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Strategies for Establishing an Environmental Health Surveillance System in California

A Report of the SB 702 Expert Working Group

CALIFORNIA POLICY RESEARCH CENTER
UNIVERSITY OF CALIFORNIA

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The California Policy Research Center (CPRC) is a University of California program that applies the extensive research expertise of the UC system to the analysis, development, and implementation of state policy as well as federal policy on issues of statewide importance. CPRC provides technical assistance to policymakers, commissions policy-relevant research, and disseminates research findings and recommendations through publications and special briefings.

About This Report

This report is the result of a state-commissioned project undertaken after Governor Davis signed into law Senate Bill 702 (Escutia, 2001), which required the Division of Environmental and Occupational Disease Control of the Department of Health Services, in cooperation with the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment and the University of California, to lay the groundwork for a statewide environmental health surveillance system. The principal activity carried out under SB 702 was the creation of a working group of technical experts on environmental chemical exposures, chronic diseases, developmental disabilities, and the sensitivities of disparate populations to environmental hazards to devise possible approaches to establishing such a system, including measurements needed to monitor Californians' health, a database to facilitate examination of the relationship between chronic diseases and the environment, and the estimated cost for each approach. The complete project is described in the introduction, and the text of SB 702 is found in Appendix A. The California Policy Research Center has represented the University of California on the steering committee for implementing SB 702.

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Acronyms

Acronym	Definition
ADAM	Aerometric Data Analysis and Management System
ARB	California Air Resources Board
BRFS	Behavioral Risk Factor Survey
CADDRE	California Center for Autism and Developmental Disabilities Research and Epidemiology
Cal/EPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CBDMP	California Birth Defects Monitoring Program
CCR	California Cancer Registry
CDC	Centers for Disease Control and Prevention
CEHTP	California Environmental Health Tracking Program
CEIDARS	California Emission Inventory Development and Reporting System
CHAPIS	Community Health Air Pollution Information System
CHDSP	California Heart Disease and Stroke Prevention Program
CHIS	California Health Interview Survey
COPD	Chronic Obstructive Pulmonary Disease
CUPA	Certified Unified Program Agencies in California
CWHS	California Women's Health Survey
DDS	Department of Developmental Services
DEODC	Division of Environmental and Occupational Disease Control
DFR	Doctor's First Report of Occupational Injury or Illness
DHS	Department of Health Services
DIR	Department of Industrial Relations
DPR	Department of Pesticide Regulation
EHIB	Environmental Health Investigations Branch
EHSS	Environmental health surveillance system
EHTN	Environmental health tracking network
ELVIS	Elevated Lead Visual Information System
EPA	U.S. Environmental Protection Agency
ETS	Environmental tobacco smoke
GEIMS	Geographic Environmental Information Management System
HAPs	Hazardous air pollutants
HIPAA	Health Insurance Portability and Accountability Act of 1996
LADHS	Los Angeles Department of Health Services
NHANES	National Health and Nutrition Examination Summary
NHEXAS	National Human Exposure Assessment Survey
NHEXAS-CA	California National Human Exposure Assessment Survey
NPL	National Priorities List
OEHHA	Office of Environmental Health Hazard Assessment

OEHT	Office of Environmental Health Tracking
OHB	Occupational Health Branch
OLPPP	Occupational Lead Poisoning Prevention Program
OSHPD	Office of Statewide Health Planning and Development
PACE EH	Protocol for Assessing Community Excellence in Environmental Health
PBDE	Polybrominated diphenyl ether
PCB	Polychlorinated biphenyl
PIR	Pesticide Illness Report
POPs	Persistent organic pollutants
PUR	Pesticide Use Report
RASSCLE	Response and Surveillance System for Childhood Lead Exposure
RCRA	Resource Conservation and Recovery Act of 1976
SNAP	Superfund NPL Assessment Program
TRI	Toxic Release Inventory
VOCs	Volatile organic compounds
WCIS	Workers' Compensation Information System
WOEIP	West Oakland Environmental Indicators Project

Executive Summary

In October 2001, Governor Davis signed Senate Bill 702 (Escutia), which declared the legislature's intent to establish an environmental health surveillance system. Environmental health surveillance is the systematic, ongoing collection, collation, and analysis of information related to disease and the environment. Reliable surveillance information is the most basic tool for preventing chronic diseases that are related to the environment.

SB 702 required the Division of Environmental and Occupational Disease Control of the Department of Health Services, in cooperation with the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment and the University of California, to establish a working group of technical experts to devise possible approaches to establishing such a system, including measurements needed to monitor Californians' health, a database to facilitate examination of the relationship between chronic diseases and the environment over time, and the estimated cost for each approach.

This report of the expert working group includes a description of the purpose and scope of our work, the need for and goals of environmental health tracking in California, and current knowledge about environmentally related diseases and their costs. In the report we list the diseases, environmental hazards, and exposures that should be tracked in California; describe community information needs; and describe ethical, legal, and policy issues. We conclude by identifying our priority recommendations.

The Case for Environmental Health Surveillance

Environmentally related chronic diseases take a fiscal and human toll on Californians. For example, we found the costs associated with only nine such diseases, including childhood asthma, cancer, and lead poisoning, to be an estimated $10 billion per year, or $288 per person. Researchers are finding that some of these illnesses are on the rise. For example, from 1984 to 2003, asthma in adults and children reportedly increased 76% nationwide.

Environmental hazards include chemicals, physical agents, and biological toxins in the environment that potentially have a negative impact on health. Exposure to environmental hazards accounts for a significant proportion of many chronic diseases, including an estimated 30% of childhood asthma exacerbations and 10% of neurodevelopmental disorders in children. More than 33 million Californians reside in areas where exposure to air pollution results in increased risk for chronic disease. The majority of Californians believe that environmental protection should be a priority for state government.

The establishment of a cost-effective environmental health surveillance system will play a key role in reducing environmentally related chronic disease. Such a system will give the state information needed to improve existing pollution- and disease-prevention programs. An environmental health surveillance system would:

- Track environmental hazards to guide exposure-prevention efforts;
- Track disease trends to understand if they are changing over time, in residents statewide, in specific populations, or in certain geographic areas;

- Link environmental-hazard information, exposure data, and disease reports to support environmental-health research;
- Inform the development and evaluate the effectiveness of disease-prevention and environmental-protection programs and policies; and
- Facilitate public access to information on environmental-health issues.

Investment in a surveillance system that enables the state to take action to prevent environmentally related diseases will result in cost savings. An effective surveillance system that reduces only 1% of the cost of environmentally related chronic diseases would save $100 million annually.

Major Findings and Recommendations

Detailed recommendations are found throughout the report, but the major findings and recommendations are summarized here.

Need to Coordinate Databases

There is an urgent need for a coordinating office for all California databases that track environmental health. Although several state health and environmental agencies collect data, there is no coordinating office that promotes collaboration and that integrates, analyzes, and disseminates data on environmental hazards and environmentally related diseases.

Integration, analysis, and dissemination of existing data can be performed at a fraction of the cost that the state spends on collection. Better collaboration and integration of environmental health data will create new opportunities for disease prevention. We urge the state to authorize the Department of Health Services (DHS) and the California Environmental Protection Agency (Cal/EPA) to establish an interagency Office of Environmental Health Tracking (OEHT) to discharge these responsibilities and implement the recommendations of this report.

Data Sharing, Integration, and Communication

Environmental health data need to be shared and integrated in a standardized manner and communicated to the public in a timely way. The OEHT should have as a goal providing web-based information dissemination and visualization tools to make environmental-hazard data timely, accessible, and useful for communities, researchers, and the general public. A tracking network should actively support research, policy, and the public's right to know by facilitating access to scientifically valid and personally relevant information. Data access should be limited only to the extent necessary to protect confidentiality.

Eroding Resources for Addressing Health Concerns

California's resources to address concerns about environmental health are eroding. The State of California needs to be able to respond to environmental health threats. Public health and environmental agencies currently lack adequate staff to address health issues related to environmental exposures.

For example, the state has reduced the funding for its premier Birth Defects Monitoring Program. Cuts during the past decade have resulted in the elimination of many highly trained and experienced scientists, health educators, and data managers in all of our health and environmental agencies. Such staffing is critical for analyzing

and communicating tracking data to inform public health action. The DHS spends many times more on treating disease through its Medi-Cal program than it does on preventing disease through the state's Prevention Services.

An effective environmental health-tracking system requires a strong infrastructure. State government must commit funding to implement such an infrastructure in California. Without this ability to address environmental health threats, collection of environmental health tracking data would be meaningless.

Need for More Complete Hazard Data

The state needs more complete data on chemical, biological, and physical hazards in California. Limited information regarding the use and distribution of chemical, biological, and physical hazards represents a major gap for environmental-health surveillance. For example, data on chemical use would improve the accuracy of air pollution inventories and exposure models, alert public health authorities to emerging hazards in workplaces and communities, and help in interpreting the results of biological monitoring. Cumulative hazard data for multiple pollutants need to be available at the community level.

Industries that produce, import, or store chemical, biological, or physical agents in California should be required to develop and provide basic information to the state, including: (1) essential chemical and toxicological properties to allow evaluation of hazards and their persistence in the environment; (2) location and quantity of manufacture, use, and/or storage; and (3) laboratory methods for measuring chemical, biological, and physical agents, degradation products, and metabolites in environmental media and human samples.

Limited Ability to Monitor Exposure

There is limited monitoring of environmental concentrations of and human exposure to toxic chemicals in California. Consequently, we know very little about where chemicals concentrate in the environment and what the public is being exposed to. Because there is no statewide environmental and biological monitoring program in place, laboratory capacity for detecting and measuring exposure of concern is limited.

