Environmental Epidemiology
Introduction and Overview

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Environmental Exposure ———- Disease

(Air, Water, Soil) ———- Death
- Inhalation ———- Cancer
- Ingestion ———- Birth Defects
- Dermal Absorption ———- Neurologic
- Physiologic

1) Is there an association between the exposure and the disease?
   (Odds Ratio, Relative Risk)

2) Is the association causal?

When the exposure is high and health effects are obvious and immediate, then demonstrating association and causality is EASY

- **Bhopal, India** - 1984 - Release of Methyl Isocyanate, est 5000 deaths, > 100,000 injured
- **Chernobyl** - 1986 - 31 confirmed deaths from acute radiation exposure. Possible 10,000 excess cancers among 200,000 high exposed group.
- **London Fog** - 1952 - 4000 excess deaths from respiratory and cardiovascular illness

**Figure 8**
London Fog Epidemic, 1954

Bhopal ———- A community downwind from a hazardous waste incinerator

Chernobyl ———- Three Mile Island

London Fog ———- “Acceptable” air pollution standards to protect against asthma attacks
But when the exposures are:

1) Uncertain or mixed
2) Low-to-moderate intensity
3) Of unknown duration

**AND** the exposed population is, 1) small and 2) mobile

**THEN** Detecting an association and establishing a causal relationship becomes Very Difficult

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Three General Situations:

1) An exposure in search of a disease
   (Love Canal, PBB)

2) A disease in search of an exposure
   (cancer, birth defect clusters)

3) A disease and an exposure in search of each other (Woburn, MA)

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Love Canal - An exposure in search of a disease

- Waste burial site for Hooker Chemical from 1942-1953 (22,000 tons of waste)
- Later developed as a residential site
- Leakage from canal into groundwater, basements, backyards, etc
- Over 80 chemicals identified, including benzene, chloroform, trichloroethylene
- Did it cause disease in the exposed population???

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Diseases looking for an exposure

Very often appear as suspected clusters of birth defects or cancer

**Problems:**

Case Definition:
- Limb defect = cleft palate = Down Syndrome
- Breast Cancer = Lung Cancer = Colon Cancer

Recall Bias and Exposure Measurement

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Woburn, MA - Exposure and Disease looking for each other

- City of 37,000; an industrial site for over 130 years: chemical and leather processing, textiles, paper, TNT, animal glue, and insecticides
- Drinking water from 8 municipal wells, two of which were identified as contaminated and shut down in 1979.
- Community concern and evidence of an excess of childhood leukemia (12 cases observed, only 5 expected)

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Questions that needed answering:

1) What are the chemicals in the well and can they cause leukemia?
2) Is there a statistical association between the leukemia cases and the contaminated wells?
3) Could the association be cause-and-effect?
How do we answer these questions?

• Study Design

• Measuring Association

• Measuring Exposure

• Evaluating/Interpreting Cause-and-Effect