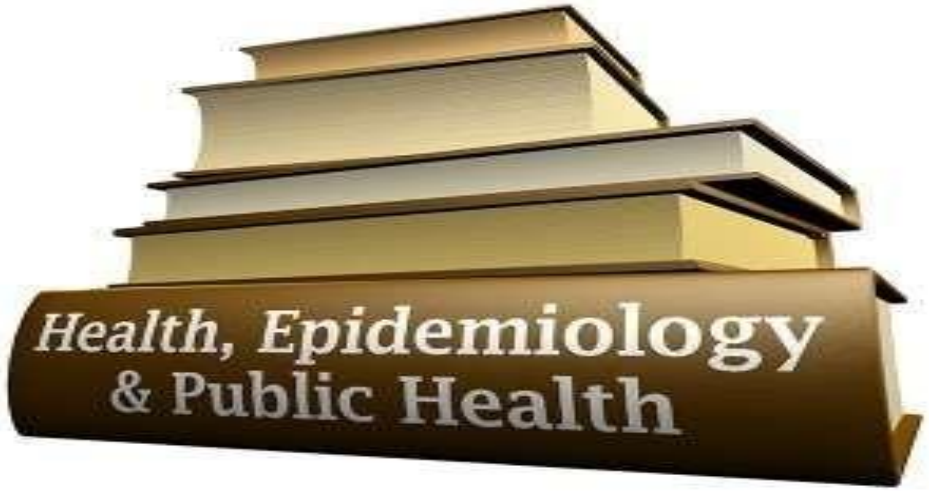
Introduction to Epidemiology



Chapter One: Introduction to Epidemiology

- **BASIC DEFINITIONS:**

- Epidemiology, medical science that involves the study of the incidence and distribution of diseases in large populations.

- Incidence= new cases of disease.

- Public health is defined as "the process of promoting health, preventing disease, prolonging life and improving the quality of life through the organized efforts of society".

