



Developing a Local Comprehensive Environment and Health Tracking System: Using What We Know to Improve Health and the Environment

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Abstract

Recent national reports have highlighted the absence of a coordinated local, state, and national environmental health tracking system. Local environmental health agencies are struggling to design and implement data systems that will allow them to evaluate environmental exposures, ecological trends, and health outcomes in order to formulate more effective prevention strategies. This paper articulates the need for local environment and health tracking systems, discusses efforts under way around the nation, and describes the initiative being undertaken in one county health department to address this need. It provides information on attributes of indicators to be included in such a system, sources of data, criteria for evaluating the usefulness of indicators, suggestions for involving the community and staff, management strategies for implementing a data system, and recommendations for resolving common barriers to data sharing and use. This information will be useful to agencies that wish to develop their own robust environment and health tracking systems to support the three core functions of public health and the 10 essential public health services.

Introduction

Numerous local and state environmental health agencies are working to develop environment and health tracking systems that will allow them to assess the status of health and the environment, detect unusual events and emerging diseases, target limited resources more effectively, and ensure that comprehensive services are in place to address community needs. The Allegheny County Health Department (ACHD) in Pittsburgh, Pennsylvania, in conjunction

with the Graduate School of Public Health at the University of Pittsburgh, Carnegie Mellon University, and the Pennsylvania and Ohio Public Health Training Center, is taking an active role in this national dialogue, and has embarked on an initiative to develop one of the first comprehensive local environmental health tracking systems in the country. This system may eventually be linked to state and national data systems as part of an effort to create a multilevel national environmental health tracking network.

National Efforts Identify the Need for an Improved Surveillance System

In the past, multiple types of data were collected, but the data were not linked among programs within an agency, much less among local, federal, and state levels. Collected in isolated programmatic areas and often in different formats, the data did not lend themselves to management analysis, to associations between environment and health status, or to measuring the effectiveness of prevention and intervention programs. Over the past two years, increasing national attention has been focused on this important gap in public health capacity.

The 1988 report, *The Future of Public Health*, published by the Institute of Medicine (IOM), and the 2000 Pew Environmental Health Commission report, *America's Environmental Health Gap*, highlighted the need to build a stronger public health infrastructure, which would include a nationwide health-tracking system. A system of this type would provide rapid access to standardized information related to environmental hazards, human exposures, and statistics on chronic disease and other related health endpoints (IOM, 1988; Pew Environmental Health Commission, 2000). As outlined in the Pew Commission report, components of a health-tracking network would include

1. baseline tracking of human exposure and health outcomes;

2. an early-warning system for critical environmental health threats;
3. statewide pilot tracking programs to test disease, exposure, and approaches for a national tracking network;
4. federal investigation for rapid-response capacity; and
5. tracking links to the communities and research.

The Centers for Disease Control and Prevention (CDC), the National Center for Environmental Health (NCEH), and the Agency for Toxic Substance Disease Registry (ATSDR) have joined forces in planning an Environmental Health Tracking Network. As a follow-up to the Pew report, NCEH, CDC, and ATSDR developed a proposed plan for an environmental public health tracking network (2001). The plan articulated priorities in the following areas:

1. organization and management to establish collaborative linkages among local, state, and federal agencies;
2. data technology and tracking methodology to identify relevant national data standards; to establish system specifications, such as systems modeling; and to set up system automation for linking data;
3. a tracking-system inventory and needs assessment to identify existing tracking systems and to identify and prioritize the development of new systems; and
4. a public policy and public health action work group to develop recommendations on rapid response to the data produced and on ways of making data more accessible to citizens.

NCEH sponsored four expert work groups to define the strategies necessary for the foregoing priority areas. Their recommendations are detailed in the *Report of the Tracking Network Workgroups* (NCEH, 2002b). In addition, CDC provides up-to-date information on the environmental public health tracking network at www.cdc.gov/nceh/tracking/.

Importance of a Robust Surveillance System to Improving Public Health

Why is a comprehensive environmental and health surveillance system so important? First, such a system is essential to fulfilling the core functions of public health, as outlined in the IOM report, *The Future of Public Health* (1988). The report defined these core functions as assessment, policy development, and assurance:

- assessing the intensity and distribution of public health and environmental issues in a community,
- developing policy that equitably and effectively addresses these needs, and
- assuring that services are provided while assessing the effectiveness over time of all of the aspects of a public health infrastructure.

