Environmental Public Health Tracking and Biomonitoring:
Bridging the gap

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Outline:

- Understanding health and the environment
- What is Environmental Public Health Tracking (EPHT)?
- National and state program priorities and activities for tracking
- What is biomonitoring?
- MN biomonitoring pilot program
Shifts in the disease burden, public concern, and scientific uncertainty

- There has been a dramatic shift in the health burden from infectious diseases to chronic diseases in the last half century.

- During the same period of time, tens of thousands of new chemical compounds have been produced and are in use by manufacturers and consumers.

- Many of these chemicals have made their way into our air, water, soil, food, homes, and bodies.

- 85% of Americans believe that the environment plays a significant role in health (MMWR 1990).

- Links between chronic diseases and environmental factors are not well understood.
Exposure-Disease Continuum

Exposure to environmental contaminant

Dose

Exposure to target organ or tissue

Pre-clinical effect

Clinical disease

Environmental monitoring
Toxicology
Pharmacokinetics
Exposure assessment
Risk assessment

EPH Tracking

Biomonitoring

Environmental/occupational epidemiology
Environmental/occupational medicine

Disease surveillance
What is Environmental Public Health Tracking?

  - Current environmental public health system is “fragmented”
  - Information gaps and data “silos” preclude health scientists from understanding relationships between environmental exposures and disease
  - Recommended systematic, coordinated public health surveillance of environmental hazards, exposures and disease
  - Web-based, secure, electronic network of integrated and nationally-consistent health and environmental data is needed.
Congress first appropriated funding to the CDC to plan and establish a national EPHT network in 2002.

The national EPHT program …
- Brings together existing health and environmental data systems
- Draws from state networks and from national data systems
- Calculates measures that are consistent across states
- Makes information available through a web-based, secure electronic network

CDC launched their national portal in July, 2009
CDC funds the National EPHT Program: (2009)

CDC currently funds 22 states, 1 city, and 4 academic partners to implement EPHT network.
EPHT in Minnesota

- A law passed in 2007 by the Minnesota state legislature directs the commissioner of health to develop a state-level EPHT and Biomonitoring program.

- Minnesota’s EPHT program goals…
  - Characterize statewide & localized trends and geographic patterns in occurrence of chronic diseases, environmental hazards, and exposures.
  - Disseminate data to the public & researchers.
  - Evaluate the efficacy of public health actions
Environmental Health Tracking System:
using data to drive public health action

Public health action can be education, research, intervention, mitigation or policy
Data collection:
“deconstruction of data silos”
Identify data sources, establish data sharing agreements

MN Dept of Agriculture

MN Pollution Control Agency

Univ. of Minnesota

Minnesota Department of Health
Kinds of EPHT data: Hazards

Pollutants measured in the water, air, or other environmental media
E.g., fine particulate matter and ozone in the air
Kinds of EPHT data: Exposures

Measurements of chemicals and their metabolites in the body; a direct measure of exposure to environmental hazards

E.g., blood lead levels
Kinds of EPHT data: Health outcomes

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<tr>
<th>Hazard</th>
<th>Exposure</th>
<th>Health outcome</th>
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Chronic or acute health conditions potentially related to environmental exposures; public health surveillance data

E.g., asthma hospitalizations and mortality
Core Tracking “Content Areas”
Priorities of the CDC program:

– Hazards
  • Air Quality (Particulate matter and ozone)
  • Drinking Water (arsenic, nitrate and DBP)

– Exposure
  • Blood Lead

– Health Outcomes
  • Hospitalizations (asthma, COPD and MI)
  • Birth Defects
  • Birth Outcomes
  • Selected Cancers
  • Carbon Monoxide Poisonings
Air Quality Tracking Data and Measures

- **Data source:** EPA Air Quality System (AQS)
- **Short term PM$_{2.5}$ exposure** -
  - percent of days with 24-hr average over the NAAQS
  - number of person days with 24 hr avg. over the NAAQS
- **Long term PM$_{2.5}$ exposure** -
  - Annual average ambient conc. PM$_{2.5}$
  - Percent of population living in counties that exceed the NAAQS of 15 µg/m³
- **Short term ozone exposure** -
  - Number of days with maximum 8-hr avg conc. Over NAAQS
  - Number of person days with max. 8hr. Avg ozone conc over NAAQS
Health People 2010 objectives

- Reduce the proportion of persons exposed to air that does not meet the US EPA’s health-based standard to PM by 2018
- Reduce the proportion of persons exposed to air that does not meet US EPA’s health-based standards for ozone by 2012
- New data sources are being explored
“Developmental” Tracking Priorities in Minnesota and CDC

Minnesota is working in collaboration with other states to develop new methods for tracking:

✦ Climate Change
  – Heat-related illness
  – Population vulnerability
  – Vector-born diseases
  – Extreme weather emergencies

✦ Pesticide Hazards and Associated Illness

We hope to develop and pilot new tracking indicators over the next 2 years
Web Portal for Data Access

New Mexico Environmental Public Health Tracking (EPHT) Program

The Centers for Disease Control and Prevention (CDC) are leading the initiative to build a Web-based National Environmental Public Health Tracking (EPHT) Network to create a better understanding of how the environment affects people's health and to educate the public about ways to protect themselves from possible exposures and their related health effects.

Environmental Exposure
- Exposure Assessment
- Contaminants of Concern
- Environmental Data
  - Air
  - Fish
  - Water
- Exposure Data - Biomonitoring
  (Hair, Blood, Urine)
- More...

Health Effects
- Health and Environment Linkage Studies
- Health Data
  - Birth and Birth Defects
  - Cancer
  - Cardiovascular (Heart Attack)
  - Respiratory (Asthma)
- More...

