Introduction to Epidemiology II

Mohammed Orloff
Department of Epidemiology
University of Arkansas for Medical Sciences
Spring 2017

Description of the Course

- Builds upon Epi – 1
- Comprehensive study of the concepts, principles and methods of epidemiology research
- Training in epidemiology methods, emphasizing
  - Study design
    - which variables to measure
    - Which design to use
    - Know/do not know exposures
    - Mixture of exposures
    - Confusion of the outcome
    - Measuring the out come short versus long term incubation

Description of the Course

- Statistical analysis
  - To determine whether a statistical association exists between a presumed risk factor and disease
    - True or biased?
- Causality
  - To derive inferences regarding a possible causal relationship from the patterns of the statistical associations
  - Effect/treatment/interventions, etc.

- Extensive reading and homework assignments
- Students will develop a frame work for interpreting, assessing and performing epidemiology research

What is Epidemiology?

- A branch of science that investigates the frequency and distribution of diseases in a defined population in an attempt to determine their causes, to discover ways to alleviate them, and to prevent their reoccurrences

- The focus on disease and health distinguishes epidemiology from the social sciences

- The use of populations distinguishes epidemiology from other biological sciences and medicine

Why study epidemiology?

- Assess burden of disease in populations
- Make meaningful comparisons of disease frequency between
  - Diseases (e.g., causes of death)
  - Population subgroups (e.g., men/women, ethnicity, etc)
  - Places (e.g., urban/rural)
  - Time periods (e.g., before/after intervention)
- Identify modifiable causes of disease: Hypotheses are tested using epidemiologic studies
- Evaluate disease control efforts

Why study epidemiology?

- Assess distribution of disease
  - Who is getting disease?
  - Where is disease occurring?
  - When is disease occurring?

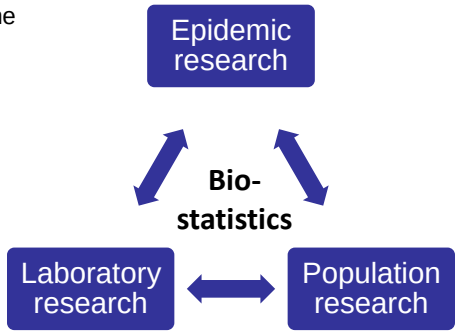
  ➔Formulation of hypotheses concerning causal and preventive factors

  ➔Formulate policies

Types of Epidemiologic Research

Epidemiology and the information generated by epidemiologic methods have many uses

It is cross discipline
- Physicians
- Geneticists
- Chemists
- Statistics



Types of Epidemiologic Research

- Epidemic investigations
  - Out break of diseases in specific populations: the agent that caused the outbreak, its mode of transmission and suggest appropriate control measures
- Laboratory research
  - Apply knowledge of basic sciences to develop procedures and strategies that enhance our ability to understand pathophysiological mechanisms
- *Population research**
  - Study of biological (including genetic), environmental and behavioral determinants of diseases and their prevention
- Statistical techniques and other quantitative methods
  - Used to make scientific generalizations that extend etiologic knowledge beyond observations

Quantitative Methods in Public Health

- Public health investigations use quantitative methods, which combine the two disciplines of Epidemiology and biostatistics
- Epidemiology is about the understanding of disease development and the methods used to uncover the etiology, progression, and treatment of the disease
  - Information (data) is collected at each point
- The methods and tools of biostatistics are used to analyze the data to aid decision making

Quantitative Methods in Epidemiology

- Measurement of variable
  - Observations are assigned a value or category (classify)
- Estimation of population parameters
  - Mathematically derive from our sample data
    - A summary value that hopefully represents a given population parameter
    - Express magnitude of association and impact on disease frequency
- Testing of statistical hypothesis
  - Assess extent to which chance (or sampling error) may have accounted for our findings as represented by estimates
  - Expressed in terms of p-values

Role of Quantitative Methods in Public Health

- Address a public health question
- Conduct a study
- Collect data
- Describe the observations/data
- Assess strength of evidence for/against a hypothesis; evaluate the data
- Recommend interventions or preventive programs

Types of research strategies

- 3 types of research strategies can be defined by 2 criteria regarding how the investigator deals with the primary exposure
  1. Does the investigator manipulate the primary exposure variable?
  2. If so, is it done randomly? (i.e. randomly assigning subjects to different exposure categories?)

Manipulation of exposure	**Randomization**	
	Yes	**No**
Yes	**Experiment**	**Quasi-experiment**
No	**-'**	**Observational study**

Example 1

- Hypothesis: owning a pet leads to low bp among patients with mild hypertension

- Hypothetical study: a group of elderly volunteers with systolic bp between 140 and 159 Hg, who are not treated with anti-hypertensive medication and who do not own any pets, are randomized into two groups. Each subject in the experiment group is offered his or her choice of a dog or a cat for 6 months; subjects in the control group do not get offered any pet. Blood pressure is measured in each subject at baseline and at the end of each month for the duration of the 6 month follow-up period

- What is the research strategy?

Example 2: Quasi-experiments?

- The intervention in quasi experiment is commonly directed at one or more populations rather than to separate individuals.
- Example: the Newburgh-Kingston Fluoridation Study, which evaluated the impact of fluoridating the common water supply on the occurrence of dental caries in children. Newburgh (NY) started sodium fluoride treatment in 1945 while Kingston (NY) continued to use fluoride-deficient water without treatment.

Example 2: Continued

- Note that the treatment here was not randomized. The city of Newburgh simply approved fluoridation in 1944 while the city of Kingston agreed not to change its water supply for the duration of the study.
- In fact, randomization would serve no purpose in this study.
- With only two communities to randomize, we would not expect to equalize the distribution of extraneous risk factors between the two communities.

Quasi-Experiments: Summary

- Generally fewer ethical and practical problems than with experiments because of the lack of randomization.
- Often feasible to conduct in large study populations, thereby enhancing generalizablity of the results.
- Investigator controls the intervention, so treatment are uniformly applied to all subjects in each treatment group.

Quasi-Experiments: Summary

Cons

- Generally not as much control of disturbing influences from extraneous factors as with experiments.
- But, there are other ways to improve control without randomization.
  - "Blinding" to treatment status the investigator who observes the outcome;
  - Fixing the values of extraneous factors that could influence the outcome; and
  - Using the analytic methods used for the lack of control in the design.

Example 3: Observational Study

- Hypothesis: Owning a pet, particularly a dog or cat, is beneficial to ones health. Specifically, we would predict that the pet owners have lower blood pressure, on the average, than they do individuals without pets.

- Hypothetical Study: A random sample of elderly residents in a community is interviewed to obtain information on pet ownership (i.e., dogs or cats). All participants' blood pressure is measured.

Hypothetical Results

Observational Studies: Summary

Pros

- Generally easiest to conduct (less cooperation required, and fewer ethical constraints)
- More generalizable results (i.e., appropriate for establishing action-oriented public-health goals)

Cons

- Generally less control of disturbing influences from extraneous risk factors.
- Some observational studies may suffer from other design problems that cannot be controlled in the analysis, including:
    1. Temporal ambiguity of cause and effect;
    2. Problems in measuring the exposure accurately; and
    3. Disturbing influences of how subjects are selected.
- Because of the relative lack of control, each observational study tends to be unique making it difficult to replicate results. Thus, inconsistent results are more difficult to explain.