INTRODUCTION TO EPIDEMIOLOGY

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DEFINITION

- Epidemiology:
  - Epi = upon
  - Demos = people
  - Logy = study of

- Epidemiology is a discipline that describes, quantifies, and postulates causal mechanisms for health phenomena in populations.

- Epidemiology is concerned with the distribution and determinants of health and diseases, morbidity, injuries, disability and mortality in populations.

EPIDEMIOLOGY IS THE STUDY OF THE NATURE, CAUSE, CONTROL AND DETERMINANTS OF THE FREQUENCY AND DISTRIBUTION OF DISEASE, DISABILITY, AND DEATH IN HUMAN POPULATIONS.

EPIDEMIOLOGY: THE STUDY OF FACTORS INFLUENCING THE OCCURENCE, TRANSMISSION, DISTRIBUTION, PREVENTION AND CONTROL OF DISEASE IN A DEFINED POPULATION

AN EPIDEMIOLOGIST IS A PUBLIC HEALTH SCIENTIST, WHO IS RESPONSIBLE FOR CARRYING OUT ALL USEFUL AND EFFECTIVE ACTIVITIES NEEDED FOR SUCCESSFUL EPIDEMIOLOGY PRACTICE

AIMS OF EPIDEMIOLOGY

As the basic method of public health, epidemiology is concerned with efforts to:

1. Describe the health status of the population
2. Explain the etiology of disease
3. Predict the occurrence of disease
4. Control the distribution of disease

BASIC CONCEPTS OF EPIDEMIOLOGY

- Human diseases do not occur by chance
- Factors that cause or contribute to diseases and injuries can be identified by means of systematic investigation

GOALS OF EPIDEMIOLOGY

- Improve the understanding of the natural history of disease and the factors that influence its distribution

- Intervention

TABLE 1.1 Seven uses of epidemiology

1. **To study the history of disease**
   - Epidemiology studies the trends of a disease for the prediction of trends.
   - The results of epidemiological studies are useful in planning for health services and public health.
2. **Community diagnosis**
   - What are the diseases, conditions, injuries, disorders, disabilities, defects causing illness, health problems, or death in a community or region?
3. **Look at risks of individuals as they affect groups or populations**
   - What are the risk factors, problems, behaviors that affect groups?
   - Groups are studied by doing risk factor assessments and health appraisal approaches, e.g., health risk, appraisal, health screening, medical exams, disease assessments, etc
4. **Assessment, evaluation, and research**
   - How well do public health and health services meet the problems and needs of the population or group?
   - Effectiveness; efficiency; quality; quantity; access; availability of services to treat, control, or prevent disease; injury; disability; or death are studied.
5. **Completing the clinical picture**
   - Identification and diagnostic processes to establish that a condition exists or that a person has a specific disease.
   - Cause-effect relationships are determined, e.g., strep throat can cause rheumatic fever.
6. **Identification of syndromes**
   - Help to establish and set criteria to define syndromes, some examples are: Down, fetal alcohol, sudden death in infants, etc.
7. **Determine the causes and sources of disease**
   - Epidemiological findings allow for control, prevention, and elimination of the causes of disease, conditions, injury, disability, or death.

TABLE 1.2 Some broad aims and goals of epidemiology

Some aims of epidemiology are to

- determine the primary agent or ascertain causative factors;
- understand the causation of disease, disorders, or conditions;
- determine the characteristics of the agent or causative factors;
- define the mode of transmission;
- define and determine contributing factors;
- identify and explain geographic disease patterns;
- determine, describe, and report the natural course of disease, disability, injury, and death;
- determine control methods;
- determine preventive measures;
- aid in the planning and development of health services;
- provide administrative and planning data.

METHODS OF EPIDEMIOLOGY

- Public Health Surveillance
- Disease Investigation
- Analytic Studies
- Program Evaluation

TERMINOLOGY

- Endemic
- Hyperendemic
- Holoendemic
- Epidemic
- Pandemic
- Epizootic
- Incidence
- Prevalence

TERMINOLOGY IN EPIDEMIOLOGY

- Endemic: a disease or pathogen present or usually prevalent in a given population or geographic region at all times
- Hyperendemic: equally endemic in all age groups of a population
- Holoendemic: endemic in most of the children in a population, with the adults in the same population being less often affected
- Epidemic: a disease occuring suddenly in numbers far exceeding those attributable to endemic disease; occuring suddenly in numbers clearly in access of normal expectancy, it is also an excessive occurrence of a disease.

