OLAOYE JUMOKE MARY_Epidemiology pdf

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Definition of Epidemiology:

Epidemiology is the study of the distribution and determinants of health-related states or events (including diseases) in specified populations, and the application of this study to control health problems.

Main Objectives of Epidemiology:

1. Identify the cause of diseases and risk factors:
- Determine what causes a disease (e.g., bacteria, viruses, environmental exposures).
- Understand risk factors (e.g., smoking and lung cancer).
2. Determine the extent of disease in the population:
- Measure how common diseases are (prevalence) and how often they occur (incidence).
- Help allocate healthcare resources efficiently.
3. Study the natural history and prognosis of diseases:
- Understand how diseases develop and progress over time.
- Predict outcomes of diseases with or without treatment.
4. Evaluate new preventive and therapeutic measures:
- Assess the effectiveness and safety of vaccines, drugs, public health interventions, etc.
5. Provide a foundation for public health policy and decision-making:
- Supply evidence-based data to guide health policies and strategies.
- Inform laws, regulations, and health education programs.

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Difference between Descriptive and Analytical Epidemiology

The following table highlights the key differences between them:

Descriptive Epidemiology	Analytical Epidemiology
To describe the occurrence and distribution of diseases in populations (who, where, and when).	To investigate the causes or determinants of disease (how and why).
Patterns of disease (time, place, and person).	Associations and causal relationships between exposures and outcomes.
Often includes case reports, case series, cross-sectional studies, and surveillance data.	Includes case-control studies, cohort studies, and experimental studies that (e.g., randomized controlled trials).
What is the problem?	Why is this happening?
Generation of hypotheses.	Testing of hypotheses.

Examples

• Descriptive Epidemiology Example:

A study reporting that the incidence of malaria is highest during the rainy season in rural areas of Ghana. It describes who, where, and when malaria occurs.

• Analytical Epidemiology Example:

A case-control study investigating whether sleeping under insecticide-treated bed nets reduces the risk of malaria infection. It tests why certain people develop malaria (the cause-effect relationship).

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Components of the Epidemiological Triangle and Their Interaction in the Spread of Infectious Diseases

The epidemiological triangle is a model used to explain the causation and spread of infectious diseases. It consists of three major components: the agent, the host, and the environment. Sometimes, a fourth component, time, is included to describe the incubation period and duration of the disease.

1. Agent (Cause of Disease)

The agent is the microorganism or pathogen that causes the disease. It can be biological (bacteria, viruses, fungi, parasites), chemical (toxins, pollutants, allergens), or physical (radiation, trauma, heat, cold).

Example: In malaria, the Plasmodium parasite is the causative agent.

Role: The agent must be present (or absent) for a disease to occur. Its ability to cause disease depends on factors like infectivity, pathogenicity, and virulence.

2. Host (Susceptible Person or Organism)

The host is the organism (usually human or animal) that can be infected by the agent. Host factors influence susceptibility and disease severity. These include age, sex, genetic makeup, nutritional status, immunity, and behavior (such as hygiene, lifestyle, and occupation).

Example: People with weak immunity or no prior exposure to Plasmodium are more susceptible to malaria.

3. Environment

The environment includes external factors that affect both the agent and the host. These can be physical (climate, geography, sanitation, housing), biological (presence of vectors), or socioeconomic (population density, healthcare access, education).

Example: In malaria, warm temperatures and stagnant water provide ideal breeding conditions for Anopheles mosquitoes, which transmit the parasite.

Interaction Among Components

The three components interact dynamically to determine disease occurrence. The agent must be transmitted from a reservoir or vector to a susceptible host under favorable environmental conditions. Interruption of any link in this triangle, such as destroying mosquito breeding sites or improving host immunity, can prevent disease transmission.

Example - Malaria:

- Agent: Plasmodium parasite
- Host: Human (susceptible person)
- Environment: Warm, humid areas with stagnant water and mosquitoes

→ If mosquito breeding sites are eliminated (environmental control), the transmission cycle is broken.

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Concept of Determinant in Epidemiology

In epidemiology, a determinant refers to any factor—whether event, characteristic, or condition—that influences the occurrence, distribution, or outcome of a disease or health condition.