- State laboratory capabilities need to be enhanced to perform biological monitoring of human samples for an array of contaminants, including certain pesticides, brominated flame retardants, and mercury.
- California needs to initiate its own Health and Nutrition Examination Survey (CalHANES), modeled after the national NHANES surveys. A CalHANES survey would provide data on a range of health indicators and environmental exposures among a representative sample of the state's population.
- The state should also conduct a California Human Exposure Assessment Survey (CalHEXAS), modeled after the NHEXAS surveys. This survey would also be used to identify exposures in the indoor environment, where many pollutants gather and concentrate.

New and Augmented Surveillance Systems

Surveillance systems need to be developed for priority environmentally related diseases, and existing systems require adequate resources. Among environmentally related diseases, priority tracking systems are either being developed or need to be developed for asthma, childhood neurodevelopmental disorders, and neurodegenerative disorders (such as Alzheimer's and Parkinson's disease).

For some diseases, innovative approaches such as tracking medication use may be a cost-effective approach to system development. The state should partner with health-care providers to support the development of cost-effective surveillance systems that take advantage of routinely collected information.

The California Cancer Registry should add and institute a rapid case-ascertainment capability. In addition, the Birth Defects Monitoring Program should be expanded to serve the entire state. The state also needs to invest resources in improving systems to collect and effectively utilize occupational illness data, because in many cases occupational groups are the most highly exposed and are likely to include the most easily identified cases of environmentally related disease.

Providing Information to Communities

Health tracking can provide helpful information to communities that have concerns about local environmental exposures or suspected disease clusters. The Department of Health Services should establish a uniform set of guidelines for state and county health authorities on how to respond to community environmental-health concerns and when and how to further investigate suspected disease clusters. Tracking data can also be used for investigating suspected disease clusters. Timely communication of relevant health and environmental information is needed when suspected disease clusters emerge.

Disparities in Hazards and Diseases

Environmental hazards are disproportionately distributed by racial and ethnic groups as well as income. The proposed Office of Environmental Health Tracking should report hazard, exposure, and health-outcome data by race, ethnicity, and income so that issues of environmental justice can be monitored. The distribution of environmentally related diseases continually needs to be monitored by public health authorities in order to inform public policies that will decrease the incidence of such diseases.

Providing Technical Assistance to Communities

The state needs to make an intensive, long-term, and consistent commitment to community outreach and education to address issues related to environmental justice. Communities and community groups need information, training, and other technical assistance to build their capacity to access and understand surveillance and exposure data so they can participate meaningfully in public health policymaking and decisions affecting their communities. California needs to allocate more resources to fund health education staff qualified to address such issues, especially in relation to concerns about chronic-disease clusters.

The legislature and executive branch should establish and adequately fund an effective environmental health surveillance system to improve environmental quality and protect public health in California. This will require a strong commitment as well as partnerships among the public and private sectors, academia, and communities. The establishment of this ambitious and innovative system will place California in a position of national and international leadership in public environmental health.

1
Introduction

Since the passage of the first federal environmental laws more than 30 years ago, California has made progress toward controlling many environmental risks (Baldassare, 2002). For example, the state has improved air quality by requiring unleaded gasoline and setting automotive emission standards. However, continued growth and development put constant pressures on our environment and require California to develop new ways to protect public health.

California Senate Bill 702 (Escutia), signed by Governor Gray Davis in October 2001, declared the legislature's intent to establish an Environmental health surveillance system (EHSS). The purpose of the EHSS is to establish ongoing surveillance of environmental exposures and diseases affecting Californians. (See Appendix A for the full text of SB 702.) As envisioned in the legislation, such a system will provide an ongoing picture of the health of Californians, and facilitate examination of the relationship between chronic diseases and the environment.

The purpose of the Environmental Health Surveillance System shall be to establish ongoing surveillance of environmental exposures and diseases affecting Californians, with a focus on the prevalence and determinants of chronic diseases.

The objectives of the EHSS include:

- **Obtain an ongoing picture of the health of Californians**
- **Establish a data base that may facilitate the examination of the relationship between chronic diseases, including birth defects and the environment.**

Source: Senate Bill 702.

Senate Bill 702 required the California Department of Health Services (DHS), in consultation with the California Environmental Protection Agency (Cal/EPA) and the University of California, to establish a working group whose members have expert knowledge of children's sensitivity to environmental exposures, women of child-bearing age, seniors, and populations disparately affected by environmental hazards (i.e., environmental justice). The statute charged this group with making recommendations and providing cost estimates for the development of an environmental health surveillance system.

Pursuant to the Senate Bill 702 mandate, an advisory group consisting of representatives from the Cal/EPA's Office of Environmental Health Hazard Assessment, the DHS Division of Environmental and Occupational Disease Control, and the UC Office of the President's California Policy Research Center, convened to identify potential participants with expertise in the issue areas identified in the legislation. Subsequently the director of the Department of Health Services appointed participants to serve as the working group.

Beginning in October 2002, the working group convened five times to consider a range of issues related to the design and implementation of an EHSS for California. The meetings were open to the public in accordance with regulations governing such activities conducted by state agencies. (See California Codes Government Code Title 2 Division 3, Part 1, Chapter 1, Article 9.) Agendas for the five meetings are contained in Appendix B. Each meeting generally included a combination of informational briefings and deliberations on a range of topics related to environmental health surveillance. The working group utilized a consensus process to guide the development of the recommendations contained in this report.

Report's Purpose and Scope

The primary purpose of this report is to summarize the working group's recommendations for establishing an EHSS. This report is not intended to be minutes or a comprehensive transcript of our deliberations, which can be obtained from program staff. (See www.catracking.com.)

Rather, in this document we discuss (1) the utility of an environmental health surveillance system; (2) a range of options for program structure and development; and (3) estimated costs for different approaches.

The scope of the report's recommendations range from narrow technical changes to policies governing existing public health and environmental data systems to broader recommendations that emphasize organizational and technological infrastructure requirements and public health policies. Each recommendation is oriented toward the goals of improving knowledge about environmental hazards and exposures, the incidence and prevalence of environmentally related disease, and the relationship between the environment and the health status of Californians. The recommendations differ according to the resources required for their implementation. The working group thought it important to provide a range of options, so the development of a surveillance system could be pursued in a manner compatible with available resources.

Definition of Terms

We present here a few selected definitions to clarify the meaning of specific terms used in this report. Some of these terms may be defined differently by other authors or in different contexts. In general, the definitions are conceptually consistent with those used in the context of environmental surveillance and public health tracking (e.g., Thacker, 1996; Pew, 2000). Our intent is not to advocate alternative definitions of specific terms, but to provide precision and clarity in this document in response to the legislature's mandate.

Whether any agent truly poses a hazard is difficult to determine without complete information on its chemical composition (e.g., structure-activity relationships) and basic toxicological properties. In addition, animal data and health studies can aid in identifying hazards. We cannot know a priori which agents have a negative impact on human health or which releases of such agents are relevant. If we confine our definition to only those substances with established toxicity, we restrict hazard tracking to known hazards and limit its ability to identify new hazards. However, if we make the universe of hazards too large, the approach loses discrimination. This report includes recommendations for obtaining more complete information on chemical, biological, and physical hazards. In preparing it, we elected to steer clear of the specifics of the process for defining "potential health impacts." Rather, this issue is best addressed in the design and implementation of a health-tracking system and, ideally, should be informed by complete hazard data.

Environment

The *environment* is the combination of social, cultural, and external physical conditions affecting the nature of an individual or community.

Environmental Hazards

For purposes of this report, *environmental hazards* are chemicals, physical agents, biomechanical stressors, and biological toxins that are present in the environment and that have a known or potential impact on human health. Examples of environmental hazards include pesticides, dioxins, environmental tobacco smoke (chemical agents); ionizing and non-ionizing radiation (physical agents); repetitive motion and vibration (biomechanical stressors); and water-borne pathogens (biological toxins). *Environmental exposures* result when individuals come in contact with environmental hazards. Some of these agents may be present in air, food, water, soil, buildings, or other structures.

1. Environmental exposures can occur at home, at school, in the workplace, in health-care facilities, during commuting, and other settings of daily life.
2. Environmental exposures are often related to social, economic, and cultural factors such as employment, income, housing, race, ethnicity, types of food consumed, and how food is produced and processed.
3. These exposures may be chronic (related to occupation or residence, for example) or acute (related to an industrial accident, such as release of radioactive materials or other hazardous substances).

The working group recognizes that other lifestyle influences such as diet, education, and behavior (e.g., degree of physical activity) are important determinants of population health. However, the group was specifically charged with developing recommendations for a surveillance system that would contribute to a more complete understanding of how environmental hazards, consistent with the definition above, relate to health and disease.

Environmentally Related Diseases

Environmentally related diseases refer to chronic diseases, birth defects, developmental disabilities, and other non-infectious health effects that may be related to exposure to environmental hazards: chemicals, physical agents, biomechanical stressors, or biologic toxins in the environment.

The causes of human disease are multifactorial, resulting from a mixture of environmental, lifestyle, socioeconomic, and genetic factors acting over an individual's lifetime. For any particular individual, any one of these factors may be more or less important with regard to disease risk. However, in most cases the environment will serve, in varying degrees, to influence the initiation, severity, and/or progression of disease.

Environmental Health Surveillance

Environmental health surveillance is the systematic, ongoing collection, collation, and analysis of data correlated to *environmentally related disease, environmental hazards,* and *environmental exposures;* and the timely dissemination of information to those who need to know about them in order to take action (Last, 2001; Thacker, 1996). Environmental health surveillance is synonymous with *environmental health tracking*.

Environmental Hazard-Tracking

Environmental hazard-tracking is a component of environmental health surveillance. It involves the ongoing, systematic measurement of the sources, amounts, concentrations, geographic, and/or temporal distribution of known or potential environmental hazards.

