Environmental Public Health Tracking - Health and Environment Linked for Information Exchange-Atlanta (HELIX-Atlanta): A Cooperative Program Between CDC and NASA for Development of an Environmental Public Health Tracking Network in the Atlanta Metropolitan Area

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Public Health

• The science and art of preventing disease, prolonging life, and promoting health through organized efforts of society.
Environmental Public Health

- Aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial factors in the environment.
- The theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.
The Public Overwhelming Believes That Environmental Factors Are A Major Cause Of Health Problems And Disease

Positioning Environmental Factors As “Causes Of Disease” Or “Causes Of Increased Rates Of Disease” Makes No Difference

Do you think environmental factors like pollution are...cause of diseases and health problems?

<table>
<thead>
<tr>
<th>Percent</th>
<th>Important</th>
<th>Not Important</th>
<th>Don't Know</th>
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<tbody>
<tr>
<td>86%</td>
<td>38% very important</td>
<td>13%</td>
<td>2%</td>
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</table>

Do you think environmental factors like pollution are...cause of increased rates of diseases and health problems?

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<tr>
<td>87%</td>
<td>42% very important</td>
<td>11%</td>
<td>2%</td>
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The Mellman Group Inc./Public Opinion Strategies 5/99

(darker shade=stronger intensity)
Public Health Approach

Surveillance: What is the problem?

Risk Factor Identification: What is the cause?

Intervention Evaluation: What works?

Implementation: How do you do it?
Public Health Surveillance

- Ongoing systematic collection, analysis, and interpretation of outcome-specific data used to plan, implement, and evaluate public health practice.
Types of PH Surveillance

- **Prevalence**
  - All cases

- **Incidence**
  - Newly diagnosed cases

- **Active**
  - Health department initiated

- **Passive**
  - Health care provider initiated
Surveillance Information Uses

- Monitor & detect changes in the magnitude & distribution of selected events
- Develop hypotheses for research
- Evaluate interventions
- Facilitate public health decision-making
# Health Effects, Exposures, Hazards

## Health Effects
- Asthma
- Poisoning – heavy metal; CO; pesticides
- Cancer
- Birth Defects
- Other adverse reproductive outcome such as low birth wt, preterm birth
- Developmental disabilities
- Other chronic respiratory disease
- Multiple Sclerosis
- Cardiovascular Disease
- Systemic Lupus Erythematosus
- Amyotrophic lateral sclerosis

## Exposures/Hazards
- PCBs
- Heavy metals
- Pesticides
- Environmental tobacco smoke
- Radionuclides
- Asbestos
- Other drinking water contaminants such as trihalomethanes, PCE, TCE,
- Outdoor air contaminants such as particulate mater, ozone, CO and air toxics
- Indoor air contaminants such as mold, carbon monoxide
Measuring Public Health

• How do we measure progress towards the aim of public health to prevent disease & promote health?
  – Idea of systematically observing, recording, collecting, & analyzing data for intervention stems from Hippocrates

• What events should be under surveillance?
  – System for organizing and classifying health-related information
  – Uniform surveillance endpoints
  – Translates complex knowledge into simple units of information for communication
Tracking = Public Health Surveillance

• Environmental public health tracking is the ongoing, systematic collection, integration, analysis, and interpretation of data about the following factors:
  • environmental hazards
  • human exposure to environmental hazards
  • health effects potentially related to exposure to environmental hazards

• Data must be disseminated to plan, implement, and evaluate environmental public health action
CDC’s National Environmental Public Health Tracking (EPHT) Program initiated in 2002

- Congressional funding for development and implementation of a nationwide environmental health tracking network and capacity development in environmental health at State and local health Departments”
Selected EPHT Network Features

- Tools for linkage, visualization, analysis, generation of alerts, & reporting
- Internet-based
- Standards-based
- HIPAA compliant
- Access to the network is based on role & purpose
National Environmental Public Health Tracking Program 2003
Public Health Surveillance Objectives

- Estimate the magnitude of a health effect in the population at risk
- Understand the natural history of a health effect
- Detect health effect outbreaks/clusters or epidemics
- Document the distribution and spread of a health effect
- Develop hypotheses about etiology
- Monitor and evaluate interventions
- Monitor and detect changes
- Assess quality and safety of health care
- Identify research needs and facilitate epidemiologic and laboratory research
- Facilitate planning
PH Surveillance System Attributes

