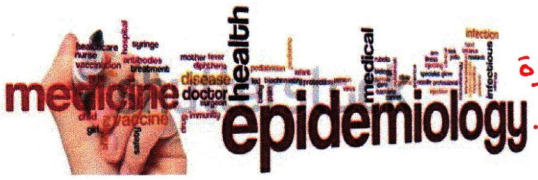
Foundation of Epidemiology



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Definition of Epidemiology

What is epidemiology?

- Epidemiology is the study of how disease is distributed in populations and the factors that influence or determine this distribution.
  - why does a disease develop in some people and not in others?
  - The premise underlying epidemiology is that disease, illness, and 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.

Definition of Epidemiology

- Another definition of epidemiology is "the study of the distribution and determinants of health-related states or events in specified populations and the application of this study to control of health problems."
  - This is broader definition of epidemiology because it includes both a description of the content of the discipline and the purpose or application for which epidemiologic investigations are carried out.

Term	Explanation
Study	includes: surveillance, observation, hypothesis testing, analytic research and experiments.
Distribution	refers to analysis of: times, persons, places and classes of people affected.
Determinants	include factors that influence health: biological, chemical, physical, social, cultural, economic, genetic and behavioural.
Health-related states and events	refer to: diseases, causes of death, behaviours such as use of tobacco, positive health states, reactions to preventive regimes and provision and use of health services.
Specified populations	include those with identifiable characteristics, such as occupational groups.
Application to prevention and control	the aims of public health—to promote, protect, and restore health.

Epidemiology has expanded into other fields such as pharmaco epidemiology, Molecular epidemiology, and genetic epidemiology.

Molecular epidemiology measures exposure to specific substances and early biological response, by:

- Evaluating host characteristics mediating response to external agents, and
- Using biochemical markers of a specific effect to refine disease categories.

Genetic epidemiology deals with the etiology, distribution, and control of disease in groups of relatives, and with inherited causes of disease in populations.

Genetic epidemiological research in family or population studies aims to establish:

- A genetic component to the disorder,
- Relative size of that genetic effect in relation to other sources of variation in disease risk
- Responsible gene(s)

Epidemiologist

مسؤول عن القيام بالنشاطات الفعالة والمفيدة لإنجاح ممارسة الوبائيات

- Are Public health scientist, who is responsible for carrying out all useful and effective activities needed for successful epidemiology practice.
- Epidemiologist normally does not deal with individual patients but an entire population
- Epidemiologist also deals with applying the knowledge gained through the study of disease

The Objectives of Epidemiology

1) To identify the etiology or cause of a disease and the relevant risk factors.
   - Risk factors are factors that increase a person's risk for a disease.
   - It is two type:
     - Modifiable risk factor such as obesity, diet, and other lifestyle factors;
     - and non-modifiable risk factors such are age, gender, and race.

Why do we need to know the etiology and risk factors for a disease?

لتقليل الأمراض والوفيات

The Objectives of Epidemiology

The aims of objective 1 are:

A. To intervene to reduce morbidity and mortality from the disease. للتدخل
B. To develop a rational basis for prevention program. لتطوير برنامج وقائية
C. To develop appropriate vaccines and treatments which can prevent the transmission of the disease to others. لتطوير لقاح أو علاج

The Objectives of Epidemiology

معرفة مدى تفشي المرض

2) To determine the extent of a disease in the community.

- What is the burden of a disease in the community?

The aim of objective 2 is:

- to plan for health services and facilities and to train future health care providers.

خطة لتدريب الـ HCP في المستقبل

The Objectives of Epidemiology

3) To study the natural history and prognosis of disease.

- Certain diseases are more severe than others.
- Not all diseases have the same duration of survival.

دراسة تاريخ المرض و التنبؤ بالمرض

The Objectives of Epidemiology

4) To evaluate both existing and newly developed preventive and therapeutic measures and modes of health care delivery.

- For example: does screening women for breast cancer using the mammography improve survival in people found to have breast cancer?

