Epidemiology overview

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Figure 2. Relationships and Dependencies among the Eight Keys of Comprehensive Health Protection to Comprehensive Effective and Efficient Global Public Health Surveillance.
Public Health Approach

- Surveillance: What is the problem?
- Risk Factor Identification: What is the cause?
- Intervention Evaluation: What works?
- Implementation: How do you do it?
Classically speaking

• Epi = upon
• Demos = people
• Ology = science
• Epidemiology = the science which deals with what falls upon people.....
• Bridge between biomedical, social and behavioral sciences
Simple Old Definitions

Oxford English Dictionary
THE BRANCH OF MEDICAL SCIENCE WHICH TREATS EPIDEMICS

Kuller LH: American J of Epidemiology 1991;134:1051
EPIDEMIOLOGY IS THE STUDY OF "EPIDEMICS" AND THEIR PREVENTION

Anderson G. In: Rothman KJ: Modern Epidemiology
THE STUDY OF THE OCCURRENCE OF ILLNESS

A Modern Definition

Study of the occurrence and distribution of health-related diseases or events in specified populations, including the study of the determinants influencing such states, and the application of this knowledge to control the health problem

(Porta M, Last J, Greenland S. A Dictionary of Epidemiology, 2008)
Epidemiological question

- Why some individuals have diseases while others not?

Basic assumptions in epidemiology

- Diseases are not randomly distributed in population
- Every individual has certain characteristics which increase or reduce the risk of getting diseases
Purpose of epidemiology

• Identify causes and risk factors of diseases
• Identify burden of diseases in given population
• Study the natural history of diseases and its’ prognosis
• Evaluate program intervention
• Provide evidence for public health policies

Classical versus Modern Applications

• Classical: descriptive, observational, field, analytical, experimental, applied, healthcare, primary care, hospital, CD, NCD, environmental, occupational, psycho-social, etc
• Modern: risk-factor, molecular, genetic, life-course, CVD, nutritional, cancer, disaster, etc
Broad Types of Epidemiology

**DESCRIPTIVE EPI**

Examining the distribution of a disease in a population, and observing the basic features of its distribution in terms of time, place, and person. We try to formulate hypothesis, look into associations?

Typical study design:
- community health survey
  (synonyms: cross-sectional study, descriptive study)

**ANALYTIC EPI**

Testing a specific hypothesis about the relationship of a disease to a specific cause, by conducting an epidemiologic study that relates the exposure of interest to the outcome of interest (? Cause-effect relationship)

Typical study designs: cohort, case-control, experimental design

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**Descriptive Epidemiology Is A Necessary Antecedent of Analytic Epidemiology**

To undertake an analytic epidemiologic study you must first:
- Know where to look
- Know what to control for
- Be able to formulate / test hypotheses compatible with a-priori lab / field evidence
Basic Triad of Descriptive Epidemiology

THE THREE ESSENTIAL CHARACTERISTICS OF DISEASE WE LOOK FOR IN DESCRIPTIVE EPIDEMIOLOGY ARE:

• PERSON
• PLACE
• TIME

Personal Characteristics (whom)

• Age
• Gender
• Socio-economic status (education, occupation, income)
• Marital status
• Ethnicity/race/genetic profile
• Behavior / habits
Place (where ?)

- Geographically restricted or widespread (outbreak, epidemic, pandemic)? Off-shore (tsunami...)
- Climate effects (temperature, humidity, combined effects...)
- Urban / sub-urban-squatter / rural
- Relation to environmental exposure (water, food supply, etc)
- Multiple clusters or one?

Time (when ?)

- Changing or stable?
- Clustered (epidemic) or evenly distributed (endemic)?
- Time-trends: Point source, propagated, seasonal, secular, combinations
History of epidemiology

Hippocrates (500 BC)

- Hippocrates (460 BC-380 BC) was the founder of Western medicine. He manifested an amazingly modern perspective in his treatise entitled On Airs, Waters, and Places that was published in the fifth century.
- Father of medicine
- First epidemiologist—sought a logic in sickness
- First known person to examine the relationship between disease and environment
- Believed sickness was caused by an unbalance in water, fire, air, and earth atoms
- Coined term ‘epidemic’
John Graunt (1620-1674)

- The period saw an increased understanding of the need to collect qualitative data for the purpose of defining the state (Political Arithmetic).
- The first solid use of data collection for the purpose of understanding health status
- The father of demography and descriptive epidemiology
- By studying London death data for the previous 75 years, Graunt found certain predictability of mortality with respect to natural events and phenomenon.
- Using this data, Graunt developed the first life table.
- Descriptive epidemiology—the first stage of epidemiologic investigation. It focuses on describing disease distribution by characteristics relating to time, place, and person.

