The Why and What of Epidemiology

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Quantitative vs. Qualitative

**Biostatistics** – **Epidemiology** – **Health Promotion**

**quant**
- Ability to add and subtract really fast and make others feel inadequate
- Ham Radio Skills
- Analysis
- Numbers
- Excel Skills

**qual**
- Ability to match shirt with shoes
- Fear of Numbers
- Empathy
- Emotions
- Zen
- I Love Glee!
Study Types

- Experimental
- Quasi-Experimental
- Observational

Randomization & Investigator Intervention

Investigator Intervention
Problem
Rumor, Anecdote
Conviction
Observation, Case Series

Intervention
Evaluate Intervention

Investigation
Look for or Gather Evidence
Existing Data Analysis
On-going Surveillance?

Importance
How important is it in the scheme of things?

Collect Data

Decision
Is there a quantifiable problem?

Why?
Evidence
Causal Pathway
For an Intervention

1. Intervention (Smoking Cessation Program)
2. Knowledge (Smoking is Unhealthy)
3. Change Behavior (Quit Smoking)
4. Reduction in Smoking Rates
5. Reduction in Lung Cancer, CVD

Policy Changes

1. Number of participants
2. Increase in knowledge
3. Self-report or measured behavior change
4. Sum of behavior change over time
5. Ultimate goal of behavior change—reduction in disease, improved health
How do you know you are an epidemiologist?

Everyone thinks you are a biostatistician except biostatisticians.

And, you can’t explain what you do to your relatives.
Social Marketing Interlude

• It’s better to wear out than rust out.
First Off - What is public health?

• “Organized community efforts aimed at the prevention of disease and the promotion of health” (Institute of Medicine, Future of Public Health)

• “The science and art of protecting and improving the health of communities through education, promotion of healthy lifestyles, and research for disease and injury prevention” (ASPH)
Academic Disciplines of Public Health

• Epidemiology

• Biostatistics

• Environmental and Occupational Health

• Health Administration

• Health Promotion
Epidemiology

• Tools of logic and analysis to find, evaluate, and use evidence to affect health and disease.

Bill Moore
What is epidemiology?

“The study of the distribution and determinants of health-related states and events in populations, and the application of this study to control health problems”

John M. Last, *Dictionary of Epidemiology*
“The **study** of the distribution and determinants of health-related states and events in populations, and the application of this study to control health problems”

**Study** – refers to measurement of disease frequency, involving **quantification** of the existence or occurrence of disease.

Examples: observation, descriptive research, hypothesis generation, analytic research, experimental research, surveillance, screening
“The study of the distribution and determinants of health-related states and events in populations, and the application of this study to control health problems”

**Distribution** – frequency of disease by person, place and time

- Look for variations from a uniform distribution, i.e., does disease cluster?
Weight Status: BMI and Body Fat by Gender: Oklahoma Health Fairs

<table>
<thead>
<tr>
<th></th>
<th>Female BMI</th>
<th>Female BF</th>
<th>Male BMI</th>
<th>Male BF</th>
</tr>
</thead>
<tbody>
<tr>
<td>UnderWt</td>
<td>29.0%</td>
<td>29.7%</td>
<td>29.8%</td>
<td>34.0%</td>
</tr>
<tr>
<td>HealthWt</td>
<td>41.9%</td>
<td>23.2%</td>
<td>48.9%</td>
<td>29.8%</td>
</tr>
<tr>
<td>OverWt</td>
<td>19.2%</td>
<td>1.1%</td>
<td>1.9%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Obese</td>
<td>1.9%</td>
<td>5.1%</td>
<td>4.4%</td>
<td>2.1%</td>
</tr>
</tbody>
</table>
Epidemiology is the study of the distribution and **determinants** of health-related states and events in populations, and the application of this study to control health problems.

**Determinants** – any factor or event that brings about a change in a health condition

- physical, biological, social, cultural and behavioral factors that influence health
Epidemiology is the study of the distribution and determinants of health-related states and events in populations, and the application of this study to control health problems.

Health-related states and events – infectious diseases, chronic diseases, deaths, injuries, disabilities, mental disorders, suicide, substance abuse, behaviors, use of health services, adverse events
What is epidemiology, really?

• The study of health and disease in populations.
• The basic science of public health
  – Who gets disease?
  – What causes disease?
  – How does disease spread?
  – What prevents disease?
  – What works in controlling disease?
The Scope of Epidemiology

• To describe the health status of populations
• To explain the etiology of disease
• To predict the occurrence of disease
• To control the distribution of disease
Fundamental Assumption

- Human disease has causal and preventive factors that can be identified through systematic investigation

- Essence of epidemiology = Comparison
The Descriptive Essence

• Counts (How many have the disease?)

• Proportions (What proportion of the population has the disease?)