هل مسح حالات سرطان الثدي حسّنت من معدل انقاذ وزيادة فترة حياة) مرضى سرطان الثدي.

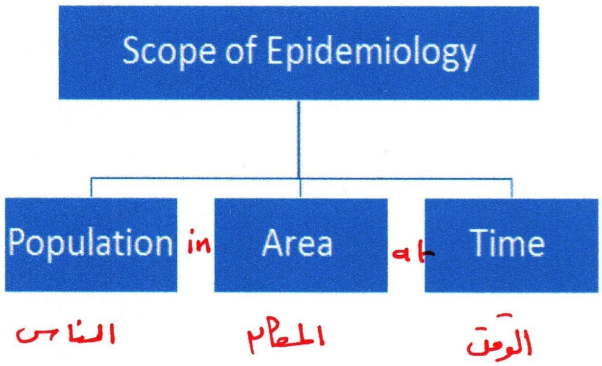
The Objectives of Epidemiology

أساس لتطوير سياسة الصحة العامة

5) To provide the foundation for developing public policy relating to environmental problems, genetic issues, and other considerations regarding disease prevention and health promotion.

- **For example:** is the electromagnetic radiation that is emitted from microwaves a hazard to human health?

هل الأشعة EMR خطر على صحة الإنسان ؟



Scope of epidemiology

- A focus of an epidemiological study is the population defined in specific geographical area at specific time.
- For example, a specific group of patients, or factory workers could be the unit of study.
- A common population used in epidemiology is one selected from a **specific area** or country at a **specific time**.

Scope of epidemiology

Epidemiology describes a disease according to these three characteristics:

1. **Population:** Age, gender, socioeconomic status, ethnicity, race, education level,…etc.
2. **Place:** Geographically restricted or widespread , relation to water or food supply.
3. **Time:** is it changing or stable? seasonal variation?

Changing Patterns of Community Health Problems

زمان

- In the developed countries, 1900, the leading causes of death were pneumonia and influenza, followed by TB and diarrhea.

الآن

- Today, the leading causes of death in the same countries are heart disease, cancer, chronic lower respiratory disease, and stroke.

What change has occurred?

Changing Patterns of Community Health Problems

- In 1900, the leading causes of death in the developed countries were all **infectious diseases.**
- However, now we are dealing with **chronic diseases** that in most situations don't seem to be communicable or infectious in origin. Rather, they are more related to **OUR lifestyle.**
- Consequently, the kind of research, investigations, and services we need today differ from those that were needed in 1900.

Changing Patterns of Community Health Problems

- Nevertheless, the pattern of disease occurrence in developing and poor countries today is often similar to that which was seen in the developed countries in 1900.

سبب الوفيات في الدول الفقيرة اليوم
=
1900 في المتطورة " " "

The Leading Causes of Death in KSA

The top 10 diseases causing mortality in Saudi Arabia are (CDC, 2018):

1. Ischemic heart disease
2. Road injuries
3. Stroke
4. Chronic kidney disease
5. Lower respiratory infections
6. Alzheimer's disease
7. Conflict and terror
8. Cirrhosis
9. Neonatal disorders
10. Diabetes

The Leading Causes of Death in KSA

- **See attached paper**

Epidemiology and Prevention

Primary, Secondary, and Tertiary Prevention

A. Primary Prevention: is the action taken to prevent the development of the disease in a person who is well and does not yet have the disease.

Aim of primary prevention: is to prevent the disease occurrence.

- **Example:** Smoking, Immunization and Regular exercise.
- Target: Total population, selected groups and individuals at high risk; achieved through public health programmes

Epidemiology and Prevention

Primary, Secondary, and Tertiary Prevention

B. Secondary Prevention: involves identifying people in whom a disease process has already begun but who have not yet developed clinical signs and symptoms of the illness. This period in the natural history of a disease is called the *preclinical phase* of the illness.

Aim of the secondary prevention: is to detect the disease earlier than it would have been detected with usual care.

