**Nies: Community/Public Health Nursing: Promoting the Health of Populations, 4th Edition**

**Chapter 4: Epidemiology**

# Chapter Outline

### **I. Use of Epidemiology in Disease Control and Prevention**

**A.** Epidemiology is the study of the distribution and determinants of health and disease in human populations. It is the principal science of community health practice.

**B.** Formal epidemiological techniques were developed in the nineteenth century and focused on identifying factors associated with spread of infectious diseases.

**C.** Descriptive epidemiology uses person, place, and time variables to describe disease patterns.

**D.** Analytic epidemiology examines complex relationships among determinants of diseases. The focus is on disease etiology.

**E.** Models for epidemiological investigation—Factors critical to the development of disease can be identified through use of models.

1. Epidemiological Triangle

a. This model is used to analyze disease development dependent on exposure to an agent, the host’s susceptibility, and the environmental conditions existing at the time of exposure.

b. The triangle is most applicable to conditions that can be linked to clearly identifiable agents.

2. Wheel Model

a. This model consists of a hub that represents the host with its human characteristics (genetics, immunity, personality).

b. The wheel surrounding the hub represents the environment, and is composed of biological, social, and physical dimensions.

c. The relative size of each component in the wheel depends on the health problem being analyzed.

d. The wheel allows for a multiple-causation theory of disease, it is more useful for analyzing complex chronic conditions.

3. Web of Causation

a. The web of causation illustrates the complexity of the interaction of risk factors that can lead to the development of chronic illness.

b. It is useful in the development of interventions to address identified risk factors.

4. Identification of Risk Factors

a. Identification of risk factors is closely associated with chronic disease reduction.

b. Risk factors are variables that have been shown to increase the rate of disease in persons who have them or have been exposed to them.

c. Identification of risk factors is critical to development of prevention interventions.

**II. Calculation of Rates**

**A.** Rates are population proportions or fractions that are used to interpret raw data and to make comparisons.

1. Rates are written as proportions or fractions in which the numerator is the number of events that occurred in a specified period of time, and the denominator consists of the population at the specified time period.

2. The proportion is multiplied by a constant (i.e., 1,000, 10,000, 100,000).

**B.** Ratios and percentages are sometimes used to express comparisons.

1. Ratios are obtained by dividing one quantity by another (e.g., number of male births divided by number of female births).

2. Proportions are expressed as percentages.

**C.** Morbidity: Incidence and prevalence rates.

Morbidity rates refer to rates of illness in a defined population. The two primary morbidity rates are incidence rates and prevalence rates.

1. Incidence rates describe the occurrence of new cases of disease or condition in a community over a period of time relative to the size of the population at risk of developing that disease during that period.

a. Incidence rates are used for detecting and monitoring short-term, acute disease changes.

b. An attack rate is a special incidence rate that documents the number of new cases of a disease in those exposed to a disease.

2. Prevalence rates refer to the number of all cases of a specific disease in a population at a given point in time relative to the population at risk of acquiring the disease at the same point in time.

a. Prevalence rates are influenced by the number of people who develop the particular condition (incidence) and the duration of the condition.

b. An increase in the incidence rate or the duration of a disease increases the prevalence rate of that disease.

c. When prevalence rates describe the number of persons with the disease at a specific point in the study they are called point prevalences.

d. Period prevalences are the number of existing cases during a specified period of time.

**D.** Other rates

1. Crude rates summarize the occurrence of births (crude birth rate) or deaths (crude death rate). The numerator is the number of events, and the denominator is the average population size. Crude rates may contain biases because the denominator is the total population rather than the population at risk.

2. Age-specific rates are used to overcome some of the biases seen with crude rates. Similar rates may also be used to control for other variables such as race and gender.

3. Age-adjustment or standardized rates reduce bias due to unequivalent age distribution of the populations being compared.

4. The proportionate mortality rate (PMR) represents the percentage of deaths resulting from a specific cause relative to deaths from all causes.

**III. Concept of Risk**

**A.** Risk is the likelihood that healthy persons exposed to a factor will acquire a specific disease.

**B.** Risk factor refers to the specific exposure factor. Risk factors may be fixed characteristics (i.e., age, sex, genetics), lifestyle factors (dietary habits, exercise regimens), or external to the individual (i.e., cigarette smoking, stress, noise).

