Cigarettes and Lung Cancer

Source: American Cancer Society CPEDFF 2002

Surveillance—1

- **Definition**
  - "the ongoing systematic collection, analysis, and interpretation of outcome-specific health data, closely integrated with the timely dissemination of these data to those responsible for preventing and controlling disease or injury"
    - Thacker and Berkelman 1992

- **Modern surveillance began with diseases such as malaria and smallpox**
  - Alexander Langmuir at the CDC in the 1940s

Surveillance—2

- **Goals**
  - Historically
    - Isolate infected individual to minimize disease transmission
  - Current
    - Assess disease status
    - Develop disease prevention and control programs

- **Implications**
  - Without action, surveillance is bad resource allocation (i.e., it is actuarial)
  - This link of research to policy (action) is the difference between public health work and biomedical research

Types of surveillance

- **Active**
  - Relies on periodic solicitation of data
    - Expensive; rarely done

- **Passive**
  - Relies on reporting by healthcare provider
    - e.g., births, deaths, cancer registries

- **Sentinel**
  - Relies on reporting of unusual diseases
    - E.g., polio, mesothelioma

Asthma Visits

Adjusted for Total Visits
Sentinel Reporting of Polio

A Typical Cluster Report

Some Reported Clusters

Defining “Disease Cluster”

Cases DO Cluster!

Some Reported Clusters

Case Map: Woburn, MA

“A Civil Action”
Example: Childhood Leukemia in Woburn, Ma.

- State Study (Kotelchuck and Parker 1979)
  - Overall cancer mortality (1969-1979) higher in Woburn than six adjacent communities and whole state
- State Study (Parker and Rosen 1981)
  - 12 childhood cancers observed, 5.3 expected, \( p=0.008 \)
- State/Federal Study (Cutler et al. 1986)
  - "This investigation confirmed an increase in incidence. Six of the persons with leukemia were located close to each other in one census tract, 7.5 times the expected number."
  - "There were no significant differences between the leukemia victims and persons in the control group"
- Harvard study positive (1984) — controversial
  - 12 childhood leukemia cases where 5.3 expected
  - New cases found after wells closed
- MADPH study finds prenatal water exposure a risk (1996)

Another Example: Toms River, NJ

Case Map: Toms River, NJ

- 14 cases mapped of 21 observed

Toms River, NJ

- Letter from NJDOH to USEPA/ATSDR
  - August 31, 1995
    - ...moderately elevated SIR for all cancers
    - Brain and CNS cancer was more than three times higher than expected for children under 20.
    - For Toms River children under five, brain and CNS cancer incidence was significantly elevated and over seven times higher than expected.
    - Because of the small number of cases included in this analysis, it is not possible to conduct studies to determine possible causes at the municipality or even county level.

Initial Toms River Data

Toms River Chronology

- Fall 1995
  - Childhood cancer excess by nurse at CHOP to USEPA
- February 1996
  - Network TV coverage of possible cluster
- March 1996
  - NJDHSS reports childhood cancer excess, 1977-1995
  - Governor and Health Commissioner at Toms River Town Mtg
- July 1997
  - State and Federal scientists begin $10 million study
- December 2001
  - 69 families settle with Ciba-Geigy, Union Carbide, United Water $13.2 million
  - State/Federal draft report associates prenatal exposure contaminated water and air from Ciba-Geigy with leukemia cases
  - No single risk factor responsible
Scientists’ Anti-Cluster Views

- "The reality is that they're an absolute, total, and complete waste of taxpayer dollars"
  - Alan Bender, Chief of the Section of Chronic Disease and Environmental Epidemiology, Minnesota Department of Health
- "With few exceptions, there is little scientific or public health reason to investigate individual clusters at all"
  - Ken Rothman, author of Modern Epidemiology and founding editor of the journal Epidemiology
- BUT
  - Etiology: Searching under the lamp post problem
  - Community Concerns

Why study clusters?

- Public concern—A Local Disease Excess
  - Clarify of misconceptions—Allay unfounded concerns
  - Initiate study when concerns are well founded
- Encourage Remediation—Disease Prevention
  - Determine if situation is a sentinel of a larger problem
  - Identify unknown exposure situations
- Facilitate Scientific Discovery—Etiology
  - Identify new exposure-disease link
  - Identify new carcinogens

Statistical Significance

- False Positives
  - consider every neighborhood and every cancer
  - adjust for multiple comparisons
- False Negatives
  - small sample size
  - methods have low power
  - persistence and a priori hypotheses

New Approach: Surveillance

- Frequent evaluation of a large database
  - evaluate locally
  - look for changes in space, time, space-time
  - assess persistence of pattern over time
- Combine data with other information
  - confounders, behaviors
- Requires new methods
  - Kulldorff (1995)
  - Rogerson (1997)

Why Surveillance?

- Addresses both WHEN and WHERE
- Responsive to community concerns
  - monitor status of variations
  - can respond meaningfully to inquiries
- Can prioritize situations based on data
- Can investigation most usual occurrences
  - highest rates, most persistent, known exposure

What Can DIMACS Offer?

- Methods for SMALL data sets
- Methods for repeated or post hoc looks at:
  - The same data set
    - Texas sharpshooter vs. sentinel surveillance
    - Routinely updated time series
  - Clusters, bioterrorism...
- Methods to integrate other types of data
  - Birth outcomes, genetics, risk factor information
- Methods for non-coincident boundaries
  - Data collected for different purposes (exposure, disease)