These core functions are supported by the 10 essential public health services, as identified by a national public health function work group in 1994.

More details on the 10 essential services and accompanying workforce competencies can be found at the Public Health Foundation online distance-learning clearinghouse (2002).

A robust tracking system supports each of the 10 essential services. A thoughtfully designed system allows public health professionals to monitor, diagnose, inform the public, mobilize the citizens, develop policies and plans, enforce laws and regulations, link people and ensure needed services, ensure a competent workforce, conduct evaluation and continuous improvement, and link programs to the latest research. A good system is especially powerful when it is able to present health, environmental, and demographic data in a visual framework such as a geographic information system. Ideally, such a system leads to improvements in both health status and environmental quality.

Initiatives Around the Nation

A great deal of interest has been expressed in the development of environmental indicators as a starting point in tracking the occurrence of environmental hazards, exposures, and adverse health outcomes. Many agencies and organizations, including the Council of State and Territorial Epidemiologists (CSTE), CDC, ATSDR, and the U.S. Environmental Protection Agency (U.S. EPA), have jointly worked toward developing a set of environmental public health indicators (EPHIs). These indicators would serve as the national standard, or common set of indicators, allowing for linkage within or across agencies for tracking purposes (Lengerich, 1999). More information about the EPHI project can be found at Web sites maintained by Anderson (2001), CSTE (2002), and NCEH (2002a).

The California Department of Health has proposed to develop an environmental health tracking system for ongoing surveillance of environmental exposures and diseases affecting Californians, with a focus on prevalence

and determinants of chronic diseases. In the fall of 2001, California's Legislature enacted a bill (SB 702) that required the creation of a work group to develop recommendations for this health tracking system. Further information on this process can be found at the Web site of the California Department of Health Services (2002).

In April 2002, the Institute of Medicine convened an environmental health roundtable, a national two-day conference of experts titled *Closing the Gap Between Environment and Health* (National Academy of Sciences, 2002). This meeting looked at data collection issues such as balancing the government's need to collect health data with the privacy rights of individuals and coordinating data collection among federal and state governments.

The Allegheny County Initiative

In 2000, ACHD entered into a cooperative agreement with NCEH to improve its environmental health capacity. The county recognized that without a robust surveillance system, it could not assure itself that it was effectively addressing the health and environmental needs of its citizens.

Within the framework of building this system, ACHD focused its attention first on the development of a set of environmental indicators that would serve as the primary mechanism to assess the environmental health status of the residents of Allegheny County. ACHD sought indicators that would provide information on the physical, socioeconomic, and geographic aspects of the environment, and provide a means of assessing environmental risk, health outcomes, and the effectiveness of environmental health interventions. For example, the county would track the number of river advisory days as a measure of the quality of river water and the threat it might pose to human health. Indicators of this sort would be used as building blocks for the health-tracking network and serve as the standard tool for assessing environmental risk and health outcomes within Allegheny County.

To advance this initiative, Allegheny County invited its staff and a national panel of public health experts with backgrounds in epidemiology, environmental toxicology, and environmental and public health practice to join in a two-day dialogue organized around a series of questions. The health department program managers worked with the information gathered from this workshop, which served as the basis for identifying

TABLE 1**Use of Indicators by Multiple Audiences**

Audience	Questions Asked by the Audience on the Basis of Information in the Indicator	What is the Action Time Frame for the Indicator?
Board of health	Should Air Quality Program priorities be reordered according to the 8-hour ozone standard? Should new regulations be enacted?	Long term
Program managers	Is the air getting better? Are our regulations adequate based on the standard? Should the department announce an ozone action day?	Intermediate Short term
Public	How do I protect myself? Should I stay indoors today? Should I cut the grass today?	Immediate

criteria and methodologies in developing a list of environmental indicators for the Allegheny County region. A summary of the panel's response to each of the four focus questions follows, along with a discussion of the process used by ACHD staff and recommendations for other local health departments.

Focus Question 1: What Makes a Good Environmental Indicator?