**C.** Rates of disease can be calculated to determine risk

1. Attributable risk is the estimate of the burden of disease in a population based on a risk factor.

2. Relative risk is the excess risk caused by a risk factor, and is the statistical basis for the concept of risk factor.

a. Relative risk ratios are valuable indicators of excess risk incurred by exposure to certain factors.

b. The relative risk is calculated by dividing the incidence rate of the disease by the incidence rate of the disease in the non exposed population.

## IV. Use of Epidemiology in Disease Prevention

**A. Primary Prevention**

Primary prevention relies on epidemiological information to indicate those behaviors that are protective and thus will not contribute to an increase in disease and those that are associated with risk. Two activities constitute primary prevention—health promotion and specific protection.

**B. Secondary and Tertiary Prevention**

Secondary and tertiary prevention can be used to detect disease at its earliest stage, identify diseases, determine effective treatments, and prevent long-term complications.

**C. Establishing Causality**

Disease causality cannot be proven definitively; however it may be established in terms of a strong association or identified causal factors. Criteria needed to determine a cause-and-effect relationship are:

1. Strength of association—Rates of morbidity and mortality must be higher in the exposed group than in the non exposed group.

2. Dose-response relationship—As exposure to a risk factor increases, there is a concomitant increase in disease rate.

3. Temporally correct relationship—Exposure to the risk factor must occur before the effect (disease).

4. Biological plausibility—The data must provide a coherent explanation for the relationship.

5. Consistency with other studies—Similar associations have been made in other studies and other populations.

6. Specificity—The exposure to the risk factor must be necessary and sufficient to cause disease.

**D. Screening**

The purpose of screening programs is to identify risk factors and diseases in their earliest stages. Screening is usually classified as a secondary prevention activity because disease is discovered *after* a pathological change has occurred. Guidelines for screening programs include:

1. Adequate and appropriate follow-up should be planned for those who test positive.

2. Early diagnosis of the disease should be beneficial.

3. Acceptable and medically sound treatment should be available.

4. Procedures for ensuring confidentiality should be in place.

5. Tests must be cost effective and acceptable to the client.

6. Costs of program, follow-up, and resulting medical care should have a bearing on the decision to screen.

7. Screening tests should ideally have high sensitivity (the ability of a test to detect those with the disease) and specificity (the extent to which a test can identify those without the disease).

**E.** **Surveillance**

Surveillance allows ongoing collection of information by monitoring changes in disease frequency and trends in occurrence of risk factors. The nurse evaluates trends in morbidity by identifying new cases and calculating incidence rates.

## V. Use of Epidemiology in Health Services

**A.** Epidemiology is useful in studying the delivery of health care to populations by describing and evaluating the use of health services by the community.

**B.** Epidemiological studies can be used to evaluate quality of care.

**VI. Epidemiological Methods**

**A. Descriptive Epidemiology**

Descriptive epidemiology focuses on the distribution of health and health problems within a population and the effects of person, place, and time factors on an illness. It describes the characteristics of people who are protected from specific diseases and of those who have a disease. Variables in descriptive epidemiology include age, sex, ethnicity or race, socioeconomic status, occupation, education, and family status.

**B. Analytic Epidemiology**

Analytic epidemiology investigates the causes of disease by determining why a disease rate is lower in one population group than in another. The epidemiologist seeks to establish a cause and effect relationship between a preexisting condition or event and the disease. To determine this relationship, the epidemiologist may undertake two major types of research studies, which are observational and experimental studies.

1. Observational studies are used to discover etiology of disease.

a. Cross-sectional studies (also known as prevalence or correlational studies) examine relationships between potential causal factors and disease at a point in time.

b. Retrospective (case control) studies compare a group of individuals known to have a disease with a similar group of individuals who do not have the disease to determine whether the diseased group differs from the non-diseased group in its exposure to a specific factor or characteristic. Data collection extends back in time to determine previous exposure or risk factors.

c. Prospective (longitudinal or cohort) studies identify a group of individuals considered to be free of disease and follow them forward in time to determine if, and when, disease occurs. The cohort (group of persons who share a common experience within a defined time period) is assessed for exposure factors suspected of being associated with a disease. The cohort is followed for the development of disease. The disease rates for those with a known exposure are compared with rates for those who remain unexposed, and incidence and relative risk are determined.

2. Experimental studies require random assignment of subjects who are considered at risk to an experimental or control group. Only the experimental group is subject to the intervention, but both groups are observed over time for occurrence of disease.