Descriptive Epidemiology

Part 1

Dr. H. Stockwell

Basic assumptions of epidemiology

- Human disease does **not** occur at **random**

- Causal and preventive factors can be identified through **systematic investigation** of **different populations** or subgroups of individuals in a population in **different places or times**

Epidemiology

- Divided in to two major components:
    Descriptive Epidemiology
    Analytic Epidemiology (hypothesis testing)

- Both important to our understanding of disease

- Cannot ask relevant questions about disease etiology without a firm understanding of the descriptive epidemiology

Descriptive Epidemiology

- Designed to describe the existing distribution of variables without regard to causal associations

- measure prevalence and incidence of disease/health

- Generate hypotheses for analytic studies

CANNOT TEST HYPOTHESES USING DESCRIPTIVE STUDIES

Descriptive Epidemiology

Time

WHEN

WHERE Place → Person **WHO**
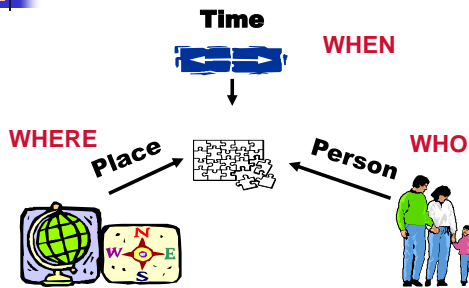
Distribution of disease: Descriptive Epidemiology

- **Person**: age, sex, race/ethnicity, SES, occupation, lifestyle

- **Place**: neighborhood, state, country, environment

- **Time**: date of exposure, date of diagnosis etc

Person

- **Who gets disease?**

Characteristics of person -- ex: gender and age

Death rates (DR) per 100,000 population from coronary disease in the U.S.,1981, by age and gender

Age	White men	White women	DR men/women
25-34	9.4	4.2	2.2
35-44	60.6	16.2	3.7
45-54	265.6	71.2	3.7
55-64	708.7	243.7	2.9
65-74	1669.9	769.4	2.2
75-84	3751.5	2359.0	1.6
85+	8596.0	7215.1	1.2

Race and Ethnicity in Epidemiologic Research

- Often used variables in research – frequently used to assess the association of these variables on disease outcomes

- Biologically race is ill defined, poorly understood and may be of questionable validity

- Race has been described as an arbitrary system of visual classification (Fullilove, MT, 1998)

- DNA evidence indicates genetic diversity is a continuum with no clear breaks that delineate racial groups

- Since 2000 census individuals can self identify with more than one racial group
  From Gordis L 3rd ed.

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Race and Ethnicity in Epidemiologic Research

- Alternative approach is to use ethnicity

- Ethnicity is complex – may involve shared origins, culture, language

- What is the relationship to disease – does it increase our understanding of disease process, risk etc?
  From Gordis L 3rd ed.

Race and Ethnicity in Epidemiologic Research

- Using race and/or ethnicity in our research may help us identify subgroups to which additional resources need to be directed.

- Some believe this further stigmatizes certain sub-groups

- If race is to be included in a study there should be a strong rationale, could other variables be better surrogates or is there a direct measure
  From Gordis L 3rd ed.

Place

- **Is there a geographic pattern?**

Characteristics of Place

Across countries: latitude, temperature, amount of sunlight
Between cities or counties, areas: urban-rural and within a city

	G.B.	Japan	Nigeria	U.S.A.
Liver cancer	LOW			
Lung cancer	HIGH			
Stomach		HIGH		
Bladder		LOW	LOW	HIGH
Colon		LOW	LOW	HIGH
Prostate		LOW	LOW	HIGH
Ovarian		LOW	LOW	HIGH
Endometrial		LOW	LOW	HIGH

Reported Rabies cases in Florida

Reported Rabies Cases in Florida
(Rabid Animal Cases' by County from January 1, 2006 through April 30, 2006)

Florida Department of Health
Bureau of Epidemiology

Time

- **Is there a temporal pattern? When is the disease occurring?**

- Short term fluctuations- in disease frequency – food borne outbreak

- Cyclic patterns: annual increases in influenza in cold months

- Secular trends: long terms changes – over decades or more- heart disease

Characteristics of Cyclical Time trends

- Periodic fluctuations on a seasonal basis/annual basis
  - valuable mostly in investigation of acute diseases or those with a short latent period (period between exposure and disease onset/diagnosis)
- Example: epidemiology of respiratory diseases/influenza – i.e., ease of transmission in winter months with increased crowding and human contact

Characteristics of Time Trends: Example

Pneumonia and Influenza Mortality for 122 U.S. Cities
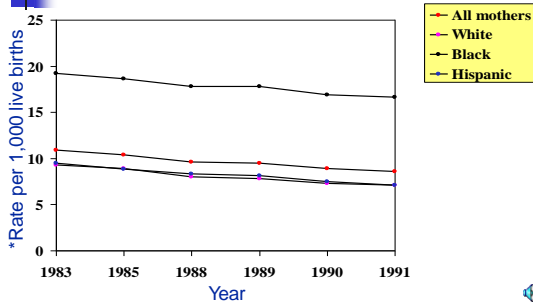**Week Ending 12/29/01**
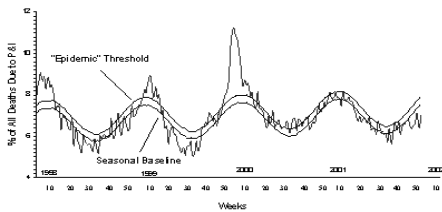
Characteristics of Secular trends

