EPIDEMIOLOGY IN MEDICINE

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Epidemiology is defined as " the science of the distribution and determinants of health related states and events in populations" with the ultimate aim of controlling and preventing health problems (Last,1990)

It includes routine surveillance as well as research strategies for the testing of hypothesis about causes, measurements of health and disease risks and evaluations of preventive, diagnostic, and therapeutic programmes. This requires methodological skills but also biological and social knowledge about disease and their determinants.

There are three basic purposes of epidemiology: to better understand health related phenomena, to supply information for decision making and to evaluate interventions.

Epidemiology usually enables one to make inferences concerning groups of individuals, rather than predictions of individual's causal mechanism. It is a challenging science, created by and with people, among people and it concern with people. We use it to study what is occurring, who is affected, where, when and why disease is occurring, and how we can influence the occurrence.

Historically, epidemiology is closely linked to social science where theories and applications to a large extent have been influence by the social, economical and political developments.

Hippocrates (406-308 B.C), tried to demystify disease occurrence, then viewed as supernatural and of religious origin, by focusing on products of the environment.

...whoever wishes to investigate medicine properly should proceed thus: In the first place oncsider the seasons of the year, then the winds, the hot and the cold, especially such as are common to all countries, and then such as are peculiar to each locality. We must also consider the qualities of the water...

Another early contributor to epidemiology was John Graunt, a London haberdasher who published his landmark analysis of mortality data in 1662. He was the first to quantify patterns of births deaths and disease occurrence, noting male female disparities, high infant mortality, urban rural differences and seasonal variations.

No one built upon Graunt's work until the mid 1800s when William Farr began to systematically collect and analyzed Britain's mortality statistics. Farr, considered the father of modern vital statistics and surveillance, developed many of the basic practices used today in vital statistics and disease classification. He extended the epidemiologic analysis of morbidity and mortality data, looking at the effect of marital status, occupation, and altitude. He also developed many epidemiologic concepts and techniques still in use today.

The basic issue for epidemiology in the nineteenth century can be found in the search for causes of the dominant epidemic diseases, in "miasma" (bad air) versus "contagion" (germ theory) (Terries 1985)

Malaria was thus long thought to be spread in a miasmic way. Miasmic theories were strongly supported in England e.g. by the statistician William Far. He also believed that during a London epidemic of cholera in the 1840's due to Miasma and mortality was inversely related to altitude. John Snow later proved cholera is spread by germ and not by bad air.

In the summer of 1831, when Snow was eighteen and in his fourth year as an apprentice, an epidemic of cholera struck London. Snow continued to treat cholera

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patients until February of 1832, when the epidemic ended as suddenly and mysteriously as it had begun. By that time, it had left fifty thousand people dead in Great Britain.

During the next sixteen years, Snow earned an M.D. degree, moved to London, became a practicing physician, and distinguished himself by making the first scientific studies of the effects of anaesthetics.

In September of 1848, when Snow was thirty-five, a new outbreak of cholera struck London. He decided to track the progress of the disease. to see if he could determine exactly how it was spread. In August of 1849, during the second year of the epidemic, Snow felt obliged to share what he considered convincing evidence that cholera was being spread through contaminated water.

At his own expense he published a pamphlet entitled On the Mode of Communication of Cholera. To avoid antagonizing the majority of physicians who rejected the theory that germs can cause disease, Snow did not directly state his view that a living organism caused cholera. Instead, he wrote of a "poison" that had the ability to "multiply itself by a kind of growth" within the membranes lining the digestive tracts of cholera victims, before being spread to new victims via polluted food or water.

Snow's pamphlet had little effect on the thinking of his colleagues. It was just one of many tracts being published either as pamphlets or as articles in medical journals.

A review in the London Medical Journal in September of 1849 complimented Snow for "endeavouring to solve the mystery of the communication of cholera," but the reviewer added that "other causes, irrespective of the water, may have been in operation" and that Dr. Snow could "furnish no proof whatever of the correctness of his views."