TERMINOLOGY IN EPIDEMIOLOGY

- Pandemic: a widespread epidemic distributed or occuring widely throughout a region, country, continent, or globally
- Epizootic: of, or related to a rapidly spreading and widely diffused disease affecting large numbers of animals in a given region
- Incidence: rate of occurrence of an event; number of new cases of disease occuring over a specified period of time; may be expressed per a known population size
- Prevalence: number of cases of disease occurring within a population at any one given point in time

DESCRIPTIVE VARIABLES FOR THE HEALTH OF THE COMMUNITY

Demographic & Social Variables

- Age and Sex
- Socioeconomic Status
- Family structure
- Racial, ethnic and religious composition

Variables related to community infrastructure

- Availability of social and health services
- Quality of housing stock
- Social stability

Health Related Variables

- Homicide and suicide rates
- Infant Mortality Rate
- Mortality from Specific Condition
- Magnitude of chronic and infectious diseases
- Alcoholism and drug abuse rates
- Teenage pregnancy rates
- Birth Rate

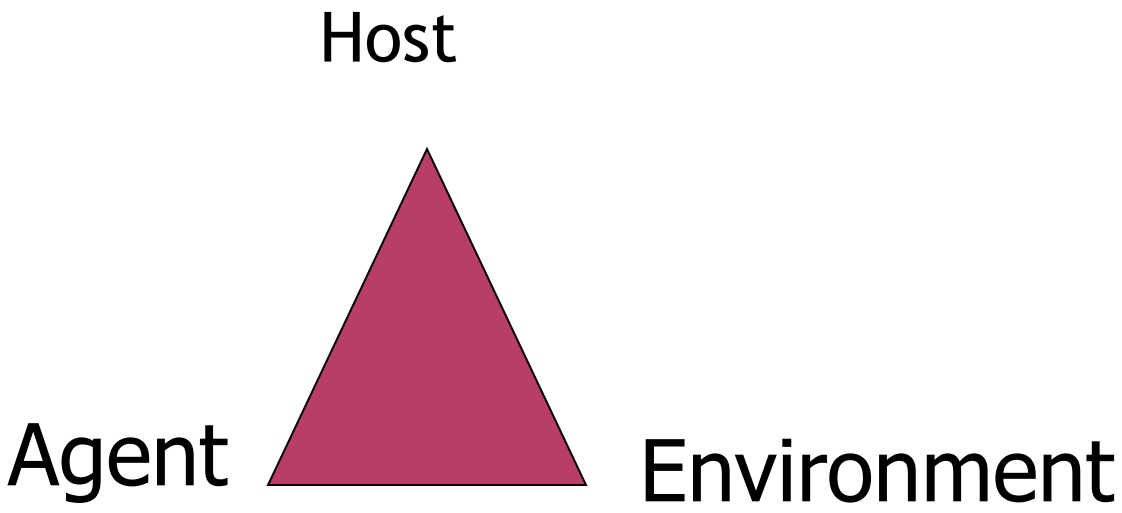
POPULATION DYNAMICS AND EPIDEMIOLOGY

- Three factors affect the size of populations:
  - Birth
  - Death
  - Migration

1. When is the population in equilibrium?,
2. What is a fixed population ?
3. What is a dynamic population ?
4. When a population is in steady state?

Epidemiologic Triad: Traditional Model of Infectious Disease Causation

The epidemiologic triangle recognized three factors in the pathogenesis of disease:



THE AGENT

- Agent: must be present for an infection to occur: Microbial agents

- Characteristics of Infectious disease agents:

1. Infectivity
2. Pathogenicity
3. Virulance
4. Toxigenicity
5. Resistance
6. Antigenicity

AGENT → HOST

- After exposure: from sub-clinical infection (inapparent) to active case of the disease.
- End Result: Recovery, disability, disfigurement, death.
- Ability to fight infections, comprises 2 broad categories:

1. Non-specific defense mechanisms
2. Disease specific defense mechanisms

THE ENVIRONMENT

- Domain in which the disease-causing agent may exist, survive or originate.
- Acts as a reservoir or niche that fosters the survival of infectious disease agents. The reservoir may be a part of the physical environment or may reside in animals or insects (vectors) or other human beings (human reservoir – host)
- External Environment: physical, biologic, social, economic components

MEANS OF TRANSMISSION – DIRECTLY OR INDIRECTLY FROM RESERVOIR

Direct Transmission: Spread of infection through person to person contact

- **Portals of exit**: sites where infectious agents may leave the body (respiratory passages, the alimentary canal, the openings in the genitourinary system, and skin lesions. Also through insect bites, the drawing of blood, surgical procedures and accidents)

- **Portal of entry**: respiratory system (influenza, cold), the mouth & digestive system (hepatits A), mucous membranes or wounds in the skin.

Indirect Transmission:

through an intermediary source

- Vehicle: contaminated H2O, infected blood on used hypodermic needles.
- Fomites: inanimated objects: doorknob or clothing.
- Vectors: animate, living insect or animal that is involved with transmission of the disease agent.