It is advantageous to have criteria for selecting the most useful indicators from the universe of possible indicators. Ideally, an indicator should measure outcomes versus activities. For example, the health department traditionally uses measures such as the number of food inspections conducted, pounds of pesticides applied, and quantities of toxic chemicals in ambient air. Outcome measures for health department activities include the number of cases of foodborne illness, incidents of pesticide-related poisoning and sickness, and unusual patterns in incidence of acute asthmatic, cardiovascular, or respiratory events.

Although it is useful to demonstrate the levels of program activity, program services, and public requests for inspections, it is important to be able to show the effectiveness of the interventions. An indicator needs to be meaningful in decision making; that is, changes in the indicator should lead to some type of action or reaction, even if it is just to affirm that the intervention is working. For instance, the blood lead levels measured in children should decline with the children's participation in lead abatement programs and the number of services provided.

Emphasis should be given to indicators that will lead to the design of interventions to prevent disease and injury. Local health departments may wish to use state and local morbidity and mortality data to evaluate which of the illnesses and fatalities might have been preventable. As an example, rising numbers of gunshot injuries suggest the need to provide more effective violence interventions.

Health departments also should review nationally established indicators such as those identified in Healthy People 2010 and the environmental public health indicators (NCEH, 2002a; U.S. Department of Health and Human Services, 2000). Guidelines highlighting the criteria used for selecting the EPHIs can be found at the CSTE Web site (2002). Another useful tool for identifying key attributes in the development of tracking indicators can be found at the Web site of the Commonwealth Scientific and Industrial Research Organisation (1999).

Indicators need to be timely, accurate, and reliable. It should be relatively easy to collect data for the indicators on a routine basis, as often as may be appropriate for a particular indicator. In addition, attention needs to be given to the cost of collecting the data, their relevance, and the ease with which they can be understood, in order to ensure that they will be both collected and used.

A good indicator provides useful and relevant information. For example, an indicator can tell researchers specifically which populations are being affected. An indicator looking at homicides would provide information about the disproportionate number of African-Americans involved in firearms-related deaths, particularly among teenagers

and young males. It would not be as effective to have an indicator on total gun violence without knowing about the burden of disease in a particular population and the relevant exposure pathways. Additional outcomes data on mental illness and toxicology related to homicides may provide valuable information about the burden of disease and lead to the development and implementation of psychological and social service programs that address the physical, mental, emotional, and social health needs of this population.

Indicators can help evaluate strategy effectiveness and indicate whether to continue or change an intervention. Good indicators are useful to the public and provide information to help individuals protect their own health. Indicators also can be used by program managers and policy makers to determine whether current resources are adequate and whether resources need to be reallocated. Attainment of U.S. EPA's annual PM_{2.5} standard for air pollution would suggest that current controls and activities are adequate. Failure to attain the standard would suggest the need to understand the effects of regulatory action, industry response, and technological capabilities, so that it can be determined what steps are necessary to reach attainment.

Selected indicators should include known priorities, established through public health knowledge and experience, research literature, community concerns, and the priorities of elected officials. It is essential to gather input at the beginning from the community and its elected officials in order to gain a broader community perspective, to educate the community about the need and the process, and to gain support for the long-term effort. In Allegheny County, at the initiation of the project, focus-group meetings were held with the dean of the Graduate School of Public Health at the University of Pittsburgh and community leaders to let them know about the process.

Table 1 illustrates the use of air quality indicators by multiple audiences. For instance, an exceedance of the eight-hour ozone standard may suggest to the board of health that new regulations for the air quality program need to be enacted. Before action is taken, however, a long-term trend analysis of the data must be completed. The ACHD Air Quality Program manager uses the indicator in an anticipatory manner. A sustained eight-hour ozone level also entails a pro-

grammatic response: the issuance of an ozone alert to the public. The Air Quality Index is the indicator used to alert the public of an ozone action day. The public responds immediately by modifying daily activities: staying indoors and not mowing the lawn. Regardless of who is using it, the indicator must be clear and understandable by the intended audience.

Focus Question 2: What Are Some Important Types of Indicators?

Each community in the United States is finding that its mix of indicators includes some local and some national indicators, depending on the needs and concerns of the community.

