Principles of Epidemiology

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Epidemiology

The study of distribution and determinants of health problems in specified populations and the application of this study to the control of these problems. It is the scientific method of problem solving used by "disease detectives"--epidemiologists, laboratory scientists, statisticians, physicians and other health care providers, and public health professionals--to get to the root of health problems in a community.
Epidemiology

Define?

- A study of all diseases/health events
  - infectious/non-infectious
  - acute/chronic
  - communicable/non-communicable.

- Science of rates expressed as probability

- “Anything that happens to people”
Epidemiology: Gen. Objectives

• Explaining the Causal mechanism of disease and process of deviation in Health.
• Explaining the reason for Local disease occurrence.
• Effective planning and administration of Health Care Services.
Specific Objectives

1. Understanding causation of disease with specific purpose of--
   - Formulation and selection/rejection of hypothesis.
   - Testing hypothesis through
     * Survey
     * Observation studies
Specific Objectives…

2. Testing validity of rationale of control /intervention programs
3. Classify disease/disability based on:
   Distribution
   Causal factors, and
   Natural history of disease
Specific Objectives

4. Explaining local disease pattern
5. Administrative Guidance
   - In assessing Need, Utilization & Effectiveness
   - In monitoring & evaluation of control programs (cost effectiveness & cost benefit analysis)
   - In Logical Planning of
     • Services
     • Resources
     • Programs
     • Reach &
     • Risk Approach
Planning: Terms

- **Planning** - “an act or process of choosing between alternatives to accomplish preset goals”.
- **Plan** denotes a blueprint of action
- **Program** is a strategy with defined Objectives.
Goal:

- The proposed long-range benefits of the program for a specified area, defined in general terms. A goal is the ultimate objective; for example, “reducing the incidence of HIV in (a country).”
Purpose:

• The overall objective (also called strategic objective) of the program, for example, “to increase the accessibility to and use of palliative care facilities in (a particular geographic area).”
• ultimate measure of the program’s effectiveness.
Objectives:

• The anticipated outcomes or benefits that are the expected results of implementing a strategy. They are described in measurable terms and indicate a specific period of time during which these results will be achieved.

• Should be SMART
  • specific,
  • measurable,
  • appropriate,
  • realistic, and
  • time-bound
Strategy

• A strategy is a plan (to choose) to achieve a particular goal or result; and reveals the logic of your choices.
Approach:

A statement that describes how the program will achieve its objective. That is, activities that will help the program achieve its objectives most effectively and feasibly.
Monitoring

• A methodological arm of evaluation that tracks the program’s incremental steps to its effect and informs the final evaluation report.
• A continual, routine effort requiring data gathering, analysis, and reporting on results at periodic intervals
• Periodic, regular
• Focuses on inputs, outputs, process outcomes, work plans
• Basic purpose is improve efficiency and adjust work plan
Evaluation

• A technical activity that measures the program’s impact and effectiveness as a whole.
• Is not about assigning a “grade” of success or failure at the end of a project.
• Episodic
• Focuses on effectiveness, relevance, impact, cost-effectiveness
• Basic purpose - improve effectiveness, impact, and future programming
Epidemiology: Basic approach

• Counts cases (events).
• Defines involved population.
• Determines rates/proportions
• Compares rates.
• Makes inferences
Epidemiology?

“Study of **distribution** and **determinants** of health related state or events & disease in human population”

“Science of rates expressed as probability”
Uses of Epidemiology

- Describe Health events
- Identify the cause of disease
- Identify the Risk factors
- Describe clinical pattern of disease and identify syndromes
- Identify effective control and/or preventive measures
- Risk Approach
Uses of Epidemiology

• Take suitable administrative measures in-
  • Assessing Need, Utilization & Effectiveness
  • Monitoring & evaluation of control programs (cost effectiveness & cost benefit analysis)
  • Logical Planning of
    » Services
    » Resources
    » Programs
    » Reach &
Epidemiological studies

• Descriptive
  • Correlation studies
  • Individual studies

• Analytical
  • Case control studies
  • Cohort studies

• Experimental
  • Randomized design
    – Blind
    – Double blind
    – Triple blind
  • Clinical trials
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Descriptive Epidemiology?

Study of distribution of a disease in a population, and observing the basic features of its distribution in terms of time, place, and person.
Descriptive Epidemiology: Objectives

- To evaluate trends and allow comparison among different population groups
- To provide basis for planning, provision and evaluation of services
- To identify problems to be studied by analytical methods
Descriptive Epidemiology describes:

- Who gets sick and who does not
- Where Rates are highest and lowest
- Temporal pattern of Disease
- Seasonality
- Secular trends decided by changes in-
  - Diagnostic techniques
  - Denominator data
  - Age distribution of population
  - Survival
  - Actual incidence
Reasons for changes in Trends: Real

• Changes in Age distribution of population
• Changes in Survival pattern
• Changes in Actual incidence for
  • Genetic
  • Environmental factors
Reasons for changes in Trends: Artifactual

- Errors in Numerator due to-
  - Changes in disease recognition
  - Change in classification of cause
  - Change in classification codes of cause of death
  - Changes in accuracy of reporting age at death

- Errors in denominator due to errors of enumeration

- ICD-10 has 8000 categories as compared to 4000 in ICD-9
Descriptive Epidemiology

Descriptive epidemiological approach attempts to describe the disease in terms of its attributes & variables and answers the questions like-

- Who (Person)
- Where (Place)
- When (Time)
Descriptive Epidemiology

Who?
Person:

Where?
Place:

When?
Time:
Who (Person)? Is getting the disease

Attributes & Variables

- Age
- Sex
- Ethnicity
- Marital status
- Occupation
- Education
- Income group

Akhilesh Bhargava
Sex

Deaths per 100000 population from CAD

Gap starts narrowing after 54 (menopause), suggests protective effect of estrogen

Men
Women
Where (Place) ?
Where Rates are highest and lowest

- Residence
- Occupation/ Work place
- At specific events
- Geographic sites
Time (When)?
Reflects on trend

- Year
- Season
- Day
- Date of Onset
- Duration
Time trends

- Secular (Changes that occur over long periods of time)
- Periodic (short term)
- Cyclic (Seasonal)
- Epidemic
Secular trend is influenced by:

- Changes in completeness of source of data
- Changes in diagnostic ability
  - Experience
  - Techniques
- Changes in data classification approach (ICD-9 to ICD-10)
- Demographic changes in population
- Changes in environment other than that which is related to disease
- Changes in clinical concepts, Diagnosis, Terminology
Cyclic (Seasonal) trends
Changes in frequency over: Days, Weeks, Months, Years

Seasonal trend-Malaria & Pf cases, 1994 Rajasthan

Changes in frequency over: Days, Weeks, Months, Years
Periodic (short term)

- Changes that occur in hours/days/weeks
- Simultaneous exposure to single source (Point source)
- John Snow - Cholera
Endemic vs. Epidemic

No. of Cases of a Disease

Time

Endemic

Epidemic
Let us make an educated guess: Hypotheses

- Why some people get the disease and others do not
- Why disease occurs in some places and not others
- Why disease occurs at some time and not at others
Developing Hypotheses

- Interrogate usual suspects!
- Source of agent
- Mode of transmission
- Usual reservoirs
- Known risk factors
- Exposures that caused disease
- Look at person, place and time for clues
Developing a hypotheses

- Requires familiarity with disease
- Hypothesis should be testable
- Still clueless?
- Talk with cases again
- Visit cases in their own situation
- Don’t forget outliers