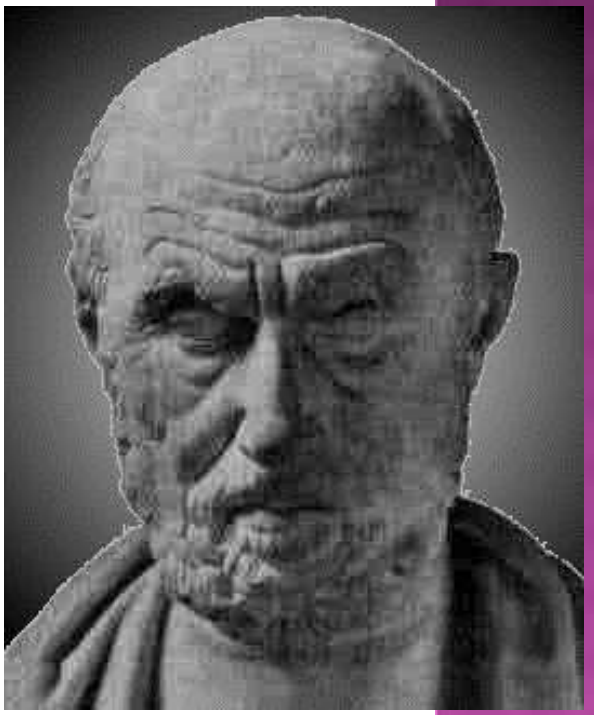
HISTORICAL ANTECEDENTS

- Hippocrates: Environment – disease causation
- Graunt: Vital statistics in the mid 1600
- Snow: Natural experiments to track cholera outbreak in London
- Koch: Human disease - micro-organism / a disease

Hippocrates (460-377 B.C.)

Airs, Waters, and Places

- ✓ Idea that disease might be associated with physical environment



Thomas Sydenham (1624-1689)

- ✓ Recognized as a founder of clinical medicine and epidemiology
- ✓ Emphasized detailed observations of patients & accurate recordkeeping

James Lind (1700's)

- ✓ Designed first experiments to use a concurrently treated control group

Edward Jenner

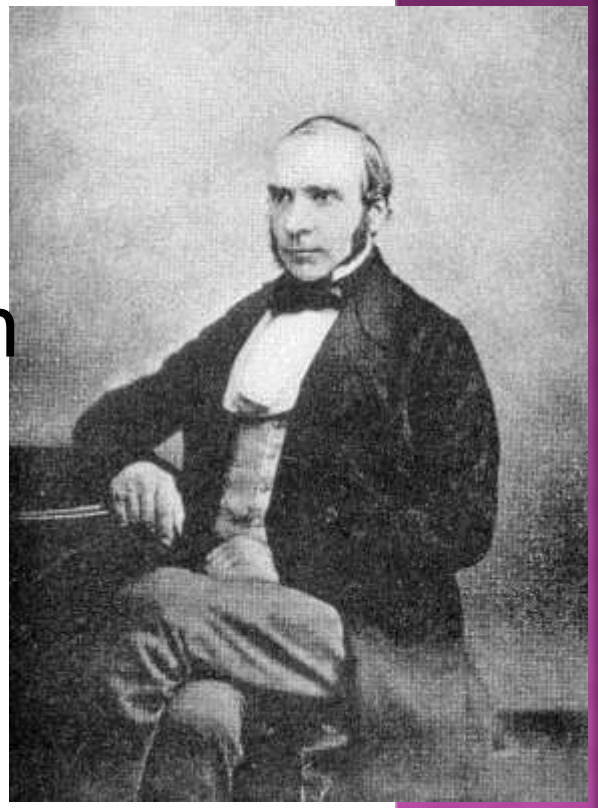
- ✓ Pioneered clinical trials for vaccination to control spread of smallpox
- ✓ Jenner's work influenced many others, including Louis Pasteur who developed vaccines against rabies and other infectious diseases

Ignas Semmelweis (1840's)

- ✓ Pioneered handwashing to help prevent the spread of septic infections in mothers following birth

John Snow (1813-1858)

- ✓ Father of epidemiology
- ✓ Careful mapping of cholera cases in East London during cholera epidemic of 1854
- ✓ Traced source to a single well on Broad Street that had been contaminated by sewage



Typhoid Mary & George Soper

- **Mary Mallon, a cook responsible for most famous outbreaks of carrier-borne disease in medical history**
- ✓ **Recognized as carrier during 1904 N.Y. typhoid fever epidemic**
- ✓ **When source of disease was traced, Mary had disappeared only to resurface in 1907 when more cases occurred**
- ✓ **Again Mary fled, but authorities led by George Soper, caught her and had her quarantined on an island**
- ✓ **In 1910 the health department released her on condition that she never accept employment involving the handling of food**
- ✓ **Four years later, Soper began looking for Mary again when two new epidemics broke out; Mary had worked as a cook at both places**
- ✓ **She was found and returned to North Brother Island, where she remained**
- ✓ **the rest of her life until a paralytic stroke in 1932 led to her slow death, six years later**

Typhoid Mary