HISTORICAL VIEW OF EPIDEMIOLOGY

I. Introduction

A. Causation and prevention
   1. Cause of a disease
      a. An event, condition, or characteristic that plays an essential role in producing an occurrence of the disease
   2. Prevention of a disease
      a. An event, condition, or characteristic that plays an essential role in preventing an occurrence of the disease

B. Historical evaluation of etiologic concepts
   1. Single cause has single effect
      a. Exposure to agent leads to a disease
      b. Time from exposure to outcome is short
      c. Situation with many infectious diseases
   2. Single cause has multiple effects
      a. Exposure to agent leads to multiple diseases
      b. Time from exposure to outcome is long
      c. Example: smoking
   3. Multiple causes have single effect
      a. Multiple agents lead to a disease
      b. Time from exposure to outcome is long
      c. Example: multiple factors that lead to heart disease
   4. Necessary and sufficient
      a. Etiologic agent and disease outcome

<table>
<thead>
<tr>
<th>Sufficient to Cause Disease</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Yes</td>
<td>Rare - depends on definition of &quot;agent&quot;</td>
<td>Most infectious diseases</td>
</tr>
<tr>
<td>No</td>
<td>Many chronic diseases</td>
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Agent is necessary

5. Multiple factor model
   a. Agent
   b. Host
   c. Environment

6. Comparison of disease detective with crime detective
   a. Detective (murder investigation)
      (1) Agent
         (a) Indirect association (murderer)
         (b) Direct association (gun and bullet)
      (2) Host
         (a) Murdered person
II. Historical Figures in Epidemiology

A. James Lind (1716-94; died at age 78)
   1. Scottish physician
   2. Scurvy
      a. Disease caused by prolonged deficiency of Vitamin C (ascorbic acid) in the diet
         (1) Progressive bodily weakness, spongy and inflamed gums, loose teeth, swollen and tender joints and a tendency toward ecchymosis (absorption by tissues of blood from ruptured blood vessels)
            (a) Anemia often follows hemorrhage
            (b) Disease appears in adults after about six months of complete lack of Vitamin C
      b. Became prevalent when sailors began to spend months at sea without fresh fruits or vegetables
         (1) Use of lemons and oranges was mentioned in the medical literature as a cure for scurvy as early as 1611
            (a) Theory was not accepted
   3. Experiment
      a. Salisbury ship, May, 1747
         (1) Lind was 31 years old
      b. Observed that the Dutch had employed citrus fruits for several hundred years on their boats
      c. Hypothesis
         (1) Some unknown factor was missing from diet
      d. Assigned twelve sick seaman to six groups of two with various combinations of dietary supplementation
         (1) quart of cider per day
         (2) unspecified elixir 3x per day
         (3) seawater
         (4) garlic, mustard and horseradish
         (5) spoonfuls of vinegar
         (6) two oranges and one lemon each day
      e. Outcome
         (1) "fit for duty"
      f. Reasoned that deficiency of citrus fruits was responsible for scurvy
   4. Policy recommendation
      a. Recommended that fresh lemons and oranges be used to cure or prevent scurvy (1753)
         (1) Rejected by Admiralty
            (a) Citrus fruits were expensive, scarce and could not be stored for very long
            (b) Believed in preventive value of sauerkraut
               i) Used by Captain James Cook to feed his crews in the Pacific
      b. Recommendations accepted in 1795 (42 years later)
         (1) One year after Lind's death
(2) Prescribed daily ration of West Indies limes
   (a) Cheaper than Mediterranean limes but much lower in biologic value of ascorbic acid
   (b) Because of daily dose of limes, British navy were referred to as "limeys"

(3) Scurvy began to disappear among "limeys"

B. Edward Jenner, 1749-1823 (died at age 74)
1. British physician and vaccination pioneer
2. Known for prevention of smallpox
   a. Jenner noted that dairy maids who had mild symptoms of cowpox did not later develop smallpox
   b. Jenner took cowpox material from the hands of a dairy maid and applied it to an eight year old boy
      (1) There was no indication of informed consent
   c. Six weeks later he exposed the child to smallpox
   d. The child did not develop smallpox
3. Many did not accept his theory since the agent was not known
   a. Years later his small study of one child contributed to the savings of countless lives

C. Ignac Semmelweis (1818-1865; died at age 47)
1. Hungarian obstetrician
   a. Worked as assistant professor in maternity ward of Vienna General Hospital (Austria)
2. Puerperal sepsis
   a. A bacterial infection of the female genital tract after childbirth
   b. Causative microbial agents were not known in his lifetime
3. Intervention (1847; aged 29)
   a. Required students to wash hands with chlorinated lime before examining patients
      (1) Among physicians, reduced from 33.3% before to 11% after
         (a) Did autopsies on patients and carried the infectious agent (theorized) for the dead house to the lying ward
      (2) Among midwives, reduced from 3.4% before to 2.8% after
         (a) Did not do autopsies
   (3) Etiologic agents remained unknown until 40 years later, with the work of Louis Pasteur and Robert Koch
4. Follow-up
   a. Findings and publications were resisted by hospital and medical authorities
   b. Suffered from nervous breakdown and went to a mental hospital in Vienna