The following summer, cholera broke out in London in the district where Snow was working. He suspected that it was being spread by contaminated water piped in from the Thames River. He searched through municipal records and discovered that two private companies were supplying water to the district.

One firm, the Southwark and Vauxhall Water Company, was drawing water from an area along the Thames that was known to be polluted by sewage, whereas the other company, the Lambeth Water Company, had recently moved its intake facilities to a location above the sewer outlets. Snow decided to compare the mortality rates of consumers of the two sources of water.

Snow began by looking at two sub districts of south London, Lambeth and Kennington, and learned that in the four-week period between July 8 and August 5, 286 of the 334 victims had used Southwark and Vauxhall water whereas just 14 of the victims had used Lambeth water. Snow took large statistical samples from other districts and discovered that deaths related to the two companies stood at a ratio of 71:5.

Excited by his results, Snow believed that he had obtained "very strong evidence of the powerful influence which the drinking water containing the sewage of a town exerts on the spread of cholera when that disease is present". His critics were not impressed by the results of the survey. They continued to believe that cholera was caused by miasmas, not by germs or a waterborne poison, and they asserted that the enormous quantity of water in the Thames would sufficiently dilute any poison to render it harmless.

In late August of 1853, cholera broke out suddenly and devastatingly in a neighbourhood just a five-minute walk from Snow's home in the west London district of Soho. Snow immediately turned his attention to the outbreak.

The following day Snow went to the General Register Office, where he copied records of the eighty-three cholera deaths that had occurred in the neighbourhood.. He obtained the name and address of each victim. He then returned to Broad Street, walked through the neighbourhood, and calculated the distance from each victim's house to the nearest pump. He discovered that seventy-three of the eighty-three deaths had occurred in homes closer to the Broad Street pump than to any other pump.

After visiting the homes of the ten victims who had lived nearer to another pump, he was told that eight of those ten victims had drunk from the Broad Street pump-some preferred that water and others, who were children, had drunk from the pump on their way to school. Of the seventy-three victims who lived close to the pump, Snow learned that sixty-one of them had drunk the water. He calculated that the number of cholera deaths that could be expected in that neighbourhood, as part of the general outbreak in London, was just fourteen. Therefore, he concluded that the higher than expected number of victims must be associated with the water from the Broad Street pump.

Finally he convinced the officials to remove the Pump handle which resulted in almost end to the epidemic.

John Snow is considered as Father of Epidemiology. Even today principles of disease outbreaks investigations are not very much different from Snow's approach.

Italian scientist and microscopist Filippo Pacini (1812-1883) discovered cholera organism in 1854 but fail to publish. Robert Koch rediscovered the organism in 1883 and widely published his findings. Vibreo cholera was then accepted as a causative organism for deadly disease cholera.

While Koch's finding eventually explain the aetiology of the disease, they were not essential for Londoners to control measures. Such actions came years earlier from the scientific study of John Snow.

A second revolution in epidemiology took place again in England where patterns of chronic disease was investigated. During the first decades of the twentieth century, when there was a transition in the Western world from infectious to chronic diseases and a shift from an agricultural to an industrial society, a socio-ecological model of 'one disease - many causes' emerged. The industrial society then had to tackle 'many disease-many causes' described by a holistic model including life style, environment, and biology as well as the health care system.

Doll and Hills study on smoking and lung cancer was an important epidemiological study in the preventive medicine. First paper published in 1950 was a case control study comparing Lung cancer patients with matched controls

Austin Bradford Hill (July 8, 1897 - April 18, 1991), English epidemiologist and statistician, pioneered the randomized clinical trial and, together with Richard Doll, was the first to demonstrate the connection between cigarette smoking and lung cancer.He served as a pilot in the First World War but was invalided out when he contracted tuberculosis. In 1922 he went to work for the Industry Fatigue Research Board. He was associated with the medical statistician Major Greenwood and, to improve his statistical knowledge, Hill attended lectures by Karl Pearson. When Greenwood accepted a chair at the newly formed London School of Hygiene and Tropical Medicine. Hill moved with him, becoming Reader in Epidemiology and Vital Statistics in 1933 and Professor of Medical Statistics in 1947.