• Rates (The proportion standardized per a fixed unit—per hundred, per thousand, etc. so that it is a whole number)
## The Analytic Essence
### The 2 x 2 Table

<table>
<thead>
<tr>
<th>Disease</th>
<th>Disease</th>
<th>Total</th>
<th>Odds Ratio (95% C.I.)</th>
<th>Risk Ratio (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>3</td>
<td>23</td>
<td>22.2</td>
<td>3.77</td>
</tr>
<tr>
<td>Exposed</td>
<td></td>
<td></td>
<td>(3.0 to 188.8)</td>
<td>(1.4 to 10.3)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>23</td>
<td>36</td>
</tr>
<tr>
<td>Disease</td>
<td>Proportion</td>
<td>23/36</td>
<td>Rate</td>
<td>63.9%</td>
</tr>
<tr>
<td>Disease</td>
<td>Disease</td>
<td>Total</td>
<td>Odds Ratio (95% C.I.)</td>
<td>Risk Ratio (95% C.I.)</td>
</tr>
<tr>
<td>Exposed</td>
<td>2,000</td>
<td>300</td>
<td>2,300</td>
<td>22.2</td>
</tr>
<tr>
<td>Exposed</td>
<td></td>
<td>1,000</td>
<td>1,300</td>
<td>(18.5 to 26.6)</td>
</tr>
<tr>
<td>Total</td>
<td>2,300</td>
<td>1,300</td>
<td>3,600</td>
<td>(3.4 to 4.2)</td>
</tr>
<tr>
<td>Disease</td>
<td>Proportion</td>
<td>2300/3600</td>
<td>Rate</td>
<td>63.9%</td>
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</tr>
<tr>
<td>Exposed</td>
<td>300</td>
<td>1,000</td>
<td>1,300</td>
<td>(18.5 to 26.6)</td>
<td>(3.4 to 4.2)</td>
</tr>
<tr>
<td>Total</td>
<td>2,300</td>
<td>1,300</td>
<td>3,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease Proportion</td>
<td>2300/3600</td>
<td></td>
<td>Rate</td>
<td>63.9%</td>
<td>62.3 to 65.5</td>
</tr>
<tr>
<td>Exposed</td>
<td>2,000</td>
<td>30,000</td>
<td>2,300</td>
<td>22.2</td>
<td>20.9</td>
</tr>
<tr>
<td>Exposed</td>
<td>300</td>
<td>100,000</td>
<td>1,300</td>
<td>(19.6 to 25.2)</td>
<td>(18.5 to 23.6)</td>
</tr>
<tr>
<td>Total</td>
<td>2,300</td>
<td>130,000</td>
<td>132,300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease Proportion</td>
<td>2,300/132,00</td>
<td></td>
<td>Rate</td>
<td>1.7%</td>
<td>1.7 to 1.8</td>
</tr>
</tbody>
</table>
Measurement

- **Validity**
  - Does it measure the intended construct?

- **Reliability**
  - Is it repeatable—the same result every time?
    - Precision

- **Accuracy**
  - Accuracy—valid and reliable
The Logic of Epidemiology

• Bias: Deviation of results or inferences from the truth
  – Ascertainment
  – Recall
  – Volunteer
  – Confounding
### Measured versus Self-report

**NHANES 2005-2006 v. BRFSS 2006**

<table>
<thead>
<tr>
<th></th>
<th>NHANES 2005-2006</th>
<th>BRFSS 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Obesity Prevalence</strong></td>
<td>34.3% Measured</td>
<td>25.1% Self-Report</td>
</tr>
</tbody>
</table>

**9.2 percentage point difference**
Epidemiology: Hits and Misses

- Low fat diet
  - BMI increase?
  - decrease in lung cancer, heart disease, stroke
- Smoking Cessation
  - decrease in lung cancer, heart disease, stroke
- Beta Carotene
  - increase in lung cancer
- Hormone Replacement Therapy
  - increase in cardiac events
  - less osteoporosis

*Age-adjusted to the 2000 US standard population.
National Center for Health Statistics, Centers for Disease Control and Prevention.

*Age-adjusted to the 2000 US standard population.
National Center for Health Statistics, Centers for Disease Control and Prevention.
### 2011 Estimated US Cancer Cases*

<table>
<thead>
<tr>
<th></th>
<th>Men 822,300</th>
<th>Women 774,370</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>29%</td>
<td>30%</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Melanoma of skin</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>All Other Sites</td>
<td>19%</td>
<td>16%</td>
</tr>
</tbody>
</table>

*Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder.

Source: American Cancer Society, 2011
QuickStats: Age-Adjusted Rates* of Death from Heart Disease, by Race and Sex --- United States, 1979--2006†

Figure 1. Risks and Benefits by Randomized Assignment to Conjugated Equine Estrogens Plus Medroxyprogesterone Acetate or Placebo Before and After Termination of the Intervention in the Women's Health Initiative Estrogen Plus Progestin Trial

Heiss, G. et al. JAMA 2008;299:1036-1045
Figure 19-4 Risk of what? How the end-point may affect an individual's perception of risk and willingness to act. (S. Kelley. ©169; 1998 San Diego Union Tribune. Copley News Service.)
J. N. Morris

The challenges to epidemiology are great: in a wide range of research, in information of the public, health service, and government, in teaching, in the example we set, and, as part of the wider public health movement, in our collective political message.