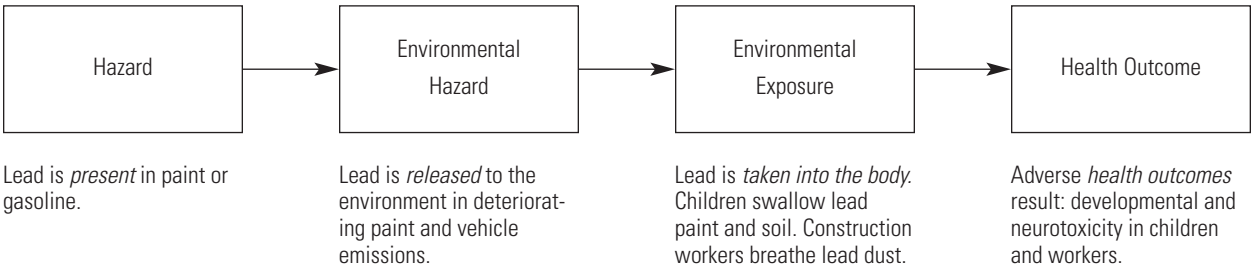
Environmental hazard-tracking activities include assessing and reviewing environmental data for the sources, amounts, and/or concentrations of environmental hazards; determining the geographic distribution of the hazards; and analyzing the data for trends of known or potential environmental hazards over time.

Environmental Exposure-Tracking

Environmental exposure-tracking is a component of environmental health surveillance. It involves measuring human contact with known or potential environmental hazards over time. Direct methods of exposure-tracking include monitoring biological samples for the presence of chemicals, their metabolites, or other valid indicators. Indirect methods of exposure tracking involve using hazard-tracking information to estimate human exposure.

Figure 1.1

From a Hazard to a Health Outcome: The Lead Example



Health Outcome-Tracking

Health outcome-tracking is the third and final component of environmental health surveillance. It involves the monitoring of disease trends and the health status of populations over time. Health outcomes include death (mortality), illness (morbidity), impairment of function (disability), adverse reproductive outcomes, and behavioral changes. (See Figure 1.1.)

Linkage

Linkage is the connection of environmental hazard-tracking or environmental exposure-tracking with health outcome-tracking information in time and place.

2
The Goals of Tracking Environmental Effects on Public Health

California in Perspective

The state's land area covers more than 156,000 square miles and is home to more than 34.7 million people (CDL, 2003). This population is the most ethnically diverse in the nation. Table 2.1 presents a demographic profile of the state. As of 2001, half of all Californians were born in the state, 26% were foreign-born, 23% were born in a different state and 1% were born abroad to a citizen of the United States. Half of all Californians are between 19 to 49 years of age.

Table 2.1
California Population by Age and Race/Ethnicity (in thousands)

Ages	White	Hispanic	Asian/PI	Black	Other	Total	%
0–4 years	884	1,273	294	143	22	2,616	8
5–17 years	2,969	2,789	862	542	80	7,142	21
18–34 years	3,705	3,223	1140	560	51	8,679	25
35–49 years	4,170	2,168	1102	656	101	8,197	24
50–64 years	2,745	994	524	253	58	4,574	13
65+ years	2,393	511	411	163	49	3,527	10
Total	16,766	10,958	4,333	2,317	361	34,735	100
%	48.3	31.5	12.5	6.7	1	100	

Source: CPS, 2002.

As of March 2001, among the 50 states and the District of Columbia, California had the 12th highest proportion of its population living in poverty: more than 13% overall, with significant differences across racial and ethnic groups. For example, 7.4% of white Californians are living in poverty, compared to 16.5% of blacks and 21.7% of Hispanics.

California is also diverse economically. More than three-quarters of the population work in a service industry, with 1 in 5 Californians employed in commercial trade, and 1 in 6 providing educational or health services. Manufacturing represents nearly 20% of the labor force, and agricultural workers represent the remaining 3%. Californians are more likely than other Americans to work in professional, scientific, management, and administrative services (CPS, 2002). Table 2.2 provides additional detail on California industries, employment, and earnings.

Table 2.2
California Industries and Employment

Industrial Group	Total Workers	Median Earnings	% of Total Workers
Agriculture, Forestry, Fisheries, and Mining	460,000	$12,000	2.8
Construction	1,008,000	$24,000	6.1
Nondurable Goods Manufacturing	778,000	$23,900	4.7
Durable Goods Manufacturing	1,475,000	$38,000	9.0
Transportation	678,000	$32,600	4.1
Communications and Other Public Utilities	429,000	$40,000	2.6
Wholesale Trade	617,000	$30,000	3.8
Retail Trade	2,604,000	$13,000	15.8
Finance, Insurance, Real Estate	1,046,000	$30,000	6.4
Business and Repair Services	1,463,000	$24,000	8.9
Personal, Entertainment, Recreation Services	1,158,000	$13,000	7.0
Health Services	1,194,000	$25,000	7.3
Educational Services	1,519,000	$30,000	9.2
Other Professional and Related Services	1,265,000	$24,000	7.7
Public Administration	741,000	$46,000	4.5
Total Workers Employed	16,434,000	$25,000	100.0

Source: CPS, 2002.

Environmentally Related Diseases

Californians in every age group are affected by a number of different environmentally related diseases. Asthma is the most common environmentally related disease in the state. An estimated 3.9 million adults and children—11.2% of the population—report that they have been diagnosed with asthma at some point in their lives (i.e., "lifetime asthma prevalence"). This figure exceeds the national average of 10.1% (Brown, 2002). From 1984 to 2003, asthma prevalence increased 76% nationwide (Mannino, 2002). Cancer is diagnosed in approximately 120,000 Californians each year and is the second most common cause of death (CCR, 2003). Birth defects occur in more than 16,000 babies (1 out of every 33 live births) each year (CBDMP, 2003). Autism is estimated to have increased in prevalence from 5.8 to 14.9 per 10,000 children between 1987 and 1994 (Croen, 2002). Table 2.3 lists some environmentally related diseases by class or subcategory identified as priorities for tracking. These are referred to as candidate diseases.

Table 2.3
Candidate Diseases for Health Tracking

Respiratory Diseases	Autoimmune Diseases
Asthma	Lupus
COPD	Multiple Sclerosis
Reproductive Outcomes	Kidney Disease
Cancers	Neurological Diseases
Dermatitis	Alzheimer's
Developmental	Parkinson's
Autism	Lead Poisoning
Learning Impairment	Potential Environmentally Related Diseases
Diabetes	Multiple Chemical Sensitivity
Cardiovascular Disease	Chronic Fatigue Syndrome

All human disease is multifactorial, resulting from a mixture of environmental, lifestyle, socioeconomic, and genetic factors that act over a lifetime (Khoury, 2000a; Berkowitz, 2002; Willett, 2002). For any particular individual, specific environmental,

lifestyle, or genetic factors may be more or less important with regard to disease risk (Aldridge, 2003). For example, lifestyle or genetic factors may place individuals at elevated risk for dying of cardiovascular or respiratory disease, but short-term increases in outdoor particulate matter (soot) have been shown to increase emergency-room visits and deaths from cardiac and respiratory disease (Zanobetti, 2003).

In the case of asthma, genetic factors, or occupational exposure to chemicals, may make an individual highly sensitive. Once sensitized, air pollution in the environment may be sufficient to initiate an attack (Delfino, 2002; Leikauf, 2002). Table 2.4 includes a partial list of some risk factors associated with asthma. Tracking and controlling the environmental contributors to disease may significantly reduce the number of people who become sick or die from environmentally related diseases.

Table 2.4
Risk Factors for Asthma

Family History (Genetics)
Exposure to Infectious Agents
Exposure to Allergens
Plants
Dust Mites
Pets
Molds
Cockroach Antigen
Occupational Exposures
Cleaning Products
Fire Smoke
Latex
Molds
Other Environmental Hazards
Air Pollutants
Tobacco Smoke

Source: Marbury, 1996.

Environmental Hazards

Californians face ongoing exposure to many recognized environmental hazards. The U.S. Environmental Protection Agency ranks California fourth among the 48 contiguous states and the District of Columbia in exposure to hazardous air pollutants (Scorecard, 2003). Figure 2.1 describes estimated emissions of air pollutants by source associated with selected candidate diseases.

Note that specific chemicals identified as hazardous air pollutants are associated with multiple health outcomes. Because of the concentration of hazardous air pollutants, more than 33 million people live in areas with elevated risk for cancer and other diseases (Scorecard, 2003). More than 17,000 public drinking-water sources serving residential customers were tested for one or more chemicals between 1984 and 1988, and 16% exceeded at least one maximum contaminant level EPA drinking-water standard (EHIB, 2002). Ninety-nine hazardous waste sites in California are on the EPA's National Priorities List (Scorecard, 2003). Use of agricultural pesticides classified as possible or probable human carcinogens has increased 87% between 1991 and 1997 (EHIB, 2002).

Hazardous air pollutants are those that are known or suspected to cause a variety of serious health effects, including cancer, damage to the immune system, neurological, reproductive (e.g., reduced fertility), developmental, respiratory, and other health problems.