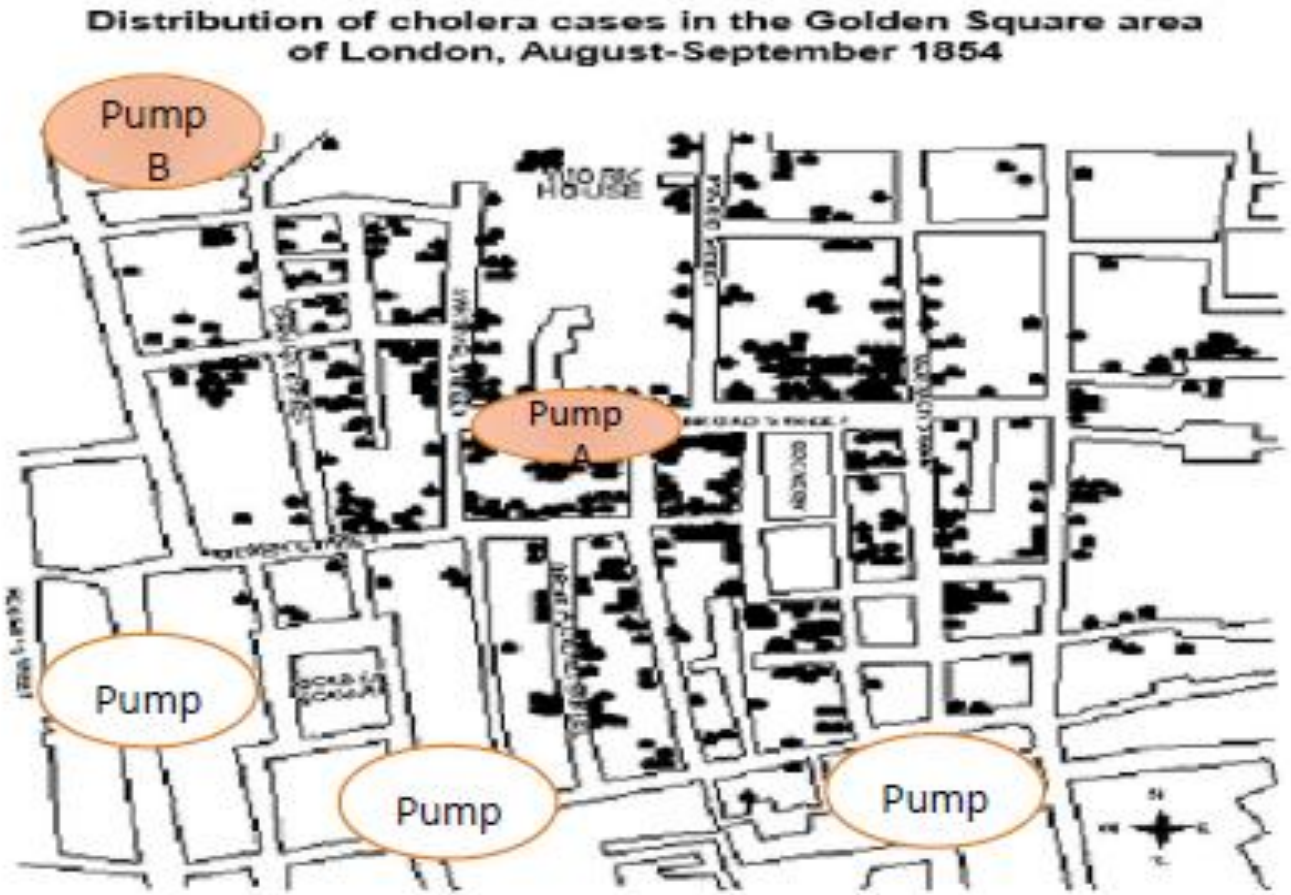
The historical context

- Epidemiology originates from Hippocrates" observation more than 2000 years ago that environmental factors influence the occurrence of disease .

Historical Evolution of Epidemiology

- in the nineteenth century epidemiology start to be defined as the distribution of disease in a specific human population groups . This was the time when English physician named John Snow which is considered as the "father of field epidemiology.", observed that the London cholera outbreaks occurred chiefly in regions served by the Broad Street pump. After the pump was shut down, the epidemic subsided.

- His research has a direct impact on public policy with an emphasize on communicable diseases where associations between environmental conditions or agents that specific diseases were investigated


Distribution of cholera cases in the Golden Square area of London, August-September 1854
Pump B
Pump A
Pump
Pump
Pump

- **Richard Doll and A. Bradford Hill in 1954**
  - Follow-up of 40,000 British medical doctors in the British Doctors Study
  - Association between smoking and lung cancer (and other diseases)
  - Male doctors born between 1900– 1930 who smoked cigarettes died, on average, about 10 years younger than lifelong nonsmokers

Achievement in Epidemiology

1.Eradication of Small pox

2. Methyl mercury poisoning

3. Smoking, asbestos, and lung cancer.

- combined effect of smoking and exposure to asbestos is multiplicative, creating exceedingly high lung cancer rates .

4. Rheumatic fever and rheumatic heart disease

- Is associated with poverty ,particularly poor housing and over crowding ,where streptococcal upper respiratory tract infection favour to spread

Achievement in Epidemiology

- Today the disease has almost disappeared from developed countries except in few areas among socially and economically disadvantage groups

- Today ,RHD is the most common forms of heart disease in developing countries

- Epidemiological studies have highlighted the role of social and economic factors that contribute to outbreaks of the rheumatic fever and to the spread of streptococcal throat infection

Achievement in Epidemiology

1.Eradication of Small pox

The elimination of small pox from the world contributed greatly to the health and well being of millions of people ,mainly in the poorest countries

- The last naturally occurring case of small pox was reported in 1977.

several factors contributed to the success of the program

1.Universal political commitment
2.Definite goal
3.Precise time table
4. Well trained staff
5. Availability of an effective heat –stable vaccine

Achievement in Epidemiology

2. Methyl mercury poisoning

in 1950 mercury compounds were released with the water discharge from afactory in minamata ,japan ,into asmall lake ,. This led to the accumulation of methyl –mercury in fish ,causing severe poisoning in people who eat them (who,1976).