Determinants help explain why and how certain individuals or populations are more likely to develop a particular disease. They are the causes or risk factors that affect health.

Epidemiologists study determinants to identify opportunities for disease prevention, control, and health promotion.

Types of Determinants

Determinants can be classified into several categories, such as:

- Biological determinants
- Environmental determinants
- Social and economic determinants
- Behavioral determinants

Below are examples focusing on biological and environmental determinants.

1. Biological Determinants

These are factors related to the biology of the host or pathogen that influence disease occurrence.They include genetics, age, sex, immune status, and presence of other infections.

Examples:

- Genetic predisposition – e.g., individuals with the sickle-cell trait have partial protection against malaria.
- Immune status – people with weakened immune systems (e.g., HIV patients) are more susceptible to tuberculosis and other infections.

2. Environmental Determinants

These are external physical, chemical, and biological factors that affect health and disease transmission.They can include climate, sanitation, living conditions, and pollution levels.

Examples:

- Poor sanitation and contaminated water – increase the risk of cholera and typhoid fever.
- Warm and humid climate – promotes the breeding of mosquitoes, leading to higher transmission of malaria and dengue fever.

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Three Levels of Prevention in Public Health

Public health prevention is aimed at reducing the burden of disease by intervening at different stages of its development.

The three main levels are:

1. Primary Prevention
2. Secondary Prevention
3. Tertiary Prevention

1. Primary Prevention

Primary prevention aims to prevent the onset of disease or injury before it occurs.

It involves actions taken to eliminate risk factors, increase resistance, or promote overall health and well-being.

Key Focus:

- Health promotion
- Specific protection

Examples:

- Vaccination programs (e.g., measles, polio, COVID-19 vaccines) to prevent infection.
- Use of insecticide-treated bed nets to prevent malaria.
- Health education about balanced diet and exercise to prevent obesity and heart disease.

Goal:

To stop disease from occurring in the first place.

2. Secondary Prevention

Secondary prevention focuses on early detection and prompt treatment of diseases to halt or slow their progression.

It aims to identify diseases in their early stages—often before symptoms appear.

Key Focus:

- Screening and early diagnosis
- Prompt treatment to prevent complications

Examples:

- Mammography for early detection of breast cancer.
- Blood pressure screening to detect hypertension early.
- HIV testing to identify infection and begin treatment early.

Goal:

To detect disease early and prevent its progression or complications.

3. Tertiary Prevention

Tertiary prevention aims to reduce the impact of an ongoing disease by preventing complications, disability, or death.

It focuses on rehabilitation and improving quality of life.

Key Focus:

- Rehabilitation
- Disability limitation

Examples:

- Physiotherapy for stroke patients to restore mobility.

- Insulin therapy and dietary control for people with diabetes to prevent complications like kidney failure.
- Cardiac rehabilitation after a heart attack.

Goal:
To minimize disability and enhance the patient's ability to live productively.

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John Snow contributed to the development of modern epidemiology by:

- Replacing superstition with evidence-based reasoning.
- Introducing data mapping and analysis of disease spread.
- Demonstrating how environmental factors (like water) influence health.
- Pioneering methods that are now central to epidemiological research and public health interventions.

The method John snow used during the cholera outbreak

During the 1854 cholera outbreak in London, John Snow used a systematic and evidence-based method to investigate how the disease spread.

1. Observation and Data Collection:

He recorded where cholera deaths occurred in the Soho district and gathered information about the victims — where they lived and which water source they used.

2. Mapping:

Snow created a dot map showing the locations of cholera cases. The map revealed that most deaths were clustered around the Broad Street water pump.

3. Hypothesis Testing:

He hypothesized that contaminated water from the Broad Street pump was the source of infection, rather than "bad air" (the miasma theory).

4. Field Investigation:

Snow interviewed local residents to confirm that most of the affected people had drunk water from that pump, even those who lived farther away.

5. Intervention:

He persuaded authorities to remove the handle of the Broad Street pump, after which the number of cholera cases quickly declined.

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Compare and contrast incidence and prevalence

Incidence: The number of new cases of a disease that develop in a specific population during a defined period of time.
•Prevalence: The total number of existing cases (both new and old) of a disease in a population at a given point or period in time.