Professor Sir William Richard Shaboe Doll, (28 October 1912–24 July 2005) was a British epidemiologist, physiologist, He also did pioneering work on the relationship between radiation and leukemia as well as that between asbestos and [[lung cancer], and alcohol and breast cancer].

Following case control study they did a prospective cohort study following 30000 British doctors for several years to see the mortality pattern among smokers and non smokers.

The association between : Smoking & Lung cancer; Smoking & Heart disease; Asbestos & Lung cancer; Radiation & Leukaemia were some of results of Doll and Hill's work.

With a mounting epidemic of cardiovascular disease beginning in the 1930s, the United States Public Health Service decided to undertake a large- scale study to investigate why heart disease had become the nation's number one killer by the late 1940s. In 1948, the Framingham Heart Study – under the direction of the National Heart Institute embarked on an ambitious project in health research.

The researchers recruited 5,209 men and women between the ages of 30 and 62 from the town of Framingham, Massachusetts, and began the first round of extensive physical examinations and lifestyle interviews that they would later analyze for common patterns related to CVD development. Since 1948, the subjects have continued to return to the study every two years for a detailed medical history, physical examination, and laboratory tests, and in 1971, the study enrolled a second-generation group – 5,124 of the original participants' adult children and their spouses – to participate in similar examinations. In April 2002 the Study entered a new phase: the enrollment of a third generation of participants, the grandchildren of the original cohort. This step is of vital importance to increase our understanding of heart disease and stroke and how these conditions affect families. With the help of another generation of participants, the Study may close in on the root causes of cardiovascular disease and help in the development of new and better ways to prevent, diagnose and treat cardiovascular disease. The first phase of the Third Generation Study was completed in July 2005 and involved approximately 4,095 participants.

Fifty years of data collected from residents of Framingham have produced over 1,000 scientific papers, identified major risk factors associated with heart disease, stroke and other diseases, paved the way for researchers to undertake singular clinical trials based on Framingham findings, created a revolution in preventive medicine, and forever changed the way the medical community and general public view the genesis of disease.

Before Framingham, most physicians believed that atherosclerosis was an inevitable part of the aging process and were taught that blood pressure was supposed to increase with age enabling the heart to pump blood through an elderly person's narrowed arteries. Before Framingham, the notion that scientists could identify and individuals could modify "risk factors" (a term coined by the study) tied to heart disease, stroke and other diseases was not part of standard medical practice. The majority of physicians did not understand the relationship, for example, between high levels of serum cholesterol and heart attacks. Many did not believe that modifying certain behaviors could enable their patients to avoid or reverse the underlying causes of serious heart and vascular conditions.

There are several epidemiological studies from the time of John Graunt up to now have contributed to the modern medicine. Like other research disciplines, epidemiology is not a value free undertaking. Concepts and values are cornerstones of theory formation and the realities are always more complex than the theories

Future Challenges

It is less probable that future health risks will be as statistically detectable as smoking and asbestos, which have demanded many corroborations before the research community reached consensus. To detect much weaker associations in future, more sensitive instruments will be needed. Here molecular epidemiology represents a potential bridge between epidemiological observational studies and experimental research. Genetic explanatory models are also gaining support in many research fields, including epidemiology. When epidemiology has difficulties establishing cause and effect relationships, it is becoming increasingly common to use qualitative methods to understand quantitative associations.

People may not realize that they use epidemiologic information in their daily decisions. When they decided to stop smoking, use a bicycle instead of motorcycle, add less sugar in their cup of tea, choose one method of contraception instead of another, they may be influenced consciously or unconsciously, by epidemiologist's assessment of risk.