Basic Principles of Epidemiology and Study Design

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Objectives in Two Parts

• Understand the basic principles of epidemiology and causal relationship
• Understand the different design types of basic epidemiological studies
**What is It?**

- Epidemiology is the study of patterns of diseases in human or animal populations.

- Epidemiology studies the patterns, circumstances, *causes*, and control of diseases using statistical determinations of incidence, frequency, prevalence and distributions of diseases.
When and where did it start?

- Dr John Snow in 1854
- Cholera deaths and mapping
- Water systems in London
- Incidence plotting
- Broad Street Pump contamination
- Infectious agent (vibrio cholera) mechanism of disease found in 1905
Map of 1854 Cholera Epidemic
Causality

• Five criteria:
  – High relative risk
  – Consistency
  – Dose related response
  – Temporal relationship
  – Plausible biological mechanism
Relative Risk

- Expected disease
- Observed disease
- Observed/expected = relative rate
- Example Smoking and lung cancer
  - $\frac{397 \text{ (OBS)}}{37 \text{ (EXP)}} = 10.73$ is relative rate over non-smokers
Consistency and Dose Relationship

- The same effect is seen in multiple studies:
- Increase in frequency/severity with increase in dose
Temporality

- The proposed cause occurs prior to the disease or event:
Plausible Biological Mechanism

• Cigarette smoke contains nicotine and tar
• Nicotine and tar have high concentrations of nitrogen compounds
• Nitrogen compounds are associated with increases in cancers
• Nicotine and tar concentrate in the lung tissue of smokers
Questions???  Take a break!!
Types of Epidemiological Studies
Cohort Studies

- Longitudinal study
- Healthy People
- Time
- Known Exposure
- Different doses of the same exposure
- What happens over time?
- Advantage = shows health before and after the exposure
Case-Control Studies

- Either case referent or retrospective design
- Specific patients with the disease under study
- Compared with controls (no disease)
- Advantage = can obtain odds ratio
- Disadvantage = Do not ascertain attributable risk
- Confounding factors are important and must be adjusted statistically
  - Matching cases and controls
  - Still needs statistical adjustments
Cross-Sectional Studies

• Ask two questions:
  – What is the current health of a population
  – What exposures have they had to possible causes of disease (Dr Snow’s early work on cholera)

• Used to discover causal relationship and etiological factors

• Advantage= easy to conduct (no need to wait for a health outcome)

• Disadvantage= only current health and exposure is studied and it is hard to relate a specific cause
Time Series and Time Trends

- Time series studies survival or some other specific endpoint
  - Lung cancer and death
  - Survival of lung cancer with drug versus non-drug therapy

- Time trends measure prevalence over short periods
  - Seasonal incidence rates of malaria
  - Melanomas and increased sunlight
Other studies

• Ecological studies- study different communities, generally looking at prevalence and incidence of disease

• Geographical comparisons- compares populations based upon geography (North Afghanistan with Southern Afghanistan) generally looking for incidence

• Migrant group comparisons- did a mobile group spread disease to a resident population

• Occupational and Social Class- different prevalence and incidence, example= welders and pulmonary disease
CONFOUNGING

- Confounders are factors that are related to both the outcome of interest and different exposures
Questions???