D. John Snow (1813-1858; died at age 45)
1. British physician who distinguished himself in the fields of epidemiology (for his work with cholera) and anesthesiology (he administered chloroform to Queen Victoria)
2. For more information see: http/www.ph.ucla.edu/epi/snow.html
3. Cholera (agent [not yet known] Vibrio cholerae)
   a. Severe diarrhea and loss of water and salts in the stool
      (1) "Rice-water stool," vomiting, thirst, muscle cramps, and sometimes, circulatory collapse
(2) Case-fatality rate is higher than 50% in severe, untreated cases

b. Grand Experiment
(1) By circumstance, the houses in one region of London received water from two different companies in a near-random manner
(a) Southwark and Vauxhall (down Thames river, heavily polluted)
(b) Lambeth Company (new location up Thames river, not polluted)
(2) Observed that households supplied water by Lambeth company had much lower rates than those supplied by Southwark and Vauxhall
(a) Made factual inferences about etiologic agent
(3) Control (one year before his death)
(a) Passage of legislation that all water companies should filter water by 1857
c. Cholera organism was widely identified by Robert Koch in 1884
(1) 26 years after Snow's death

E. Etiologic agent
1. James Lind
   a. Disease: Scurvy
   b. Agent: Vitamin C
   c. Not yet identified
2. Edward Jenner
   a. Disease: Smallpox
   b. Agent: Smallpox virus
   c. Not yet identified
3. Ignac Semmelweis
   a. Disease: puerperal sepsis
   b. Agent: Various infectious microbes
   c. Not yet identified
4. John Snow
   a. Disease: cholera
   b. Agent: Vibrio cholerae
   c. Not yet widely identified

III. Contemporary History

A. Time between cause and effect is often long
   1. Agent is not clearly identified
      a. Control is possible before agent has been definitively identified
      b. Example that follows: Smoking and lung cancer

B. Determining causation
   1. Medical and nursing personnel
      a. Often precede epidemiologic investigations
         (1) Many hypotheses but none are proven
      b. Autopsy data (pathologists)
         (1) Noticed by pathology of lung that many persons dying of lung cancer had smoked
      c. Clinical observations
         (1) Noticed that many patients with pulmonary disease smoked
2. Public health personnel
   a. Vital statistics
      (1) Comparison of trends over time
         (a) New cases and deaths due to cancer of lung and bronchus in United States, 1975-2002
            i) Surveillance, Epidemiology, and End Results (SEER)
               a) a surveillance program of the US National Cancer Institute
            ii) Males: reduction in lung cancer incidence and mortality started in 1980s and early 1990s
            iii) Females: incidence of lung cancer started to level off in the late 1990s, while mortality continues the gradual increase
         (b) Long term smoking trends
            i) Males: reductions in smoking began many decades ago.
            ii) Females: reductions in smoking were more recent, beginning to accelerate in the late 1970s.
               a) National Health Interview Surveys, 1920-1988
                  - Adults, aged 20-34 years
               b) Behavioral surveys, CDC/NCHS, 1965-2003
   b. Special study designs
      (1) Case-control studies
         (a) Cases - new lung cancer cases
            i) Looked for smoking history (long time lag)
         (b) Controls - persons free of lung cancer
            i) Looked for smoking history

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<thead>
<tr>
<th>History of smoking</th>
<th>New lung cancer cases</th>
<th>Others (controls)</th>
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<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
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<tr>
<td>No</td>
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(2) Cohort studies
   (a) Exposed - persons who smoke
      i) Followed forward in time for possible cases of lung cancer
   (b) Unexposed - persons who do not smoke
      i) Followed forward in time for possible cases of lung cancer

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<thead>
<tr>
<th>Smoker</th>
<th>Lung Cancer Cases</th>
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<tbody>
<tr>
<td>Yes (exposed)</td>
<td></td>
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<tr>
<td>No (unexposed)</td>
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3. Methods of infectious disease epidemiology have been expanded for chronic disease epidemiology and now serve both areas
C. Historical figures in epidemiology remind us that...
1. It is important to understand the biology and pathogenesis of a disease
   a. such is usually the concern of research scientists
2. It is not necessary to know all details (or even the etiologic agent) to prevent a disease
   a. the historical giants of epidemiology are deemed great because they also focused
      on the control of disease
      (1) such is usually the concern of public health activists