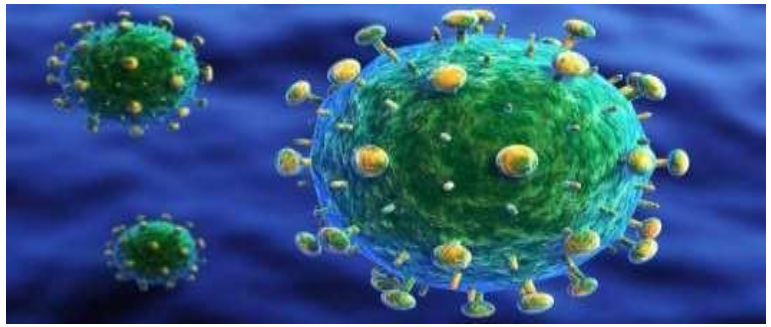
- Areported epidemic of disease caused by environmental pollution
- The first cases thought to be infectious meningitis
- Through observation they found that 121 infected patients were living near the minamata lake .

Achievement in Epidemiology

- Asurvey was done to investigate the causes .
- The results showed that victims were exclusively members of families whose main occupation was fishing
- People visiting these families did not suffer from this disease .
- It was concluded that some thing in the fish poisoned the patients and the disease was not communicable or geneticall determined .

What is epidemiology

Greek word
Epi: on/upon
Demos: people
Logos: study of



FDD:
F: Frequency
D: Distribution
D: Determinants

PPT- model

:study of frequency (*number*), distribution, and determinants (*cause*) of health-related states or events in human population and the application of this study on prevention and control of health problems.

The purpose of epidemiology:

To identify things in people and their surroundings that affect the occurrence of Health-related states or events.

- Things in people= genetic factors
- Surroundings= environmental & social factors

Objectives of Epidemiology

1. Identify etiology or cause, and risk factors (i.e., factors that increase a person's risk for a disease) for diseases .

- We want to know how the disease is transmitted from one person to another or from a nonhuman reservoir to a human population or why it arises due to risk behaviors the person engages in.
- Our ultimate aim is to intervene to reduce morbidity and mortality from the disease.

- eliminate exposure to those etiologic factors,
- and we can develop a basis for prevention programs
- In addition, we can develop appropriate vaccines and treatments, which can prevent the transmission of the disease to others.

Objectives of Epidemiology

2. Determine extent of disease in community- Burden of disease-BOD. (for planning and training) .

- What is the burden of disease in the community?

- This question is critical for planning health services and facilities
- and for estimating how many future health care providers should be trained.

3. Describe natural history and prognosis of disease

- Certain diseases are more severe than others; some may be rapidly lethal, whereas others may have extended durations of survival.

- Many diseases are not fatal but may affect quality of life or be associated with disability.

Objectives of Epidemiology

- We want to define the **baseline natural history** of a disease in quantitative terms so that as we develop new modes of intervention, either through treatments or through new ways of preventing complications .

- we can compare the results of using these new modalities with the baseline data to determine whether our new approaches have truly been effective

4. Evaluate existing and new preventive and theraputic methods and modes of health care delivery . E. g (Prostate Specific Antigen) PSA- prostatic cancer. Mammogram for breast cancer

- For example, does screening men for prostate cancer using the prostate-specific antigen (PSA) test improve survival in people found to have prostate cancer?

Objectives of Epidemiology

- Has the growth of managed care and other new systems of health care delivery and health care insurance had an impact on the health outcomes of the patients involved and on their quality of life?

- If so, what has been the nature of this impact and how can it be measured ?

5.Provide information for public policy towards environmental and genetic problems genetic issues, and other social and behavioral considerations regarding disease prevention and health promotion.

- For example, is the electromagnetic radiation that is emitted by cell phones, electric blankets and other household appliances (eg. **microwave at home**) a hazard to human health ?