Thomas Sydenham (1624-1689)

- The first to recognize the difference in the plagues that affected London in the 1600s
- Believed that observations should drive the study of diseases
- In the middle of the 1600s, Thomas Sydenham began his exacting studies of epidemics
- * "Observations Medicae*: a standard textbook for two centuries on 1676
- * "Presented the theory of an epidemic constitution, *Vg. Conditions in the environment which cause the occurrence of acute diseases* (1685)
- * "He noted the link between fleas and typhus fever
- * "Introduced opium into medical practice and was the first to use iron-deficiency anemia
- * "Treatment fever with fresh air and cooling drink was an improvement on the sweating methods previously employed
- * "Moderate treatment of smallpox by using cinchona
Edward Jenner (1749-1823)

- Jenner theorized that cowpox (a much milder but similar disease to smallpox) was somehow protecting the farmers in his small community.
- Developed a vaccination to small pox by using a small portion of extracted liquid from small pox sores.
- The remarkable thing about Jenner's discovery of vaccination, is that it came before people knew that viruses existed, or much about the immune system.
- He used his observation of case studies to fit the puzzle pieces together and start a truly lifesaving procedure (epidemiology).

Lemuel Shattuck (1793-1859)

- "Prophet of American Health"
- First to publish report on sanitation problems and public health in the United States.
- Report led to public health programs and local boards of health in the United States.
- Exchange of health recommendations, sanitary inspections, and analysis of vital statistics.
- Outlined basic system of public health
- Began awareness for sickness in America.
Edwin Chadwick (1800-1890)

- This report outlined the major public health challenges facing England at the time leading to the beginnings of reform.
- Efforts produced a salutary improvement in the public health.
- The formation of the Health of Towns Association and the creation of various city-based branches followed rapidly.
- These national and local movements contributed to the passing of the Public Health Act 1848.

John Snow (1813-1888)

- "father of epidemiology"
- He came to the unconventional conclusion that they might be caused by invisibly tiny parasites.
- The "germ theory" of disease had first been proposed in ancient times, and the discovery of microscopic organisms in the late 1600s had made the theory seem plausible, but no one had ever proved that miniature organisms could make people sick.
- Decided to track the progress of the disease to see if he could determine exactly how it was spread.
- When cholera epidemic hit London, Snow observed patients and symptoms - the discovery that cholera was spreading through water.
- Identified water pumps and used chlorine to clean water and eventually helped end the epidemic.
- Major event in history of public health - the founding event of the science of epidemiology.
John Snow Cholera study

Figure 1.2. Snow’s map of the 1854 London cholera epidemic. Lines (——) and show deaths and bullets (●) show the location of water pumps. The map reveals a strong association between cholera mortality and the pump on Broad Street. (Source: Snow, 1855.)

Louis Pasteur (1822-1895)

- French microbiologist who conducted experiments that supported the germ theory and effectively debunked the theory of spontaneous generation.
- His work involved the development of systems of inoculation including the first vaccine for rabies.
- He is best known, however, for his work in studies on fermenting beverages.
- He found that micro-organisms could develop during this process.
- He invented a process in which liquids such as milk were heated to kill all bacteria and moulds (Pasteurization)
Modern Epidemiological study

DOLL & HILL (1950): Used a case-control design to describe and test the association between smoking and lung cancer.

FRANCES at al. (1950): Huge formal field trial of the Poliomyelitis vaccine in school children.

DAWBER et al. (1955): Used the cohort design to study risk factors for cardiovascular disease in the Framingham Heart Study.
Topics in epidemiology course

• Measuring diseases burden
• Association and causality
• Epidemiological study designs
• Bias and confounding
• Validity
• Epidemiology and disease control

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