Focus

- Incidence: Focuses on the risk of developing the disease.
- Prevalence: Focuses on how widespread the disease is.

Formula

- Incidence rate = (Number of new cases during a time period) ÷ (Population at risk during that period)

- Prevalence rate = (Total number of existing cases) ÷ (Total population)

Time Frame

- Incidence: Always involves a time period (e.g., new cases per year).
- Prevalence: Can be measured at a specific point (point prevalence) or over a period of time (period prevalence).

Usefulness

- Incidence: Useful for studying causes and risk factors of diseases.
- Prevalence: Useful for understanding the burden of disease and for planning healthcare resources.

Example

- If 100 people develop flu in a town of 10,000 during one month →
Incidence = 100 / 10,000 = 1%.
- If 300 people currently have flu (including old and new cases) →
Prevalence = 300 / 10,000 = 3%.

Why it is necessary to study both incidence and prevalence when studying a disease like diabetes

It is important to understand both incidence and prevalence rates when studying a disease like diabetes because incidence shows how many new cases are occurring (indicating the risk and spread of the disease), while prevalence shows how many people are living with the disease (indicating the overall burden on the population). Together, they give a complete picture needed for effective prevention, treatment, and health planning.

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Common type of Epidemiology study designs

1. Descriptive studies – Describe patterns of disease (e.g., case reports, cross-sectional studies).
2. Analytical studies – Explore causes and associations (e.g., cohort and case-control studies).
3. Experimental studies – Test interventions (e.g., randomized controlled trials).

How does a cohert study differ from a case control study

Cohort study: Starts with disease-free people and follows them over time to see who develops the disease, comparing those exposed and not exposed to a risk factor.

- Case-control study: Starts with people who already have the disease (cases) and compares them to those without the disease (controls) to look back and find past exposures.

👉 In short:
Cohort = follow forward in time,
Case-control = look backward in time.

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Define and differentiate between relative risk (RR)and odd ratio (OR),including when each is typically use ·

Definitions

- Relative Risk (RR): The ratio of the risk (probability) of developing a disease in the exposed group compared to the unexposed group.
 Formula: RR = (Incidence in exposed) / (Incidence in unexposed)

- Odds Ratio (OR): The ratio of the odds of exposure among cases to the odds of exposure among controls.
 Formula: OR = (Odds of exposure in cases) / (Odds of exposure in controls)

Differences

Relative Risk (RR)	Odds Ratio (OR)
Compares risk of disease between exposed and unexposed	Compares odds of exposure between cases and controls
Used in cohort studies or clinical trials (where incidence can be measured)	Used in case-control studies (where incidence cannot be directly measured)
RR = 1 → no association; RR > 1 → exposure increases risk; RR < 1 → exposure is protective	OR = 1 → no association; OR > 1 → exposure increases odds; OR < 1 → exposure is protective
Requires information on new cases over time	Uses existing cases and controls (no need to follow over time)

In Short

- Relative Risk measures how much more likely exposed people are to get the disease - used in cohort studies.
- Odds Ratio measures how much more likely cases were to be exposed than controls - used in case-control studies.
- Both express the strength of association between an exposure and a disease.

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Explain the role of epidemiological surveillance in managing public health ,How can it help

Epidemiological surveillance plays a vital role in managing public health by continuously collecting, analyzing, and interpreting health-related data to guide disease prevention and control efforts.

Here's how it helps:

1. Early Detection of Outbreaks

- Surveillance helps identify unusual increases in disease cases quickly.
- Early detection allows rapid response to contain outbreaks before they spread widely.

2. Monitoring Trends

- It tracks patterns of disease occurrence over time and across regions.
- This helps identify emerging diseases or changes in existing disease patterns (e.g., rising diabetes or malaria cases).

3. Guiding Public Health Actions

- Data from surveillance informs policy decisions, such as vaccination programs, sanitation improvements, or health education campaigns.
- It helps target resources to areas or populations most in need.

4. Evaluating Interventions

- Surveillance systems assess how effective public health programs and control measures are over time.
- For example, tracking COVID-19 or measles cases after vaccination campaigns helps measure success.

5. Supporting Research and Prevention

- The data collected helps researchers identify risk factors, modes of transmission, and populations at risk.
- This guides preventive strategies and health education efforts