The demographics of the community should play an important part in the decision about what to collect and track. What are the differences in health outcomes and environmental and community living conditions for different ethnic, income, and racial groups? What about the mortality rates by age group, and what more can be done within each age group to prevent death? For instance, community data related to perinatal conditions and birth defects may be useful in the design of interventions to enhance nutrition, prevent environmental exposures, and improve access to health services. Community demographics can inspire collaborative partnerships to decrease injuries and even homicides. Additional community strategies might emerge from dialogue about the acceptability of rates of tobacco use, domestic violence, and access to and use of firearms. It is the responsibility of the health department to bring these data to the attention of policy makers and the public, who can work together to bring about a more effective strategy than the health department can implement on its own.

In addition, health departments may wish to select indicators to measure suspected hazards for which there are not yet data, and to work with the academic community on research that might lead to the identification of possible environmental contributors to such things as autism, ADHD, immune system impairments, and neurological diseases. The research community should also be helpful in suggesting emerging public health issues that will be important in the next five to 10 years and in noting whether there is research related to an indicator.

TABLE 2

Selected Indicators for the Allegheny County Health Department

Name of Indicator	Suggested Measure
Air quality index	Maximum air quality index on any particular day
Ambient pollutants	Attainment of ozone 8-hour standard Days exceeding ozone standard Attainment of the annual PM _{2.5} standard (fine particulates) Annual PM _{2.5} level Attainment of sulfur dioxide standard Attainment of nitrogen dioxide standard Attainment of carbon monoxide standard Attainment of lead standard
Hazardous air pollutants	Toxins emitted by large point sources Toxic chemicals in ambient air
Illnesses caused by food pathogens	Infectious-disease agent (rate of occurrence of pathogen-specific disease—e.g., shigatoxin from <i>E. coli</i> , salmonellosis)
Food safety assessment	Violation of critical risk factors (e.g., cooking temperature, cooling, facility sanitization)
Facility outbreaks	Outbreaks confirmed through —positive hospital report —positive food sample —positive agent at facility —epidemiological evidence
Public drinking water	Drinking-water standards (federal standards)
Medical (water) surveillance	Waterborne outbreaks (rate of occurrence of specific diseases—e.g., legionellosis, giardiasis)
Private well monitoring	Well sites Well construction Well abandonment Well water safety (bacteriological quality)

In building a tracking system, health departments should select a few priority areas in which to collect data. The priority indicators may be linked in a tiered system in which each audience reviews a related set of indicators. In such a system, program managers would review a larger set of indicators, while the board of health would review representative indicators that reflect effectiveness and trends.

As a beginning point for three of the programmatic areas, ACHD selected the indicators listed in Table 2. Staff experts believe that these indicators were a good starting point in light of the availability and accessibility of the data, and the ability to align indicators with program objectives.

For comparison purposes, it is good where possible to collect the indicators in the same formats as those used by like-sized units of government around the country, and to stay informed about the indicators that others are developing to encourage dialogue and best practices. NCEH maintains a free environ-

mental health listserv for environmental health personnel (2002c) and provides a list of the EPHIs (2002a). The Web site and the tracking network work groups are two excellent sources of information on indicators (NCEH, 2002b). Participating in state and national conferences is another way to promote excellence in the practice of environmental health, and to learn about emerging issues for which additional indicators might be developed.

Focus Question 3: Where Does One Find the Data for the Environmental Indicators?

There are many places to look for data other than traditional public health programs. The health department collects data for land use permits, community resources, immunizations, hospitalizations, and health outcomes. Other local government agencies have a great deal of data; however, the data may not be readily accessible or located in a central repository. Hospitals, primary-care physicians, and

TABLE 3**Types of Data Sources and Use of Data**

Data Sources	Data Collection Methods	Questions Suggested by the Data
Environmental & business	Survey	Are you meeting regulatory goals? How many establishments are not meeting an important regulation?
State & local environmental agencies	Monitoring systems	How many lakes and streams are polluted?
Medical surveillance	Sentinel, Passive Surveillance National Electronic Database System	Do we have the appropriate alert system in place?
Employer	Top 10 medical diagnoses	How can we collaborate with employers to address common health issues?