Objectives of Epidemiology

- Are high levels of atmospheric ozone or particulate matter a cause of adverse acute or chronic health effects in human populations?

- Which occupations are associated with increased risks of disease in workers, and what types of regulation are required to reduce these risks ?

Epidemiology is concerned with the **frequency and pattern** of health events in a population:
Frequency refers not only to the number of health events such as the number of cases of meningitis or diabetes in a population, but also to the relationship of that number to the size of the population.

Pattern refers to the occurrence of health-related events by time, place, and person.
1- Time patterns may be annual, seasonal, weekly, daily, hourly, or any other time that may influence disease or injury occurrence.

2Place patterns include geographic variation, urban/rural differences, and location of work sites or schools.

3Personal characteristics include demographic factors which may be related to risk of illness, injury, or disability such as age, sex, marital status, and socioeconomic status, as well as behaviors and environmental exposures.

PPT model: Model to explain occurance of disease, and epidemic behavior

Definition of Public Health

,Totality of all evidence-based public and private efforts that preserve and promote health and prevent disease, disability, and death

PPP against DDD

Determinants, Epidemiology is used to search for determinants, which are the causes and other factors that influence the occurrence of disease and other health-related events.

Epidemiologists assume that **illness does not occur randomly** in a population, but happens only when the right **accumulation of risk factors or determinants** exists in an individual.

To search for these determinants, epidemiologists use epidemiologic studies to provide the **"Why" and "How"** of such events.

They assess whether groups with different rates of disease differ in their demographic characteristics, genetic or immunologic make-up, behaviors, environmental exposures, or other so-called potential **risk factors**.

Risk factors: factors occurring more frequently among diseased than among undiseased.

Smoking and lung cancer.

Demography

Births

Aging Deaths

Migration

Quantitative Study of Human Populations

Health - related states or events

Epidemiology was originally focused exclusively on epidemics of **communicable diseases** but was subsequently expanded to address endemic communicable diseases and non-communicable diseases.

By the middle of the 20th Century, additional epidemiologic methods had been developed and applied to chronic diseases, injuries, birth defects, maternal-child health, occupational health, and environmental health.

Then epidemiologists began to look at behaviors related to health and well-being, such as amount of exercise and seat belt use.

Uses of Epidemiology:

1- Assessing the community's health:

To assess the health of a population or community, relevant sources of data must be identified and analyzed by person, place, and time (descriptive epidemiology).

- What are the actual and potential health problems in the community?
- Where are they occurring?
- Which populations are at increased risk?
- Which problems have declined over time?
- Which ones are increasing or have the potential to increase?
- How do these patterns relate to the level and distribution of public health services available?

2- Making individual decisions

When persons decide to quit smoking, climb the stairs rather than wait for an elevator, eat a salad rather than a cheeseburger with fries for lunch they may be influenced by epidemiologists' assessment of risk.

Epidemiologists have provided information related to all those decisions.

Examples:

- In the 1970s, epidemiologists documented the role of exercise and proper diet in reducing the risk of heart disease.
- In the mid-1980s, epidemiologists identified the increased risk of HIV infection associated with certain sexual and drug-related behaviors.

3- Completing the clinical picture

- Epidemiologists contribute to physicians' understanding of the clinical picture and natural history of disease.

For example, epidemiologists, clinicians, and researchers around the world have collaborated to characterize SARS, a disease caused by a new type of coronavirus that emerged in China in late 2002.

Epidemiology has also help in characterized many non-acute diseases, such as the numerous conditions associated with cigarette smoking — from pulmonary and heart disease to throat and lung cancer

4- Searching for causes

Much epidemiologic research is devoted to searching for causal factors that influence one's risk of disease.

Ideally, the goal is to identify a cause so that appropriate public health action might be taken.

Nevertheless, epidemiology often provides enough information to support effective action.