- Simplicity
- Flexibility
- Data quality
- Acceptability
- Sensitivity (ability to detect)
- Predictive value positive (false-positives)
- Representative
- Timeliness
- Reliability
Planning a PH Surveillance System

1. Establish objectives
2. Develop case (event) definitions
3. Determine data sources, data collection mechanisms, and type of system
4. Develop data collection instruments
5. Field-test methods
6. Develop and test an analytic approach
7. Develop a dissemination mechanism
8. Assure use of analysis and interpretation
HELIIX-Atlanta

• Provide information regarding the 5-county Metro-Atlanta Area
  • Clayton, Cobb, DeKalb, Fulton, & Gwinett

• Integrate environment & public health data into a local network that is part of a national network

• Take action to prevent & control environmentally related health effects
HELIX-Atlanta Purpose and Goals

To enable different environmental and non-infectious public health information systems to build bridges to communicate with each other for environmental public health surveillance.

Goal #1: Build a Sustainable 5-County Metropolitan Atlanta Area EPHT Network consistent with the national EPHT Network

Goal #2: Increase EPHT Capacity in the 5-County Metropolitan Atlanta Area

Goal #3: Disseminate Credible Information

Goal #4: Advance Environmental Public Health Science and Research

Goal #5: Build Bridges Between Health and Environment in the 5-County Metropolitan Atlanta Area
**HELIX-Atlanta Partners**

- **Federal**
  - CDC / ATSDR
  - EPA*
  - NASA*

- **State**
  - GA Div. of Pub. Hlth. & GA EPD

- **Local**
  - Cty. Health Depts.

- **Academic**
  - Emory Univ.
  - GA Tech Univ.

- **Other**

* Memorandums of Understanding (MOUs)
HELIX-Atlanta Projects

- **Birth Defects**
  - Integrate data for air & birth defects

- **Developmental Disabilities & Lead**
  - Integrate data for housing age, blood lead biomonitoring, & developmental disabilities

- **Cancer**
  - Integrate data from traffic & childhood cancers

- **Asthma**
  - Select a standardized classification system & evaluate existing data sources

- **Water**
  - Identify data gaps & strengths
What Do We Have?
Partnerships

- Memorandums of Understanding
  - CDC/EPA (existing)
  - CDC/NASA (existing)

- Public Health and Environmental Partners
  - Federal
  - State
  - Local
  - Academic
  - Other

- National Environmental Public Health Tracking Cooperative Agreements (33)
  - State
  - Local
  - Academic
HELIX-Atlanta Approach

- Network has shared functionality
- Network is a tool to access interoperable information systems with optional linkage functionality
  - Information technology linkages driven by scientific rationale
  - Agreed upon core ongoing linkages to respond to priorities
  - Linkage, analysis, and other functions sit within the network, but outside the information systems
  - Agreed upon standards used for data exchange and access
What Do We Have?
Public Health Databases

- Existing Surveillance Information Systems in 5-County Metropolitan Atlanta Area
  - *Metropolitan Atlanta Congenital Defects Program (MACDP)
  - *Metropolitan Atlanta Developmental Disabilities Surveillance Program (MADDSP)
  - *Georgia Perinatal Surveillance/Vital Records
  - *Georgia Childhood Lead Poisoning Prevention Program
  - National Adult Blood Lead Epidemiology and Surveillance
  - *Surveillance, Epidemiology, and End Results (SEER) Atlanta Registry
  - Other

- Existing Information Systems (not surveillance or not local level)
  - Emory Study of Particles and Health in Atlanta (SOPHIA)
  - *Asthma/Respiratory Health
  - Other

*Selected at October 30, 2003 HELIX-Atlanta Partners Working Meeting
What Do We Have?

Environmental Monitoring Databases

- *EPA air quality monitoring
  - Criteria air pollutants
  - Air toxics
  - National Air Toxics Assessment Analysis (NATA)
- EPA emissions inventories
- EPA drinking water monitoring
- EPA other monitoring
- *HUD lead in housing monitoring
- USGS source water monitoring
- *NASA remote sensing
  - Land surface temperature
  - Particulate matter
- Other

*Selected at October 30, 2003 HELIX-Atlanta Partners Working Meeting
What Do We Do?