Secular trends in chronic diseases may be caused by changes in:
- Diagnostic techniques
- Case finding
- Accuracy in enumerating the population at risk
- Age distribution of the population
- Management of disease after diagnosis

Secular trends in chronic diseases may be caused by a change *in the actual incidence of disease due to alterations in environmental, genetic or lifestyle factors*

Infant mortality rates*, U.S., 1983-1991 by ethnicity
Data from: National Linked Files of Live Births and
Infant Deaths

Legend:
- All mothers
- White
- Black
- Hispanic

Y-axis: *Rate per 1,000 live births (0, 5, 10, 15, 20, 25)
X-axis: Year (1983, 1985, 1988, 1989, 1990, 1991)

Epidemic

- "the occurrence in a community or region of cases of an illness, specific health related behavior or other health related events clearly in excess of normal expectancy"

- Consider person, place and time

Disease Clusters

- "aggregation of relatively uncommon events or diseases in space and/or time in amount that are believed or perceived to greater than could be expected by chance"

Study Designs

- Studies are classified as **Descriptive** or **Analytic**

- **Descriptive** studies describe the situation – they do not test a hypothesis

- **Analytic Studies** test a hypothesis

Types of Descriptive Studies

- Case reports/case series- describe the experience of a patient or group of patients-may lead to a new hypothesis

- Correlational studies- measure characteristics in entire populations not individuals. May also be analytic and test a hypothesis

- Cross sectional surveys -exposure and disease measured at the same time in a group of individuals. May also be analytic and test a hypothesis

Case Report

Careful and detailed report by one or more clinicians of the clinical profile of a single patient

Strengths:
- Document unusual medical history/clinical features of disease
- Can provide clues in the identification of a new disease or adverse effects of exposures

Case Report

Limitations:

- There is nothing with which to compare the data - can't determine whether something is unusual unless you know what's usual

- Cannot be used to test for presence of a valid statistical association

- Since based on 1 person, presence of characteristic (risk factor - RF) may be coincidental

Case Series

Collections of individual case reports, usually within a fairly short period of time; description of clinical/epidemiologic characteristics of a number of patients with a given disease

Strengths:

- Better because it does not rely on a single case; shows better probability of a pattern

- Can examine the dose-response (D-R) relationship by examining the levels of exposure with the levels of disease severity

Limitations:
No comparison group so cannot test for the presence of a valid statistical association

Correlational/Ecologic Studies

- Uses data from the entire population to compare disease frequencies between different groups during the same time period or same population at different points in time

- Example: per capita consumption of meat and colon cancer rates

- May be descriptive or analytic depending on whether testing a hypothesis

Ecologic Studies

- **Strengths:**
  - Cheap, quick
  - May stimulate additional epidemiologic research
  - May be the only design for uncovering assoc. at group level.
  - Becoming popular again since there is GIS local level data

- **Weaknesses:**
  - Cannot link exposure with disease in individuals, therefore possibility of making an ecological fallacy.
  - Sources of information may not be very accurate (Use average exposure levels rather than actual levels).
  - Summary measures therefore imprecise Cannot control for confounding factors
  - Cannot establish temporal sequence

- **Examples: Cigarette sales and mortality from CHD**
  Death rates from breast cancer and dietary fat

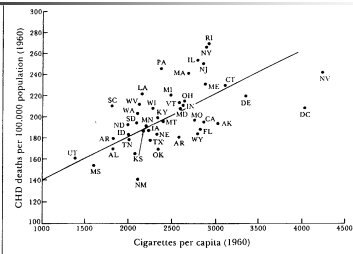## Coronary heart disease mortality rate

Fig. 5-1. Coronary heart disease mortality rates in the United States by per capita cigarette sales in 1960, by state. (From G. D. Friedman, Cigarette smoking and geographic variation in coronary heart disease mortality in the United States. *J. Chronic Dis.* 20:769, 1967.)

Ecological Fallacy
(also known as Aggregation Bias)

- Patterns observed on the aggregate level are not observed at the individual level

- Cannot control for outside factors which may explain the association

Erroneous conclusions based on grouped data:
  - The ecologic fallacy refers to a bias that occurs when an association seen at the aggregate level does not represent the association seen at an individual level

The association seen at the aggregate level is not true (biased association)

Many ecologic studies provide the basis for individual-level studies to be conducted - ecologic studies are often a good "first look"

Cross-Sectional Studies

- Exposure and disease outcome measured simultaneously
- Includes prevalent cases of disease(everyone with the disease at that point in time)
- No information on the temporal relationship between exposure and disease
- Good for variables that do not change (eye color, blood type etc) or good correlation between current and past practice - diet
- Both disease and exposure may have been the result of a third factor

Cross–sectional studies

- A snapshot (of a cohort) at one point in time

- Exposure and disease measured at same time

- Can compare (point) prevalence ratios or prevalence odds

- May be descriptive or analytic

Repeated Measures Studies

- Successive cross-sectional studies

- Repeated surveys of same population – not same individuals

- Detect overall time trends in a population

Person, Place and Time

- To learn more about the importance of place, please listen to the TED lecture

  - http://www.ted.com/talks/lang/en/bill_davenhall_your_health_depends_on_where_you_live.html