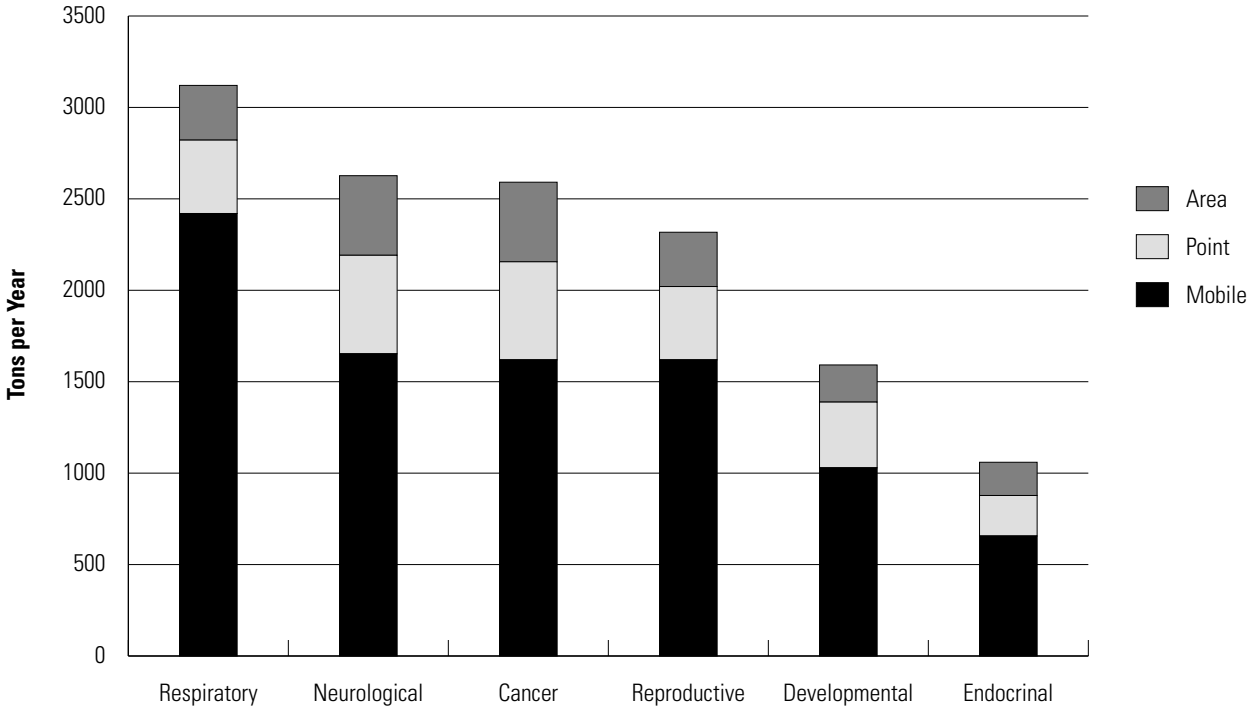
The Cost of Environmentally Related Diseases

About 125 million people in the United States suffered from chronic diseases in 2000, at an estimated total cost of $887 billion: $572 billion for direct health-care costs and $315 billion in indirect costs, resulting from lost productivity attributed to missed work and premature death (Partnership, 2002, Levit, et al., 2001, Hoffman, 1996). (We estimated these costs by applying 78% of all health-care spending on people with chronic conditions [from Partnership for Solutions, 2002] to $1.14 trillion in personal health-care spending in the U.S. [from Levit, et al., 2002]. The distribution of direct and indirect costs is 64.5% and 35.5%, respectively [from Hoffman, 1996].)

The economic toll experienced by individuals, their families, and society as a result of these chronic diseases is enormous. The direct and indirect costs of chronic diseases are not available for California. Assuming that national costs are proportional to the state's population, we estimate the total costs of chronic conditions in California in 2000 to be $107 billion: $69 billion in direct medical-care costs and $38 billion in indirect losses

Figure 2.1

Estimated Tons per Year of Hazardous Air Pollutants by Potential Health Effects in California



Source: ARB, 2003.

Note: Area sources include small pollution sources like dry cleaners, gas stations, and auto-body paint shops. Area sources are defined as sources that emit less than 10 tons per year of a hazardous (criteria) air pollutant, or less than 25 tons per year of a combination of pollutants. Mobile sources include both on-road vehicles (such as cars, trucks, and buses) and off-road equipment (such as ships, airplanes, agricultural, and construction equipment). Point sources include major industrial facilities like chemical plants, steel mills, oil refineries, power plants, and hazardous-waste incinerators. Point sources are defined as those that emit 10 or more tons per year of any of the criteria pollutants or hazardous air pollutants or 25 or more tons per year of a mixture of air toxics (source: Scorecard, 2003).

in productivity. We estimate that the total documented costs of environmentally related diseases in California amounted to more than $10 billion in 2000 (see Table 3.5).

The Need for Tracking Environmental Health

Public health professionals seek to prevent or reduce disease by changing the conditions or the environment that put populations at risk. Surveillance or "tracking" represents a data-driven activity that is crucial for detecting and characterizing the conditions that put populations at risk (Declich, 1994). Surveillance involves documenting the patterns of disease among different groups of people. The process typically includes observing groups of people based on age, sex, ethnicity, or occupation. Researchers then analyze the information to identify exposures or other factors (often referred to as *risk factors*) related to the occurrence of disease.

Follow-up investigations are often required to link the occurrence of disease with case-specific risk factors. For example, the DHS Occupational Health Branch maintains a work-related asthma surveillance system. The

system uses doctors' reports to identify asthma cases, and follow-up investigations (e.g., interviews with workers) to document potential risk factors. Linking asthma cases to occupational risk-factors provides the factual basis for prompting preventive actions. Ongoing surveillance or tracking enables public health officials to determine whether preventive actions are effective (Koo, 2001).

Health and environmental agencies are routinely called upon to address questions about the occurrence of environmentally related disease and/or exposures to identified risk factors. Examples of familiar questions include:

> *My son has been diagnosed with severe autism; is the prevalence of this disease increasing?*
>
> *There are a lot of highways and industrial facilities here; are we being exposed to pollution at dangerous levels in our community?*
>
> *My child is asthmatic; is air pollution making his situation worse?*
>
> *Have new diesel-emission standards resulted in cleaner air?*

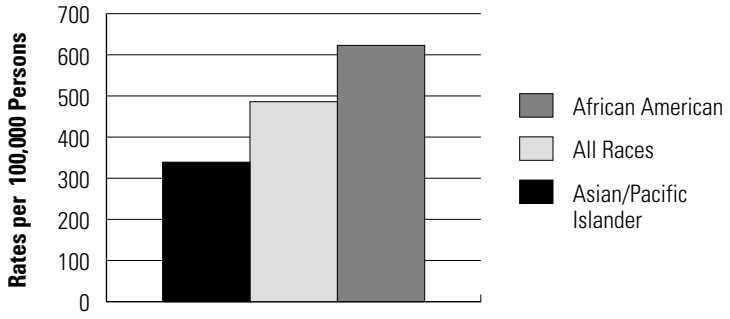
In order to respond to such questions from concerned community members, legislators, the media, and others, agency staff need information regarding (1) the health of Californians and (2) the distribution of environmental hazards and exposures. Public health officials often have difficulty addressing these type of questions because of limited electronic communications capacity, data systems, and other information tools (Detmer, 2003; Koo, 2001). Ongoing development of electronic data systems to track outcomes and environmental exposures is a critical step in closing this information gap. Ideally, an environmental health surveillance (tracking) system would enable collection, analysis, and preventive actions on all environmentally related diseases in California. Currently, the state has a very limited capacity to monitor and improve public health.

Tracking Health Outcomes

Some health outcomes such as lead poisoning, cancer, and birth defects are tracked in well-developed registries that follow disease occurrence over time. In other cases, such as autism, asthma, Parkinson's, Alzheimer's, and diabetes, registry systems are nonexistent or not completely developed. Effective registry systems can provide answers to questions about the frequency and geographic distribution of diseases, and are vital to research intended to evaluate the relationship between health and the environment. However, registries are not always the most practical or appropriate way to track all diseases. We discuss additional measures available for heath tracking in Chapter 4.

For tracking cancer cases, California maintains a statewide population-based surveillance system called the California Cancer Registry (CCR). CCR staff continuously collect information about all diagnosed cancers. This information furthers our understanding of cancer and is used to develop strategies and policies for its prevention, treatment, and control (CCR, 2003). Figure 2.2 illustrates that cancer rates in African-American

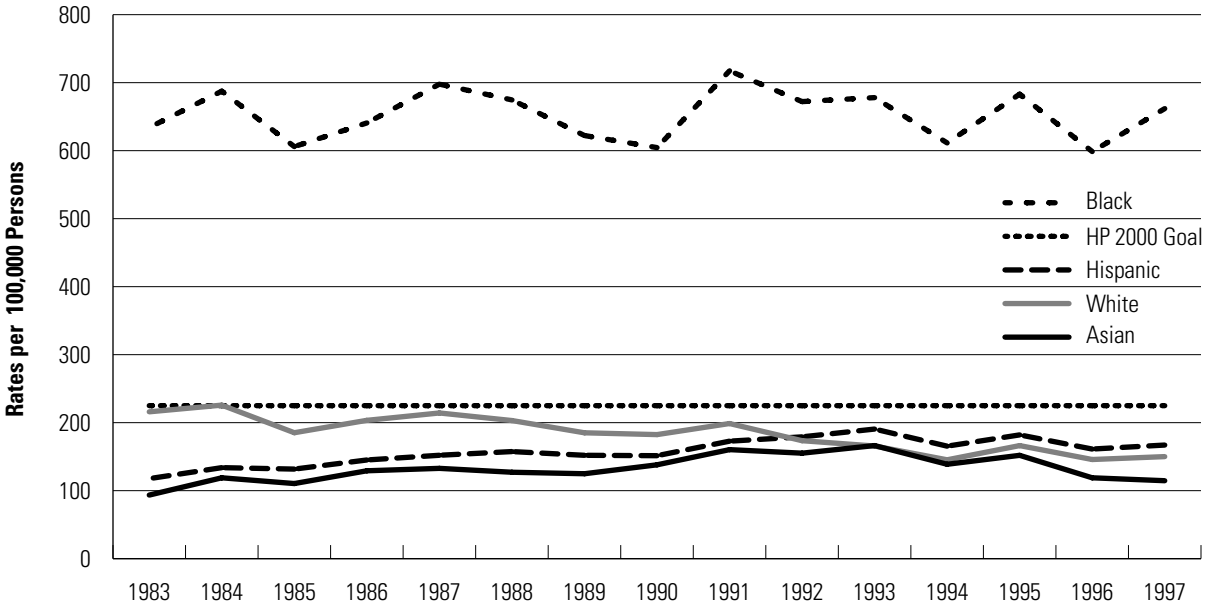
Figure 2.2
Cancer Incidence in Males by Race in California, 1999



Source: CCR, 2003.