- **Examples:** Screening for high blood pressure and breast self-examination through mammography.
- Target: Individuals with established disease; achieved through early diagnosis and treatment.

rehabilitation

Epidemiology and Prevention

Primary, Secondary, and Tertiary Prevention

C. Tertiary prevention: is preventing complications in those who have already developed signs and symptoms of an illness and have been diagnosed, people who are in the clinical phase of the disease. This is achieved through appropriate treatment of the illness.

Aim of the tertiary prevention: is prevent complication and improving health of the ill person.

- **Examples:** Rehabilitation for stroke
- Target: Patients; achieved through rehabilitation.

Approaches of Prevention

Two possible approaches of prevention:

1. **Population-based approach:** in this approach a preventive measure is widely applied to an entire population.
   - **Example:** advice against smoking.
2. **High-risk approach:** in this approach a preventive measure is directed to specific group of people, those who are at high risk for specific health problem.
   - **Example:** developing lifestyle change program for people who are at high risk for diabetes and cardiovascular disease.

Approaches of Prevention

- Population-based approach can be considered public health approaches.
- Where as high-risk approaches more often require a clinical action to identify the high-risk group to be targeted.
- In the most situations, a combination of both approaches is ideal.

Epidemiology and Clinical Practice

- Epidemiology is critical not only to public health but also to clinical practice.
- The practice of medicine is dependent on population data.
  - **Example:** if a physician hears an apical systolic murmur, how does he or she know that it represents mitral regurgitation?
  - The diagnosis is based on correlation of the clinical finding.

Epidemiology and Clinical Practice

- Example 2: a patient asks his physician, "how long does it take for the disease to be cured? And the doctor replies, four to six months. **On what bases does the doctor prognosticate?**
- He does so on the bases of experience with large groups of patients who had the same disease, were observed at the same stage of disease, and received the same treatment.

Epidemiology and Clinical Practice

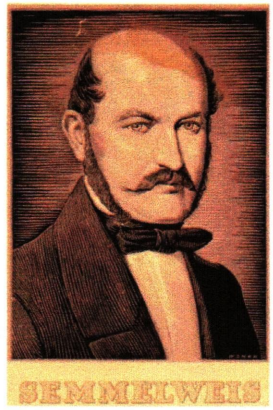
1. The process of diagnosis is population based.
2. The process of prognosis is population based.
3. Selecting of appropriate therapy is population-based.

Thus, population-based concepts and data underlie the critical processes of clinical practice, including diagnosis, prognostication, and selection of therapy.

From Observation to Preventive Action

- We will discuss two examples that demonstrate how epidemiologic observations have led to effective measures in human populations.
  1) Ignaz Semmelweis and childbed fever.
  2) Edward Jenner and smallpox

Ignaz Semmelweis and childbed fever.



Ignaz Semmelweis and child bed fever.

- He is specialized in Obstetrics and become interested in a major clinical and public health problem of the day: childbed fever which is fever that is related to childbirth or the period after the birth.
- In the early 19th century, childbed fever was a major cause of death among women shortly after childbirth, with mortality rates from childbed fever as high as 25%.

Postpartum fever

Ignaz Semmelweis and child bed fever.

- Because the cause of the childbed fever was unknown, many doctors start correlating the finding at autopsies of women who had died of the disease with the clinical manifestations that characterized them before their death.

Ignaz Semmelweis and child bed fever.

- There were two Obstetric clinics. The first is run by physician and medical students and the second is run by midwives.
- The physician and medical students in the first clinic began their days by performing autopsies on women who had died from childbed fever, then they proceeded to provide clinical care for women in the first clinic.

Ignaz Semmelweis and child bed fever.