Examples date from the removal of the handle from the Broad St. pump following John Snow's investigation of cholera in the Golden Square area of London in 1854 to the withdrawal of a vaccine against rotavirus in 1999 after epidemiologists found that it increased the risk of intussusception, a potentially life-threatening condition.Just as often, epidemiology and laboratory science converge to provide the evidence needed to establish causation

- **Epidemiological Approach:**
- The epidemiological approach can be considered as occurring as a number of steps:

1- Definition of the disease

2- The cause, etiology

3- How it spreads/occurs: risk factors:

- in the population
- in the environment

4- How to control disease (treatment)

5- How to prevent disease

6- How to eliminate disease.

- **Example of epidemiological approach on Non-communicable diseases:**
- One disease that received intense interest is myocardial infraction, sometimes known as coronary thrombosis or a heart attack.
- Diseases with multifactorial causes are harder to define clearly in the way used for infectious diseases like smallpox or cholera.

2- Etiology:

Intense efforts have been made to find the cause of myocardial infraction but so far, no single cause has been defined.

Instead we know of certain characteristics that are more common in people who get myocardial infraction compared with people who do not.

These are the risk factors.

- **Risk factors: (**A risk factor is any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury**)**
- There are around 20 well-documented risk factors associated with coronary heart disease, three have most attention because they are capable of modification:
- Cigarette smoking.
- Hypertension.
- Dyslipidemia: serum cholesterol and other lipid factors.

- Other population risk factors:
- Family history.
- Diabetes.
- Regional factors
- Relative poverty: poor diet

- Family history is a risk factor for any disease because families have their genetic make-up and environment in common.

- Genetic make-up: many lipid diseases,

- Environment: Japanese people who moved from Japan to USA.

4- Control:

- Removal of risk factors has been possible in a few experiments & the rate of people suffer from myocardial infraction fallen.
- It is difficult to persuade people to avoid the risk factors like smoking.
- There is an increase in smoking rates among young girls in developed countries like USA & UK.

5- Prevention:

- Elimination of risk factors for a disease is the ideal situation.

- For myocardial infraction, not all factors are known & population education does not always work.

- Risk factors interact in a complex manner.

- Protective factors include:

1- diet: increase fruits, vegetables & fatty fish content

2- exercise

3- aspirin for high-risk groups

Principles Of Epidemiology:

1.Crude numbers of affected individuals must be related to the number at risk Crude number

2 All the data should be used wherever possible.

3.The source of a disease & the methods of limiting it can be identified without necessarily knowing the cause.

Example: AIDS, SARS

4.Risk factors are characteristics or habits that are consistently more common in those who suffer a disease than in those who do not.

Limitations of epidemiology:

A- Epidemiology assume that there are direct causes of disease, but in fact it can not be certain which indicate that we have an association.

- Example: epidemiologists can say smoking causes lung cancer which mean in a large population, the smokers were much more likely to get lung cancer than the non-smokers.

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C- Epidemiologists can suspect the risk factors using population-based methods but these methods can lead only to associations but can not prove that a cause leads to an effect.

D- Prevention: prevention may be better than cure but it is not cheaper.

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BIG GEMS

Behavior: Smoking, diet, exercise, seat belt, alcohol consumption

Infections: Agents contributing to disease or protection. E. g. . . .