Figure 2.3

Childhood Asthma Hospitalization Rates by Race/Ethnicity, California, 1983–1997



Sources: OSHPD, 2000; EHIB, 2002.

males are 1.3 times greater than the rate for all races and 1.8 times greater than the rate for Asian/Pacific Islanders (the group with the lowest combined rate). The reasons for these differences are not well understood. Research into race/ethnic differences in cancer risk may help us understand some of the underlying causes of cancer. The CCR provides important clues about populations with higher and lower risks, and it can facilitate research designed to understand the underlying causes.

Like the cancer example, public health officials studying information on asthma hospitalization have found that certain populations experience an elevated burden of disease. While the differences may be due only in part to environmental factors, for African American children asthma hospitalization rates are nearly three times higher than those for all other races in the state as well as the Center for Disease Control's Healthy People 2000 goal (HP 2000); see Figure 2.3 (OSHPD, 2000). In addition, Imperial, Alameda, San Bernardino, San Francisco, and Fresno counties experience unusually high asthma hospitalization rates for children age 14 years and under (EHIB, 2002). An estimated 3.9 million Californians have been diagnosed with asthma, so developing an understanding of the underlying factors influencing these ethnic and geographic differences in hospitalization rates is an important first step toward reducing this burden of disease. Tracking of asthma rates in time, place, and within specific groups is a first step in prevention research.

Tracking Environmental Hazards and Exposures

Hazard-tracking systems were initially developed to describe environmental quality and document regulatory compliance. Environmental databases, therefore, have tended to focus on the release of chemical pollutants and pesticides into air, water, and land, and typically have not included data on chemical use and human exposure.

Lack of information about chemicals used and population exposure is a major limitation of existing systems (discussed in Chapter 5).

Of the 3,000 high-production-volume chemicals that the United States imports or produces at more than 1 million pounds a year, the EPA found that 43% lack testing data on basic toxicity, and only 7% have a full set of basic test data. This lack of test data compromises the public's right to know about the chemicals that are found in their environment, their homes, their workplaces, and the products they buy. There is an urgent need to ensure that basic information is available on every high-production-volume chemical (EPA, 2003c). Of the 1,400 potentially hazardous common chemicals that are produced in high volume, national exposure surveys monitor exposure to only 6% (GAO, 2000).

Despite these limitations, existing reporting and monitoring systems (such as the Toxics Release Inventory, Pesticide Use Reporting, and air-pollutant monitoring) provide an important, albeit incomplete, picture of what environmental hazards are present in the environment. Based on existing systems, we know that more than 33 million Californians live in areas with an elevated risk for cancer and other negative health effects (Scorecard, 2003). This same population experiences high ozone exposure for one-third of each year, with certain communities experiencing disproportionately higher exposures than others.

Exposure tracking can provide estimates of the risks air pollutants pose to communities and facilitate health research. Unfortunately, a number of important environmental hazards are not tracked, making it impossible to estimate or accurately measure population exposures. These include air pollutants not captured by existing tracking systems, as well as hazards in water, soil, food, workplaces, and other indoor environments.

Public Perception of Environmental Health Risks

A survey of 2,029 Californians by the Public Policy Institute of California found that most residents believe little progress has been made in solving environmental problems during the past 20 years, and they are pessimistic about improvement (Baldassare, 2002). More than three-quarters of those surveyed believe there has been only some (58%) or hardly any (20%) progress since the early 1980s, and a similar number has only some (51%) or hardly any (28%) optimism that environmental problems will be under control 20 years from now. While 72% of residents say they are currently somewhat (49%) or very (23%) satisfied with the quality of the environment in their region, more than half say it is getting worse; only one-fourth believe it is improving (Baldassare, 2002). Half say they have at least some confidence in government to understand and solve today's environmental problems, but only 9% say they have a great deal of confidence. Although residents say they trust state government (32%) more than county (20%), federal (19%), or city (16%) government to deal with environmental problems, a majority (51%) say that the state is not doing enough.

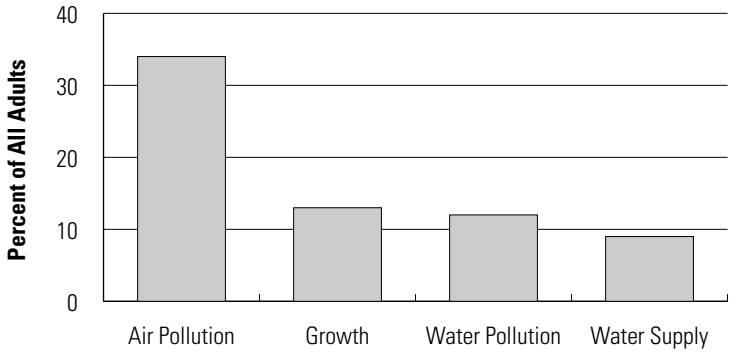
Figure 2.4 illustrates that the residents surveyed think air pollution is the most important environmental issue the state faces today, followed distantly by growth and development (13%), water, ocean, and beach pollution (12%), and water supply contamination (9%). Although air pollution is the top issue in every region, Central Valley residents are more likely than others to mention it.

The Pew Charitable Trust has supported survey research to ascertain public perceptions of environmental health risks, and found that 54% of the state's registered voters believe environmental factors are very important in causing disease (PEW, 1999). Among these voters, African Americans (81%) believe more strongly than whites (50%) or Hispanics (52%) that environmental factors play a very important role in causing disease.

What is the environmental health gap? It is the lack of basic information that could document possible links between environmental hazards and chronic disease. It is the lack of critical information that our communities and public health professionals need to reduce and prevent health problems.

Source: Pew, 2000.

Figure 2.4
Priority Environmental Issues in California



Source: Baldassare, 2002.

Table 2.5
California Voters' Perceptions of the Severity of the Threat of Pollution to Public Health

	Severity of Environmental Factors in Causing Disease			
	Very Serious	**Somewhat Serious**	**Somewhat Minor**	**Not a Threat**
Air Pollution	43%	34%	14%	8%
Water Pollution	50%	27%	11%	10%
Drinking Water with Harmful Chemicals	53%	24%	11%	9%
Pesticides in the Foods People Eat	42%	30%	16%	10%
Toxic Waste	58%	19%	12%	9%

Source: PSRA, 2000.

Table 2.5 identifies how California voters ranked different environmental hazards according to their perceived severity. Ninety percent say federal, state, and local governments should make it a priority to reduce environmentally related illness. These findings are consistent with national priorities identified in a precedent-setting environmental health tracking report sponsored by the Pew Commission.

The Pew Environmental Health Commission

In September 2000, the Pew Environmental Health Commission published *America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network* (Pew, 2000). The commission refers to the lack of complete information regarding the health of populations and the distribution of environmental hazards as the *environmental health gap*, which is crippling our ability to reduce and prevent chronic disease.

The Pew Commission proposes a nationwide health tracking network to close this gap. Major goals of a tracking network are to facilitate examination of the relationship between environmental hazards and disease and to guide intervention and prevention strategies. The goals of the California environmental health surveillance system, as defined in Senate Bill 702, are consistent with those identified in the Pew Commission report.

Tracking to Guide Prevention Strategies

Tracking health outcomes and environmental exposures is a critical step toward reducing the burden of environmentally related disease. Preventing environmentally related disease is a fundamental responsibility of California's health and environmental agencies. Health tracking provides fundamental knowledge about where, how often, and in what groups diseases are occurring—the population distribution of disease. Hazard tracking provides fundamental knowledge about where environmental hazards are, their concentration or quantity, and how these concentrations change over time—the distribution of hazards in our environment. Developing new capacity to link health-tracking information and hazard-tracking information will facilitate examination of the relationship between environmentally related diseases and the environment and improve the scientific basis for public health and environmental policies.

Tracking supports evaluation of health and environmental policies. The example of removing lead from gasoline is particularly illustrative. As shown in Figure 2.5, before the lead phaseout was implemented, some model-based analyses predicted that the policy would result in only a modest decline in exposure. Tracking actual blood-lead levels demonstrated that exposure declined significantly in direct relation to reduced lead levels in gasoline. This example illustrates two important points. First, tracking is a valuable tool of policy evaluation. Second, although exposure modeling plays an important role in a tracking system, there is a continuous need to validate the results with direct measurements, such as air sampling and biological monitoring.

Tracking blood-lead levels in adults and children continues to provide important information to state and local health departments, researchers, and community organizations. Tracking levels in children identifies populations at greatest risk for lead poisoning. County health departments and community organizations use blood-lead testing combined with geographic information systems to guide screening and exposure-prevention activities (Reissman, 2000). In Alameda County, for example, information from blood-lead tracking identifies homes for lead-abatement actions, which include removing and replacing lead-containing materials from homes.

The California Environmental Protection Agency

The mission of the California Environmental Protection Agency is to restore, protect, and enhance the environment to ensure public health, environmental quality, and economic vitality.

The mission of its Office of Environmental Health Hazard Assessment (OEHHA) is to protect and enhance public health and the environment by scientifically evaluating the risks posed by hazardous substances. OEHHA is responsible for developing and providing risk managers in state and local government agencies with toxicological and medical information relevant to decisions involving public health.

State agency users of such information include all boards and departments within Cal/EPA, as well as the Department of Health Services, the Department of Food and Agriculture, the Office of emergency Services, the Department of Fish and Game, and the Department of Justice. OEHHA also works with federal agencies, the scientific community, industry, and the general public on issues of environmental as well as public health.