- Staff in the second clinic ' Midwives' did not perform autopsies.
- The mortality rates in both clinic was as follow:

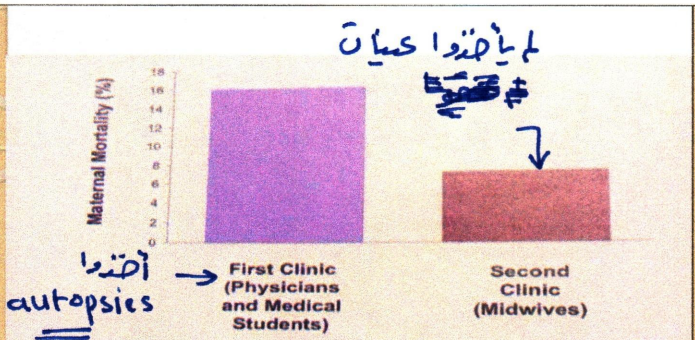


Figure 1-11. Maternal mortality due to childbed fever, First and Second Clinics, General Hospital, Vienna, Austria, 1842. (Adapted from the Centers for Disease Control and Prevention: Hand hygiene in health care settings—Supplemental. www.cdc.gov/handhygiene/download/hand_hygiene_supplement.ppt. Accessed April 11, 2013.)

Why do you think this happen?

Ignaz Semmelweis and child bed fever.

- Semmelweis had been impressed by mortality rates in the two clinic in 1842.
- He came to believe that mortality was higher in the first clinic than in the second clinic **because the physicians and medical students went directly from the autopsies to their patients.**

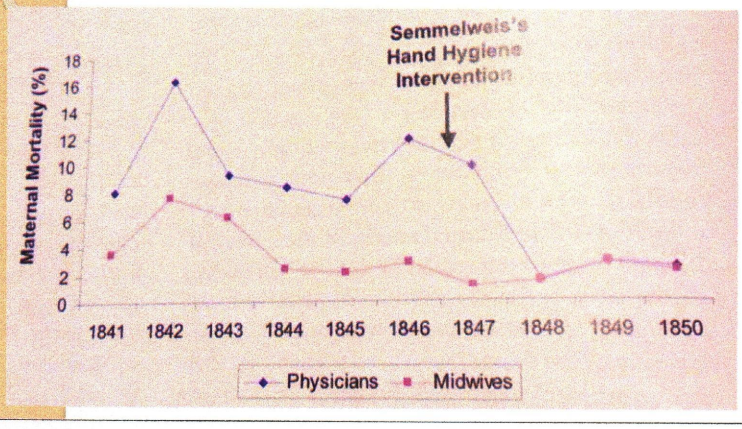
Ignaz Semmelweis and child bed fever.

- He suggested that the hand of physicians and medical students were transmitting the infection "disease-causing particles" from the autopsy room to the women in the first clinic.
- He then developed and implemented a policy for the physicians and medical students in the first clinic to prevent childbed fever.
- He required them to wash their hands and to brush under their fingernails after they had finished the autopsies and before they came in contact with any of the patients.

Ignaz Semmelweis and child bed fever.

- As a result, the mortality rate in the first clinic dropped from 12.2% to 2.4%, a rate comparable to that seen in the second clinic.
- Years later, the major cause of childbed fever was recognized to be a streptococcal infection.

Ignaz Semmelweis and child bed fever.



Edward Jenner and Smallpox

- Edward was very interested in smallpox which was a world wide problem.
- In the late 18th century, 400,000 people died from smallpox each year, a third of the survivors became blind as a result of corneal infection.
- He was very interested to find a good and safe approach to prevent this infection.

Edward Jenner and Smallpox

- Edward noticed that one young woman whose occupation was milking the cows developed a mild disease called cowpox.
- Later, during smallpox outbreaks, smallpox didn't develop in this young women.
- Edward then convinced that cowpox could protect against smallpox and decided to test the hypothesis.

Edward Jenner and Smallpox

- Edward took cowpox material from that young woman and administered it to an 8-year-old volunteer.
- Edward was so convinced that cowpox would be protective 6 weeks later.
- In order to test his convection, he inoculated the child with material that has just been taken from a smallpox pustule.
- The child did not contract the disease.