Genetics: Genetic predisposition. Breast cancer

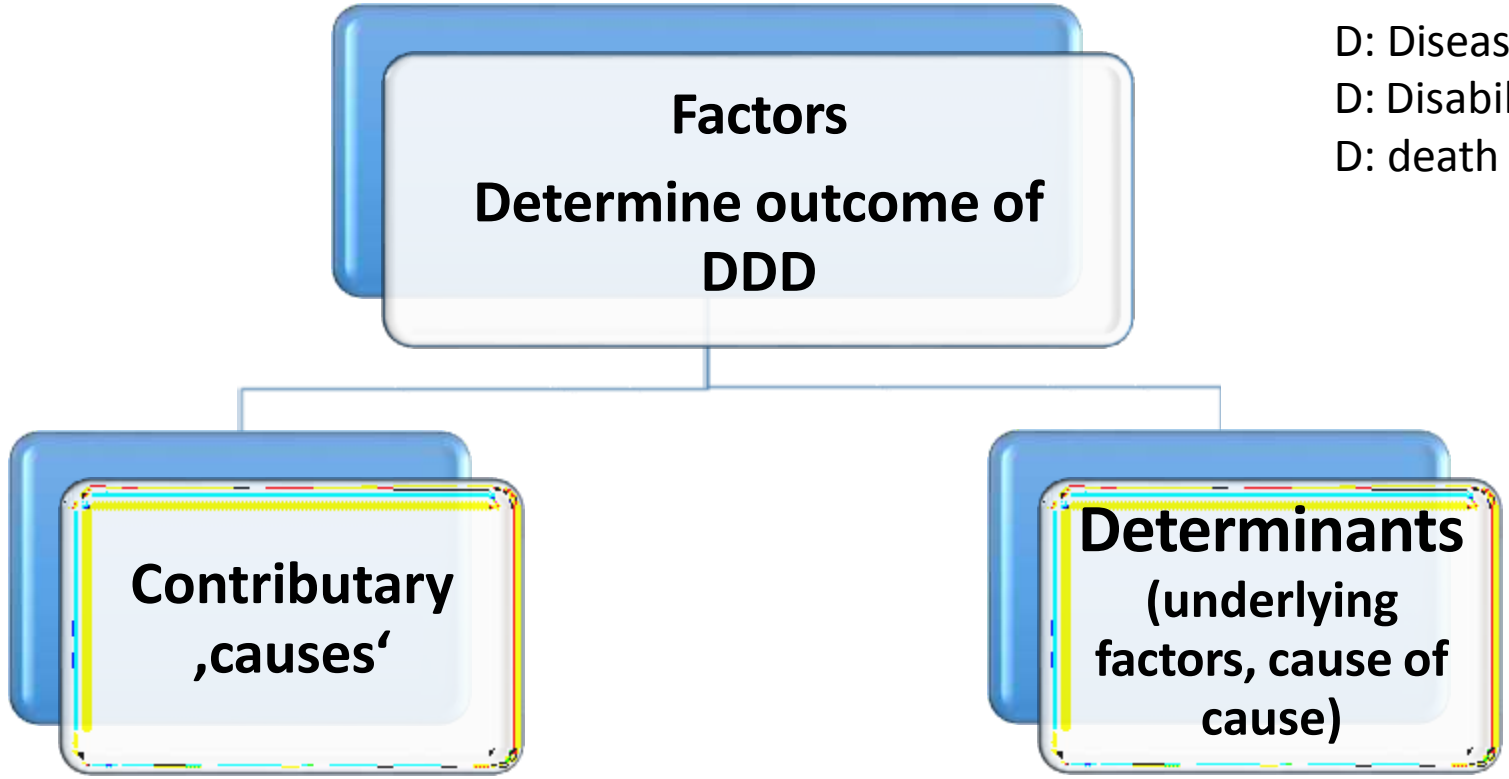
Geography: Influences frequency of disease. leishmaniasis in Jericho. etc

Environment: Pollution, natural disasters like earthquakes,

Medical Care: Access to and quality. Vaccine. Vs non-vaccine.

SES (Socioeconomic status) -Cultural: Education, income, occupation, religion. . .

Factors Determining Occurance of 3Ds



D: Disease
D: Disability
D: death

- **HIV cause AIDS and cigarette smoking cause lung cancer, but why?**

(Immediate cause)

→ **BIG GEMS**

Epidemiology and Prevention

A major use of epidemiologic evidence is to identify subgroups in the population who are at high risk for disease .

- Why should we identify such high-risk groups?

- First,, we can direct preventive efforts, such as screening programs for early disease detection, to populations who may not have been screened before and are most likely to benefit from any interventions that are developed for the disease.

- In sub-Saharan Africa, targeted HIV counseling and testing to men who are not aware of their status can effectively reduce epidemics if they are linked to care, started on antiretroviral therapy, and continued in care.

Epidemiology and Prevention

- Second, if we can identify such groups, we may be able to identify the specific factors or characteristics that put them at high risk and then try to modify those factors. It is important to keep in mind that such risk factors may be of two types.