The California Department of Health Services

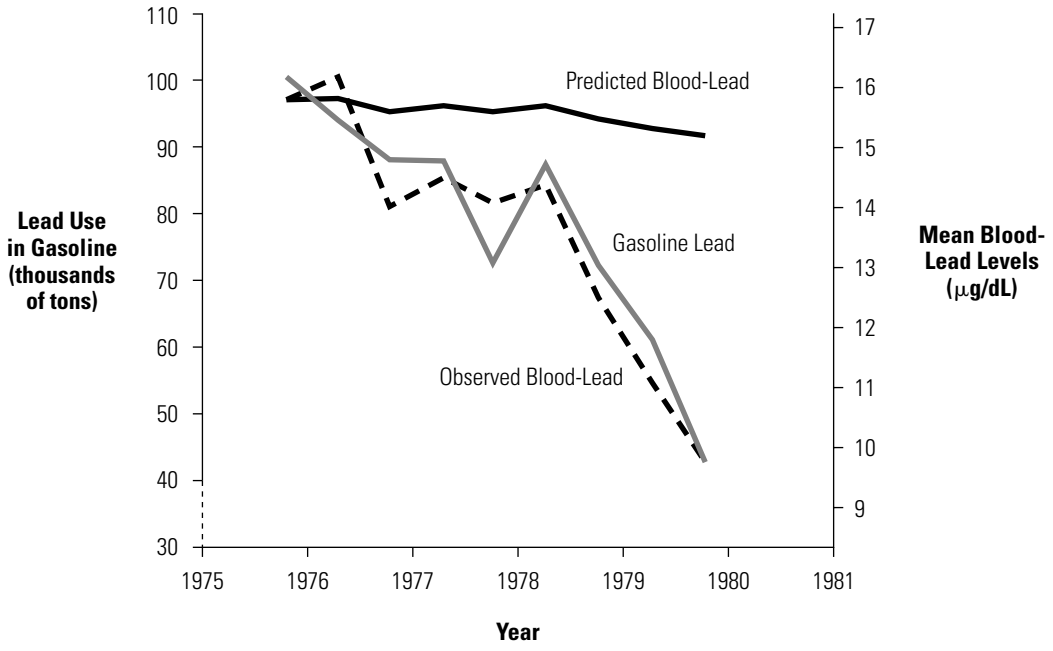
The mission of the California Department of Health Services DHS is to protect and improve the health of all Californians.

The mission of its Division of Environmental and Occupational Disease Control (DEODC) is to contribute to the prevention and control of environmental and occupational disease through exemplary scientific public health assessment: surveillance, investigation, laboratory innovation, education, and technical assistance.

DEODC must determine how environmental and occupational diseases are related to harmful exposures to noninfectious environmental agents (e.g., chemicals, physical agents, ionizing and nonionizing radiation) and all workplace pathogens and factors leading to injury and disease. Because environmental and occupational hazards work interactively with genetic susceptibility, nutrition, and dangerous habits, the division takes a comprehensive approach to understanding risks and formulating policy.

DEODC works with stakeholders, county health departments, and regulatory agencies to resolve environmental and occupational problems and controversies.

Figure 2.5
Predicted and Actual Declines in Blood-Lead Levels



In the case of occupational lead poisoning, exposure tracking serves to identify problem industries and employers so they may be targeted for prevention activities. DHS has implemented specific strategies in the construction and automotive repair industries for reducing environmental lead levels and human exposure statewide, thus preventing lead poisoning. Blood-lead tracking also provides important information for evaluating the impact of health programs and policies. One example is a comparison of information from two adjacent northeastern states, one where lead-prevention statutes were strictly enforced and one where they were not. Results showed that the risk of identifying one or more children with an elevated lead level was 4.6 times higher in the areas with limited enforcement (Brown, 2001).

The lead example illustrates how tracking exposures in individuals can identify exposure hotspots and populations at risk. Tracking can enable targeted actions to reduce or eliminate exposures, and tracking systems can be used to evaluate the effectiveness of policy actions.

The Economic Benefits of Preventing Environmentally Related Diseases

The benefits of targeted environmental policies have been shown to greatly exceed their costs. For example, the estimated total annual net benefits of federal environmental polices between 1992 and 2002 range from $110 to $188 billion (OMB, 2003). The majority of the benefits are attributable to EPA clean-air rules. Reductions in the risk of premature mortality dominate the benefits estimates in these analyses. (For an expanded discussion of benefit/cost methodology see *Federal Register,* Vol. 68, No. 22, Monday, February 3, 2003.) The high monetary value ascribed to prolonging life makes mortality risk-reduction the most important health endpoint in the

analyses. A major goal of environmental health tracking is to inform the further development of targeted environmental policies to reduce premature mortality.

If an environmental health tracking system were able to decrease the burden of environmentally related diseases in California by only 1%, the annual savings would exceed $100 million. These analyses valued life in terms of income lost and medical costs avoided, amounting to hundreds of thousands of dollars per life. An alternative economic approach looks at both societal expenditures for various kinds of life-saving activities and the number of lives these activities save, and infers the "willingness to pay" to avoid a death (Tengs, 1995). Tengs shows that the average "willingness to pay" is in the millions of dollars. Using this approach, costs and cost savings associated with tracking and preventing environmentally related diseases could easily be tenfold higher than the figures we have cited.

Linking Hazard, Exposure, and Disease Data: Advantages and Pitfalls

In the case of lead, a cause-effect relationship between the hazard and the health effect is clear and it is easy to measure lead levels in blood. Unfortunately, lead is an unusual case. For most hazards and health outcomes the cause-effect relationship is not clear and exposure cannot be measured as easily. Moreover, many health outcomes may result from exposures to multiple environmental hazards.

The capacity to link information about hazards, exposures, and health outcomes over time is a valuable step toward a more complete understanding of the relationship between disease and the environment. For example, recent research has linked proximity to traffic to adverse birth outcomes during a three-year period (Wilhelm, 2003). In this example, mobile-source emissions were linked to the occurrence of low birth-weight and/or preterm birth. Another study has linked airborne ozone with acute asthma attacks (Peden, 2002).

These examples illustrate the value of linking environmental hazards and exposures to the occurrence of disease. In the first example, the specific chemical constituents responsible for adverse pregnancy outcomes remain uncertain, but linkage to mobile sources guides preventive actions and informs further research. In the second example, a cause-effect relationship is more apparent. This type of information can support a scientific basis for making policies and assessing the effect of environmental hazards on health.

Linkage of various databases will not answer all of our questions. In fact, if linkage is not approached in a scientifically rigorous manner, it could lead us astray (Yerushalmy, 1957; Yerushalmy, 1959). Simply superimposing data by geography or time-trend may generate spurious associations. For example, superimposing data on breast-cancer rates over time with television ownership could lead one to conclude that owning a television may increase the risk of breast cancer. In addition, linkage can create the statistical problem of false positives resulting from multiple comparisons. When numerous hazards are linked to numerous diseases, the laws of statistics dictate that some apparent associations will emerge by chance alone. Therefore, linkage may not allow us to conclude that a particular hazard or exposure *causes* a certain disease. Instead, linkage will be most useful in generating hypotheses for further research and investigation.

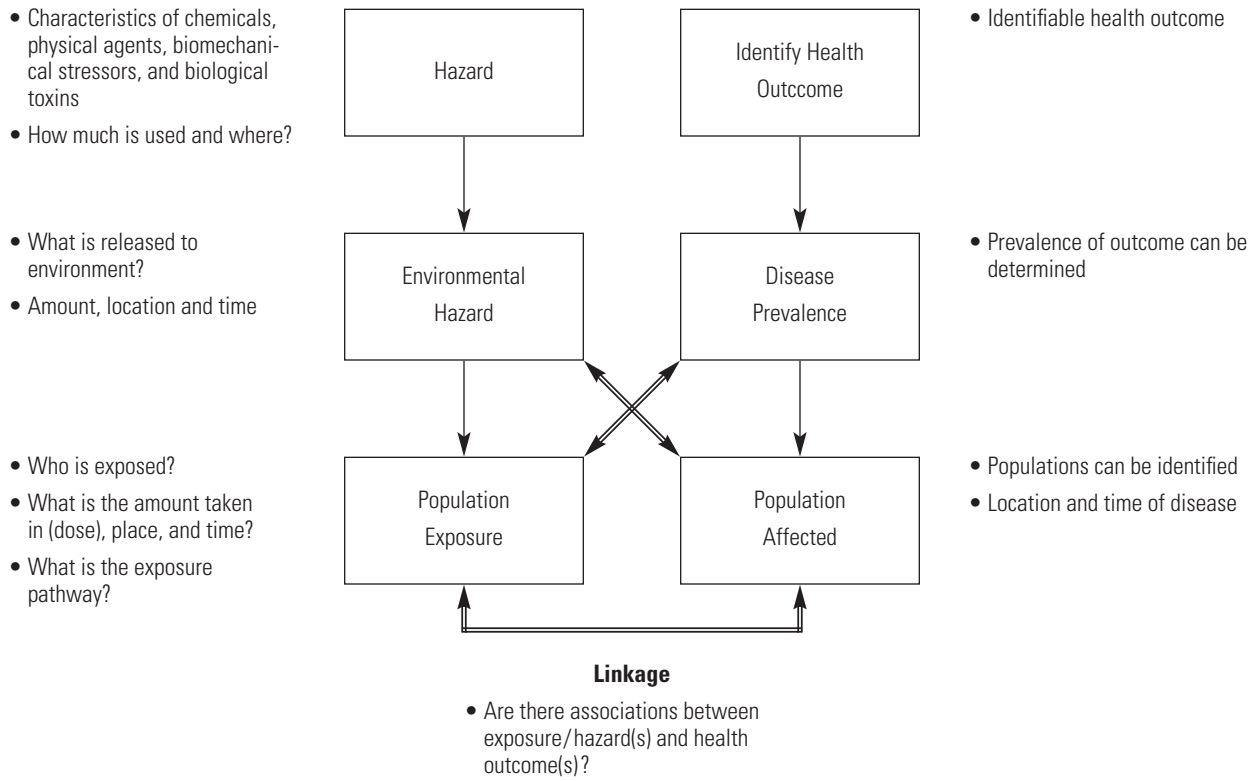
Research and investigation must apply more systematic methodologies to investigate causative factors in chronic diseases. (For a discussion of methods and criteria for investigating causative factors in chronic disease see Yerushalmy, 1959, and Hill, 1965.) It is also important to remember that linkage is only one of the five major goals of environmental health surveillance.

