countries. Rigorous standardization and quality control of investigative methods are essential. These data then are subjected to quantification, which includes the measurement of random variables, the estimation of population parameters, and the statistical testing of hypotheses.

Epidemiologists study the occurrence of disease or other health-related conditions or events in defined populations. A key feature of epidemiology is the measurement of disease outcomes in relation to a population at risk. The population at risk is the group of people, healthy or sick, who would be counted as cases if they had the disease being studied. Disease in populations is more than the sum of the disease in individuals. Populations differ in their disease experience, disease experiences within populations differ in subgroups of the population, disease variations can be described and their causes explored by assessing whether exposure variables are associated with disease pattern knowledge about health and disease in human populations can be applied to individuals. For example, if a general practitioner were measuring how often patients consult him about high blood pressure the population at risk would comprise those people on his list who might see him about a blood pressure problem if they had one.



Implicit in any epidemiological investigation is the notion of a target population about which conclusions are to be drawn. Occasionally measurements can be made on the full target population. In a study to evaluate the effectiveness of dust control measures in coal mines, information was available on all incident (new) cases of coal workers' pneumoconiosis throughout the country.

Epidemiological conclusions (on risk) cannot be drawn from purely clinical data (on the number of sick people seen). More often observations can only be made on a study sample, which is selected in some way from the target population. Small samples can be unrepresentative just by chance, and the scope for chance errors can be quantified statistically. Systematic sampling errors can be avoided by use of a random selection process in which each member of the target population has a known (non-zero) probability of being included in the study sample. However, this requires an enumeration or census of all members of the target population, which may not be feasible. Often the selection of a study sample is partially random. The definition of a study population begins with some characteristic which all its members have in common. This may be geographical ("all residents in 1985" or "all residents in a specified health district"); occupational ("all employees of a factory", "children attending a certain primary school", "all physicians in a certain country"); based on special care ("patients on a GP's list", "residents in an old people's home") or diagnostic ("all people who first had an epileptic fit"). Within this broad definition appropriate restrictions may be specified - for example in age range or sex.

Topics suggested for students' oral presentations:

1. Present the story of Semmelweis' research in the obstetrical wards of Vienna University from point of view of the modern epidemiology.
2. Show the interrelation of epidemiology and preventive medicine on a specific screening program of your home country.
3. Present a special study (if you know any, e.g. based on ethnic/racial differences) of your home country about the interrelation of health status and socio-economic circumstances.