New Mexico Mapping
- Discover, Query, and Map Data
- State Maps and Images
- Land Surface/Wildfires
- Pollen, Vegetation Greenness
- Dust Forecast
- Legislative Districts
- More...

Environmental conditions and hazards in New Mexico have substantial impacts on health, with related medical costs estimated at nearly $1 billion per year. Although the exact burden of environmentally related disease, disability, and death is unknown, recent studies have shown how significantly environmental exposures contribute to chronic diseases: lead poisoning (100%), childhood asthma (10%-35%), cardiovascular disease (7%-23%), childhood cancer (2%-10%), all cancers (1%-5%), and neurobehavioral disorders in children (5%-26%). Much chronic disease caused by exposure to environmental pollutants can be reduced through pollution prevention and exposure mitigation measures.

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Asthma Hospitalization Rates in Twin Cities Metro and Greater Minnesota

Source: Minnesota Hospital Association, MDH Asthma Program
**Biomonitoring**

*Definition:* The direct measurement of chemicals or their metabolites in human specimens, e.g. blood or urine.

“The most health relevant method of determining human exposure to environmental hazards is biomonitoring.”

*Public Health Goal:* to monitor and track trends over time, to identify exposure disparities, to target and evaluate interventions, and make better public policy decisions for protecting health.
Blood lead levels in the U.S. population, 1976-2002

NHANES II, III, 1999-2002

Year

Blood lead levels (g/dL)

- Blood lead levels in the U.S. population, 1976-2002
- NHANES II, III, 1999-2002
- unleaded gasoline introduced 1975
- lead paint ban 1976
- lead soldered cans, phase-out begins 1978
- lead & copper rule 1991
- leaded gas removal complete 1991
- lead soldered cans, phase-out ends 1992
- leaded gas removal complete 1991

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Exposure of the U.S. Population to Tobacco Smoke: Serum Cotinine Levels, 12,000 People, 1988-1991

Serum cotinine (ng/mL)

Percentage of population

Nonsmokers (ETS exposure)

Smokers

Serum cotinine (ng/mL)
Decline in Exposure of U.S. Population to Environmental Tobacco Smoke

Serum cotinine (50th percentile in ng/mL)

1988 - 1991: 0.20
1999 - 2000: 0.05

This facility is smoke free.
Biomonitoring has shown levels of Perfluororochemicals (PFCs) declining in the general population since 2000. 3M stopped production in 2002.

Temporal trends for five polyfluoroalkyl concentrations (ng/mL) from the CDC NHANES and American Red Cross study populations for the population geometric means (95% confidence intervals.)

Biomonitoring Pilot Program in Minnesota

Minnesota Statutes 144.995-144.998

- 4 Pilot projects:
  - Perfluorocarbons (PFCs)
  - Arsenic
  - Mercury
  - Environmental phenols and cotinine

- Projects must be done in communities “likely to be exposed” and conducted in a manner that is community-based

- Seeks recommendations for ongoing “Base” biomonitoring program
Developing guidelines and recommendations for an ongoing program

★ MDH has developed guidelines to guide decisions for the pilot projects including:
  – Ensuring privacy
  – Informed consent (NIH)
  – Inclusion of children
  – Storage (banking) of samples
  – Interpretation of results
  – Follow-up support and medical consultation

★ With recommendations of the Advisory Panel, MDH is engaged in a strategic planning process that will recommend:
  – A statement of vision and purpose for a state biomonitoring program
  – Best practices, strategies and methods for biomonitoring
  – Criteria and a process for selecting chemicals for future biomonitoring

★ Lessons learned will be summarized. Development of recommendations and strategic planning is ongoing.
Integration of Biomonitoring and Tracking

- A priority for CDC and many states
- New federal grants to public health laboratories have been awarded and encouraged collaboration between environmental epidemiologists (funded Tracking programs) and laboratorians
- Goal: track population exposures over time and integrate data on a scale that can be linked with health outcome and source data
Environ. Health Tracking and Biomonitoring: Bridging the Gap

Next:
• Biomonitoring Projects and Lessons Learned
• Tracking asthma in MN
• Linking data: air quality and asthma

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- Public Health Lab
- Univ. Of MN
- MPCA
- MDA
- Advisory Panel
Measuring the Impact of PM Reductions by EH Indicators

Minnesota Department of Health
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Minnesota Pollution Control Agency
Gregory Pratt, Lisa Herschberger, Kari Palmer, Margaret McCourtney

Olmsted Medical Center, Rochester, MN
Barbara Yawn, Peter Wollan
Measuring Impacts & Accountability

- Regulatory or Policy Changes
- Reductions in Population Exposures
  - PM10
  - PM2.5
  - PM2.5 species
  - Co-variates: ozone, pollen
- Reductions in Population Health Outcomes (Attributable Fraction)
  - Hospitalizations
  - ED Visits
  - EMS Runs
  - Clinic Visits
  - Prescriptions
Data Linkage Methods in Environmental Epidemiology

- Correlation
- Ecological
- Case-control
- Cohort
- Case-crossover
- Time series
- Panel studies
- Spatial epidemiology
Ecological Studies

Exposures and health outcomes are measured in groups of people rather than individuals, as the unit of analysis

- County, zipcodes or census block level

- Uses aggregate measures of exposures
  - Average exposure over a specific time period
  - Proportion of defined population exposed

- Compares to aggregate health measure
  - Counts or rates of disease

Traditional used for “exploratory analysis” due to validity concern “ecologic fallacy” –error due to misclassification of individual exposure

Plays a larger role in environmental epi when large populations are assumed to share the same exposure
  for example-air pollution epidemiology studies