The Five Major Goals of Environmental Health Tracking

Senate Bill 702 states that an Environmental Health Surveillance System should establish ongoing surveillance of environmental exposures and diseases afflicting Californians. As shown in Figure 2.6, environmental health surveillance includes tracking hazards, exposures, and health outcomes. Hazard tracking provides information about what is released to the environment. Exposure tracking provides information about population contact with environmental hazards. Health-outcome tracking includes information about the distribution of specific diseases. Linking hazard or exposure information with health information will facilitate the examination of potential relationships between the two and close the environmental health gap identified by the Pew Commission. An environmental health surveillance or tracking network can help meet the following five public health objectives:

1. ***Evaluating and tracking environmental hazards and environmental exposures to guide prevention efforts*** Currently the state has limited ability to describe the distribution of environmental hazards and even less ability to characterize human exposures to environmental hazards. Further, little information is available about new or emerging hazards that may have a future impact on worker and community exposures. Basic information regarding the chemical and toxicological properties of hazards, combined with improved tracking (e.g., chemical hazard inventories) and monitoring methods (e.g., pollutant

Figure 2.6
Environmental Health Tracking



modeling and biological monitoring), will allow us to improve hazard and exposure tracking in the workplace and communities. These methods can serve to document population (by race/ethnicity, gender, age, income, occupational group, etc.) exposures to environmental hazards and guide prevention efforts.

2. ***Tracking health outcomes to identify changes over time in residents statewide, in specific populations, or in certain geographic areas***
   Well-established tracking systems exist for a few chronic diseases, such as cancer and birth defects. However, data are limited or absent for many chronic diseases, including neurological diseases, autoimmune diseases, and developmental conditions such as learning disabilities. Ongoing monitoring will provide information about disease trends that can be valuable in guiding research and prevention activities. Further, accurate information on disease rates is fundamental to understanding whether an unusually high rate of disease is occurring statewide or in a specific community or population.

3. ***Developing the capacity to link tracking information to generate hypotheses about possible relationships between the environment and disease to support environmental health research***
   Linking hazard, exposure, or health-tracking information over time will facilitate examination of the relationship between diseases and the environment. Linked information may first be used to develop hypotheses about associations between specific environmental hazards and diseases. An Environmental Health Surveillance System could facilitate follow-up investigation by providing data on appropriate populations and exposures for in-depth studies.

4. ***Informing the development and evaluating the effectiveness of disease-prevention and environmental-protection policies***
   The economic benefits of preventing environmentally related disease through targeted environmental policies have been documented. Monitoring health as well as environmental hazards and exposures over time will provide a credible foundation for further development and evaluation of public-health and environmental-protection policies. Pollution standards, workplace exposure limits, and remediation programs and policies will have more complete environmental health information, thus strengthening the scientific and economic basis for decision-making.

5. ***Providing access to information on environmental health issues***
   Addressing environmental health concerns requires objective information, which can facilitate coordinated actions by government, business, researchers, community groups, and other organizations. A tracking network can provide accurate and timely objective information about environmental hazards, exposures, and health outcomes. Such a network should actively support research, policy, and the public's right to know by facilitating access to scientifically valid and personally relevant information while ensuring privacy protection.

Future Directions

During the course of our deliberations we had several conversations regarding the relationship between a tracking network and promising areas of environmental and public health research. We were unable to develop these topics further in this report because of space and time constraints, and sensitivity to avoid expanding the activities of the working group beyond our legislative mandate. These topics are identified briefly in recognition of their value to environmental research.

Genetics and Health

Our discussion of biological makers is limited to indicators of the burden of environmental hazards on the human body. Biological monitoring is used to measure the concentration of toxic substances in individuals resulting from environmental exposures, so it has a range of applications for health tracking. There are other types of biological makers related to exposure and disease. For example, researchers have identified host genetic factors that modify individual disease risk, such as some known to increase risk for certain cancers and developmental disorders (Khoury, 2000b). Genetic epidemiology studies focus on the joint effects of genes and the environment at the population level (Thomas, 2000). Other genetic markers reflect changes in the body due to environmental exposures. These may ultimately prove useful for assessing exposures or providing early indicators of environmental disease. Current research is limited by a lack of ongoing and systematic information about environmental exposures. Health tracking can complement gene-environment studies by providing researchers with more complete information about environmental exposures.

Healthy Cities and Planning

Existing information enables us to identify major forces contributing to population exposure to environmental hazards. Motor vehicles and other mobile sources of emissions are a dominant source of air pollutants in California, and are associated with numerous environmental diseases. Traffic density has been linked to adverse birth outcomes (Wilhelm, 2003). These exposures can be substantially reduced by buffering roads from homes, schools, and other structures. Tracking can provide a scientific basis for developing buffering strategies, which ultimately may be included in building codes, environmental impact reports, and zoning and land-use polices.

Ecological Indicators of Exposure

Environmental hazards are ubiquitous, resulting in uptake and exposure in plants and animals. The presence of mercury, dioxin, DDT, and other priority environmental hazards in fish is well documented (EPA, 2003a). These measurements are important ecological indicators of health because they describe exposures that affect other organisms, and they may reflect human exposure. For example, high concentrations of polybrominated diphenyl ethers (a class of widely used flame retardants) have been detected in harbor seals in the San Francisco Bay—mirroring trends in Bay Area women, who have among the highest human concentration levels reported to date (She, 2002). Ecological indicators should be tracked to ensure the health of ecosystems, and to provide data that are suggestive of human exposures. Because privacy and confidentially concerns are generally diminished with ecological samples, they may enable administratively efficient sampling methods.

3
Environmentally Related Disease in California

This chapter summarizes (1) current knowledge about disease and the environment, (2) the distribution of selected diseases in California, (3) the economic cost of selected diseases, and (4) issues relating to the distribution and cost of diseases in special populations. This summary is not intended to be a comprehensive review. Rather, our intent is to highlight evidence to support the scientific, economic, and social rationale for developing a California health-tracking system, which can provide the capacity to inform and evaluate efforts to address these concerns.

The Relationship Between Disease and the Environment

The major objective of environmental health tracking, or surveillance, is to facilitate examination of the relationship between disease and the environment. As discussed earlier, all human disease is multifactorial, resulting from a mixture of environmental, lifestyle, socioeconomic, and genetic factors that act over a lifetime (Khoury, 2000a; Berkowitz, 2001; Willett, 2002). For any particular individual, specific environmental, social, or genetic factors may be more or less important with regard to disease risk (Aldridge, 2003), and in many cases the environment will influence the initiation, progression, or relapse of disease (Delfino, 2002; Leikauf, 2002). Tracking facilitates identification of hazards in the physical environment that affect the health of populations. By studying exposures to populations (e.g., residents of a city) or groups (e.g., chemical workers), relationships between exposures and health effects become more evident.

Table 3.1 indicates where research supports strong or suggestive association between exposure to categories of environmental hazards and candidate diseases. A "strong" association can be said to exist when the data are specific, consistent, and plausible for the disease/exposure relationship. A "suggestive" association can be said to exist when the literature is inconsistent (e.g., some positive and some negative findings) for the disease/exposure relationship. (Sarah Janssen, working-group member Gina Solomon, and Ted Schettler have prepared a more detailed matrix of environmental hazards and diseases, which is available at www.protectingourhealth.org/corethemes/links/2004-0203spreadsheet.htm.) Categorical associations are derived from research studies involving specific exposure/disease relationships. For example, inhalation of the metal chromium VI (a specific agent) is associated with lung cancer (a specific disease).

Because the working group recognizes that all human disease is multifactorial and that environmental factors may contribute to virtually all diseases, this list is not meant to be exhaustive but represents conditions we consider to be important initial targets for tracking. Additional conditions should be added as new scientific data or community concerns arise.