Implementation

- Evaluate database(s) for use in HELIX-Atlanta
- Develop partnerships
  - Obtain authorization to access data (trading partner agreements)
- Develop plan to prepare and compile data for linkage
- Identify appropriate analysis techniques and tools
  - Who does analysis?
  - What is the frequency of analysis?
- Be compliant with standards and specifications of the Public Health Information Network (PHIN)
- Be interoperable with the EPA National Environmental Information Exchange Network (NEIEN)
- Develop a Technical Implementation Plan
  - Address other architecture, software, and electronic communications questions
- Obtain IRB and OMB Approval or Exemption
What Do We Do?

Timeline

- **January 2004**
  - Confirm partners and roles
- **January 2004-June 2004**
  - Protocol development and planning (team & overall)
- **July 2004-December 2004**
  - IRB and OMB process
  - Ongoing
    - Communications
    - Evaluation
- **January 2005-December 2005**
  - Implementation
  - Ongoing
    - Communications
    - Evaluation
- **January 2006**
  - Recommendations for sustainability of network
  - Next steps
  - Communications
  - Evaluation
Estimating Surface PM 2.5 Concentrations using NASA MODIS Satellite Data
Surface Temperature (MODIS)
PM2.5 (inferred from MODIS data)
Objective: Estimate daily PM$_{2.5}$ concentrations across the Atlanta area using data from NASA’s MODIS satellite

- **MODIS Aerosol Optical Depth (AOD) characteristics:**
  - Provided on a 10x10 km grid
  - Used in NOAA/EPA Air Quality Forecast Initiative to produce air quality forecasts for northeastern US; forecasts for entire US by 2009
  - Available twice per day (~10:30 AM, 1:30 PM)
  - Not available when clouds are present
  - Available since spring 2000
Procedure

• For a base time period (2002-2003), obtain MODIS Aerosol Optical Depth (AOD) and EPA AQS PM$_{2.5}$ data
• Extract AOD data for AQS site locations
• Calculate daily averages from hourly AQS PM$_{2.5}$ data
• Using daily PM$_{2.5}$ averages from hourly sites, as well as daily values from sites reporting daily, determine statistical regression equations between and PM$_{2.5}$ MODIS AOD
• Also determine regression equations using mean values across all sites
• Apply regression equations to estimate PM$_{2.5}$ for each 10 km grid cell across region
PM 2.5 Data Examples

- Excellent agreement between measurements at multiple sites each day
- Only slight seasonal variations
- Large day-to-day variations
MODIS Aerosol Optical Depth (AOD) Data Examples

- 31-day averages at each site and mean of all sites
- 2003 shows higher summer values and more seasonal variation
- Daily all-site means of observed and predicted PM$_{2.5}$
- MODIS-based predictions follow seasonal PM$_{2.5}$ patterns
- MODIS AOD is nearly constant in fall and winter, while observed PM$_{2.5}$ is not
### PM 2.5 – MODIS AOD Correlations

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<tr>
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<th>S. Dekalb</th>
<th>Doraville</th>
<th>E. Rivers</th>
<th>Means</th>
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<tr>
<td><strong>2002</strong></td>
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<tr>
<td>All days</td>
<td>0.526</td>
<td>0.616</td>
<td>0.543</td>
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<td>April-Sept</td>
<td>0.605</td>
<td>0.601</td>
<td>0.581</td>
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<td>Oct. - Dec.</td>
<td>0.126</td>
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<tr>
<td>All days</td>
<td>0.653</td>
<td>0.400</td>
<td>0.740</td>
<td>0.606</td>
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<tr>
<td>April-Sept</td>
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<td>0.743</td>
<td>0.704</td>
<td>0.687</td>
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<tr>
<td>Oct. - Dec.</td>
<td>0.322</td>
<td>0.386</td>
<td>0.377</td>
<td>-0.056</td>
<td>0.224</td>
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</table>

- Correlations between PM$_{2.5}$ and MODIS AOD are generally high (> 0.5) for all days and for the warm season
- Correlations are slightly higher in 2003 than in 2002
- Correlations for Oct-Dec are very low for all sites
Conclusions

• On a given day, both \( \text{PM}_{2.5} \) and MODIS AOD show excellent between-site agreement across the Atlanta area.

• Day-to-day variations in \( \text{PM}_{2.5} \) and AOD are large but seasonal variations are small.

• MODIS AOD tracks the seasonal patterns of \( \text{PM}_{2.5} \).

• MODIS AOD does not capture the day-to-day \( \text{PM}_{2.5} \) variability in fall and winter.

• Correlations between AOD and \( \text{PM}_{2.5} \) for the warm season are generally > 0.5 for individual sites and for the means of all sites.
www.cdc.gov/nceh/tracking