- Characteristics such as age, sex, and race, for example, are not modifiable, although they may permit us to identify high-risk groups.

- On the other hand, characteristics such as obesity, smoking, diet, sexual practices, and other lifestyle factors may be potentially modifiable and may thus provide an opportunity to develop and introduce new prevention programs aimed at reducing or changing specific exposures or risk factors.

PRIMARY, SECONDARY, AND TERTIARY PREVENTION

1) Primary prevention

- denotes an action taken to prevent the development of a disease in a person who is well and does not (yet) have the disease in question. For example, we can immunize a person against certain diseases so that the disease never develops

or,

- if a disease is environmentally induced, we can prevent a person's exposure to the environmental factor involved and thereby prevent the development of the disease.

PRIMARY, SECONDARY, AND TERTIARY PREVENTION

- However, although our aim is to prevent diseases from occurring in human populations, for many diseases, such as prostate cancer and Alzheimer disease, we do not yet have the biologic, clinical, or epidemiologic data on which to base effective primary prevention programs

PRIMARY, SECONDARY, AND TERTIARY PREVENTION

- Primary prevention is our ultimate goal. For example, we know that most lung cancers are preventable. If we can help to stop people from ever smoking, we can eliminate 80% to 90% of lung cancer in human beings.

PRIMARY, SECONDARY, AND TERTIARY PREVENTION

2) Second 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
- Once a person develops clinical signs or symptoms it is generally assumed that under ideal conditions the person will seek and obtain medical advice. Our objective with secondary prevention is to detect the disease earlier than it would have been detected with usual care.

PRIMARY, SECONDARY, AND TERTIARY PREVENTION

- By detecting the disease at an early stage in its natural history, often through screening, it is hoped that treatment will be easier and/or more effective.
- For example, most cases of breast cancer in older women can be detected through mammography.
- Several recent studies indicate that routine testing of the stool for occult blood can detect treatable colon cancer early in its natural history but colonoscopy is a better test, although far more expensive and invasive.

PRIMARY, SECONDARY, AND TERTIARY PREVENTION

- The rationale for secondary prevention is that **if we can identify disease earlier in its natural history than would ordinarily occur, intervention measures may be more effective and life prolonged**. Perhaps we can prevent mortality or complications of the disease and use less invasive or less costly treatment to do so.

PRIMARY, SECONDARY, AND TERTIARY PREVENTION

3) Tertiary prevention

- *Tertiary prevention* denotes preventing complications in those who have already developed signs and symptoms of an illness and have been diagnosed (i.e., people who are in the clinical phase of their illness).
- This is generally achieved through prompt and appropriate treatment of the illness combined with ancillary approaches such as physical therapy that are designed to prevent complications such as joint contractures (تقلصات المفاصل).

Epidemiology and Prevention

TABLE 1.2 Three Types of Prevention

Type of Prevention	Definition	Examples
Primary	Preventing the *initial development* of a disease	Immunization, reducing exposure to a risk factor
Secondary	Early detection of *existing disease* to reduce severity and complications	Screening for cancer
Tertiary	Reducing the *impact of the disease*	Rehabilitation for stroke

TWO APPROACHES TO PREVENTION

Two possible approaches to prevention are **a population-based approach and a high-risk approach.**[2]

1) In the population-based approach, a preventive measure is widely applied to an entire population. For example, prudent dietary advice for preventing coronary disease or advice against smoking may be provided to an entire population using mass media and other health education approaches.

2) An alternate approach is to target a high-risk group with the preventive measure. Thus screening for cholesterol in children might be restricted to children from high-risk families. Clearly, a measure applied to an entire population must be relatively inexpensive and noninvasive. A measure that is to be applied to a high-risk subgroup of the population may be more expensive and may be more invasive or inconvenient but also has to be able to correctly identify individuals with the disease

TWO APPROACHES TO PREVENTION

Population-based approaches can be considered public health approaches, whereas high-risk approaches more often require a clinical action to identify the high-risk group to be targeted.