TABLE 4**Barriers to Data Collection and Process Improvement Strategies**

Barriers to data collection and use	Process improvement strategies
Lack of standard approach to collecting and storing data with the health department.	Provide written protocols and guidelines for data collection health department and data storage.
Community data has not been accessible, usable, user-friendly, and/or shared.	Memorandum of agreement with collaborative partners to define format, access protocol, and confidentiality statement.
Perception of data entry as clerical task slows down data collection and use.	Dedicated staff person trained in the data analysis process. Management requires all staff to be trained in the data gathering and entry process.
Turf issues-confidentiality.	Provide a written guideline for ownership and confidentiality issues.
Lack of information infrastructure hardware, software, and human resources.	Seek necessary funds for data infrastructure and hire a dedicated systems employee.
Lack of training employees on vision and importance.	Enlist employees as stewards of the data collection and data management process. Encourage employee and involve with public health data management.

employers represent rich sources of data; access to these data can be gained through establishment of partnerships outside the local health department or local agency. Once partnerships are formed, regular meetings should take place to discuss methods for data collection, access to the data, and use of the data, as described in Table 3.

As shown in Table 4, gathering data presents several challenges. Barriers to data collection can be reduced or eliminated through process improvement activities. Suggestions are provided below for strategies to help eliminate barriers to data collection and sharing.

Focus Question 4: What Is the Vision for How These Indicators Can Be Used?

Ideally an environmental health system is used by the public, by policy makers, and by environmental health professionals together to improve the environmental health of the community. While one indicator can be useful and provide meaning, a tracking system with multiple indicators offers a more powerful capacity to support collaborative efforts among the public, policy makers, and environmental health professionals to improve the health of the community. Often, the most powerful indicators are those that are geo-specific and

cross-referenced to sociodemographic, economic, and land use data. Some communities are beginning to think in terms of "suites" of indicators. These groups of data say more together than any one indicator on its own. When these are collected and portrayed visually, the data then become powerful information for systems and policy change. Community members and elected officials are more likely to see the connections with the need for additional public health resources, as well as the links between health and economic improvement, healthy land use decisions, job training and access, daycare, and a healthier workforce. Mapping of data often contributes to the best use of limited resources by demonstrating effectiveness, targeting priorities, and making visible problems and constituencies that would have been invisible. Those agencies and programs that can most powerfully demonstrate community demand, constituency, need, and effectiveness obtain the necessary financing. Visible data create constituencies.

Obtaining, reporting on, and re-evaluating the data are all part of an ongoing process that involves participants across all levels of the organization. This area is one in which health departments often fail, because of the lack of a management system for using the data once collected. It is important to have a system in place to ensure that the indicators are collected, analyzed, and incorporated into ongoing program and policy improvements on a regular basis.

If a department is fortunate enough to have an epidemiologist, that staff person may have an important function as a facilitator, supporter, and analyst. Department managers need, however, to set expectations that each supervisor actively and regularly assess existing data, identify gaps, collect new or additional data, and redesign or redirect resources. Once trained, supervisors should be able to evaluate data and take a leadership role in identifying questions and new programs and policy needs.

Managers can institutionalize this expectation as part of annual performance objectives by asking supervisors to demonstrate what new assessments they have made and what changes they have made as a result of their observations. This expectation leads to a data-driven learning environment of continuous improvement and best practices. The emphasis is on the active engaged learner rather than the expert, on open rather than closed minds.

Supervisors should be demonstrating why they should be continuing to use the existing approaches, on the basis of data that indicate that those approaches work.

The development of indicators, standards, and best practices is an iterative, ongoing process. Staff can be further involved through active participation in national and state efforts to develop indicators, in-house training on standards and outcome objectives, and active involvement in professional organizations and research activities.

Discussion

The first essential public health service is surveillance, the collection and regular analysis of key environmental and health indicators. It forms the basis for the fulfillment of the three core functions of public health—assessment, policy development, and assurance—and underlies all of the other nine essential public health services. It is important to prioritize the indicators collected so that they will be most helpful in decision making and in noting emerging trends in the status of the environment and community health. The selection and use of indicators requires a thoughtful process that engages both the technical staff and key community representatives and elected offi-

cial to ensure that the data collected are relevant to community concerns and will be used in decision making.

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