The Distribution of Selected Diseases

In California, four diseases—heart disease, cancer, cerebrovascular disease, and chronic lower-respiratory disease—accounted for two-thirds (66%) of all deaths and more than half (56%) of years of life lost in 2000. Heart

Table 3.1

Evidence of Association Between Candidate Diseases and Pollutant Categories and/or Environmental Media

Candidate Diseases	Major Classes of Environmental Hazard									
	Chemicals					Environmental Media				References
	Endocrine Disrupters[a]	Metals	Pesticides[a]	POPs	VOCs	Air Pollution[b]	Indoor[c,d]	Occupation[c]	Water Pollution[b]	
Respiratory Diseases										12, 47, 22
Asthma			√		√	√+	√+	√+		8, 24, 46
COPD						√		√+		44
Reproductive Outcomes	√	√	√	√	√	√	√	√	√	18, 24, 25, 37, 38
Cancer	√	√+	√	√+	√+	√+	√	√+	√	1, 3, 24, 27, 28. 38, 46
Dermatitis		√+	√+	√+				√+		4, 41
Neurodevelopmental										40, 43
Autism[e]										
Learning Impairments		√+	√	√			√			17, 19, 20, 26
Diabetes		√		√				√		7, 23, 45
Heart Disease and Stroke		√				√+	√+	√+		2, 14, 21, 42, 47
Autoimmune Disorders										6, 11, 32
Lupus								√		6, 13
Multiple Sclerosis								√		6, 35
Kidney Disease		√+						√+		10
Neurological Diseases										39
Alzheimer's		√	√					√		5, 31, 36
Parkinson's		√	√					√		5, 15, 16, 33,34
Lead Poisoning		√+					√+	√+		24, 46
Potential Environmental Diseases										
Multiple Chemical Sensitivity[f]					√			√		9, 30
Chronic Fatigue Syndrome[g]			√					√		29

Notes:
Indented items indicate specific outcomes of concern within a candidate disease category. Unindented candidate diseases may include multiple outcomes (e.g. , cancer includes all site-specific cancers).
√ Denotes suggestive evidence of a possible association between chemical category and health outcome.
√+ Denotes strong evidence of association between chemical category and health outcome.
a. Excludes DDT and DDT byproducts. Excludes PCBs and dioxins. These compounds are included under POPs.
b. Excludes hazards from previously identified pollution categories. For example, suggestive evidence of cancer risk in water is a result of chlorination by products. Bladder cancer risk from arsenic in water is indicated under metals.
c. May include hazards from previously identified categories.
d. Includes radon.
e. Autism is identified as a priority outcome for tracking because researchers hypothesize that environmental exposures during pregnancy could interact with genetic factors to cause or contribute to autism (see London, 2000).
f. MCS is not broadly recognized as a definitive health condition and hence is considered a potential environmental disease.
g. Linkage to environmental factors is limited or tentative.

References:
[1] AAP,1998; [2] Ahijevych K., et al., 2003; [3] Alavanja M., et al., 2003; [4] Andersen K., et al., 2003; [5] Baldi I., et al., 2003; [6] Cooper G., et al., 1999; [7] Cranmer M., et al., 2000; [8] Delfino R., 2002; [9] Eberlein-Konig B., et al., 2002; [10] Elinder C., et al., 2003; [11] Hess E., 2002; [12] Hoppin J., et al., 2002; [13] Garabrant D., et al., 2000; [14] Guallar E., et al., 2002; [15] Gorell J., et al., 1998; [16] Gorell J., et al., 1999; [17] Guillette, E., et al., 1998; [18] Ha, E. et al., 2002; [19] Jacobson JL. Et al., 1996; [20] Jacobson JL. et al., 1997; [21] Kawachi, I., et al., 1997; [22] LaDou, J., 1997; [23] Longnecker M., et al., 2001 [24] Manuel, J., 1999; [25] Mayani, A., 1997; [26] Mendola, P. et al., 2002; [27] Montesano R., et al., 2001; [28] Moore, L., et al., 2002; [29] Natelson, B., et al., 2002; [30] Pall, M., 2002; [31] Polizzi, S., et al., 2002; [32] Powell J. et al., 1999; [33] Priyadarshi, A. et al., 2001; [34] Rajput, A., 2001; [35] Riise, T., et al., 2002; [36] Rondeau V., 2002; [37] Rylander, L. et al., 1995; [38] Schettler T. et al., 1999; [39] Schulte P. et al., 1996; [40] Seegal R., 1996; [41] Shum, K., et al., 2003; [42] Sooden, K., et al., 1996; [43] Stewart P., et al., 2000; [44] Trupin L., et al., 2003; [45] Tsai, S., et al., 1999; [46] EPA, 2000; [46] Wilkinson, C. et al., 1999; [47] Zanobetti, A. et al., 2003.

Table 3.2

Number of Deaths and Years of Life Lost (YLL) by the 10 Leading Causes of Death, California, 2000

Diseases	Deaths	YLL	YLL per Death
Total	228,173	4,032,672	17.7
Heart Disease	68,521	913,194	13.3
Cancer	53,001	954,780	18.0
Cerebrovascular Disease	18,090	228,833	12.7
Chronic Lower-Respiratory Disease	12,751	173,603	13.6
Accidents	8,781	322,653	36.7
Pneumonia/Influenza	8,355	97,686	11.7
Diabetes	6,202	105,359	17.0
Alzheimer's	4,397	40,507	9.2
Chronic Liver Disease	3,672	95,998	26.1
Suicide	3,112	109,858	35.3
All Other Causes	41,291	999,201	

Sources: Ficenec, 2002; YLL calculations by Wendy Max, Institute for Health and Aging, University of California, San Francisco.

disease, the leading cause of death, amounted to 68,521 deaths—30% of total deaths in California, and 913,194 life years lost, or 13.3 years per death. Cancer deaths accounted for 23% of the deaths, and 954,780 life-years lost. Table 3.2 describes the relative impact of the 10 leading causes of death in California and the years of life lost. Years of life lost as a result of a particular cause of death is the sum of the years that all persons who died from the disease would have lived had they reached average life expectancy, based on the number of years of life expectancy remaining at the age of death. In 2000, a total of 228,173 deaths occurred in California, accounting for more than 4 million life-years lost, or an average of 17.7 years of life lost per death (Ficenec, 2002).

The prevalence of nonfatal disease is another important measure of population health. In California, 11.9% of the population (an estimated 3.9 million adults and children) report having been diagnosed with asthma at some point in their lives (Brown, 2002). This lifetime asthma prevalence exceeds the national average of 10.1%. Statewide, 8.8% of the population (nearly 2.9 million people) experience asthma symptoms at least once a year, and 1 in 4 of them experience symptoms at least every week (Brown, 2002). About 527,000 babies are born annually in California, and more than 16,000 have birth defects. The types of birth defects are summarized in Table 3.3. Between 1987 and 1994, the prevalence of autism was estimated to have increased from 5.8 to 14.9 per 10,000 (Croen, 2002).

Table 3.3

Number of Children with Birth Defects in California, 2000

Birth Defects	Number of Children
Major Heart Defects	1,470
Cleft Lip/Palate	750
Down Syndrome	530
Spina Bifida and Neural Tube Defects	240
Abdominal-Wall Defects	260
Deaths Before First Birthday	1,600
Diagnosed with Mental Retardation by School Age	5,000

Source: CBDMP, 2003.

Economic Costs of Environmentally Related Diseases

People with chronic conditions are the heaviest users of medical-care services and incur high medical-care costs, lost productivity caused by inability to work, and premature mortality. They account for 96% of all home health-care visits, 88% of prescriptions filled, 72% of physician visits, and 76% of all hospital inpatient stays. Seventy-eight percent of all health-

Table 3.4

Total Annual Costs of Cancer by Type of Service and Diagnosis, California (costs in thousands of dollars)

Type of Health Care Service	Prostate	Cervical	Ovarian	Uterine	Totals
Total Costs (Direct and Indirect)	$360,501	$205,657	$292,074	$126,178	
Total Direct Costs	180,303	47,078	90,940	61,677	
Hospitalizations[a]	105,070	25,967	48,880	32,525	$212,442
Inpatient Physician Care	7,898	3,024	5,693	3,788	20,403
Emergency Room Visits	872	51	95	63	1,081
Outpatient Visits	25,135	7,748	14,585	9,705	57,173
Office-Based Provider Visits	23,010	4,704	8,854	5,891	42,459
Prescription Medications	3,827	1,603	3,017	2,008	10,455
Home Health Visits	5,692	2,500	4,706	3,131	16,029
Nursing-Home Care	8,799	1,482	5,110	4,566	19,957
Value of Lives Lost	180,198	158,579	201,134	64,501	

Sources: Prostate cancer, Max, 2002; cervical, ovarian, and uterine cancer, Max, 2003.

Note: a. Includes costs for primary and secondary diagnoses.

care spending is attributed to 44% of the noninstitutionalized population that has one or more chronic conditions (Partnership, 2002). About 125 million people in the United States suffered from chronic diseases in 2000, at an estimated total cost of $887 billion: $572 billion for direct health-care costs and $315 billion in indirect costs, resulting from lost productivity resulting from missed work and premature death. (We estimated these costs by applying 78% of all health-care spending on people with chronic conditions [from Partnership for Solutions, 2002] to $1.14 trillion in personal health-care spending in the U.S. [from Levit, et al., 2002]. The distribution of direct and indirect costs is 64.5% and 35.5%, respectively [from Hoffman, 1996].)

The economic toll experienced by individuals, their families, and society as a result of these chronic diseases is enormous. The direct and indirect costs of chronic diseases are not available for California. Assuming that these costs are proportional to the state's population, we estimate the total costs of chronic conditions in California in 2000 to be $107 billion: $69 billion in direct medical-care costs and $38 billion in indirect losses in productivity.

California has estimates for the annual costs associated with a few specific chronic conditions, as shown in Table 3.4. The total cost for prostate, cervical, ovarian, and uterine cancer in California amounted to $984 million in 1998, including $380 million in direct costs and $604 million in lost productivity due to premature death. These cancers represent only a small proportion of cancers in California, and thus the total cost of cancers is significantly higher. It is clear that cancer is costly to the state, and many cancers are environmentally related.

In addition to the cancer costs shown in Table 3.4, the costs of environmentally related diseases in children have been estimated for California based on estimates for the United States, assuming that the distribution of costs mirrors the population distribution. Thus, 12% of the U.S. costs are attributed to California. Table 3.5 shows the estimated annual costs of selected environmentally related diseases in California.

The costs of child lead poisoning alone are estimated at more than $6 billion in 2000, followed by birth defects at $1.8 billion, and neurobehavioral disorders at $1.3 billion. The total documented costs of these environmentally related diseases in California amounted to more than $10 billion in 2000. If an environmental health-

Table 3.5

Total Documented Cost of Nine Environmentally Related Diseases in California

Diseases	Study Year	Cost (thousands)	Estimated Cost 2000[a] (thousands)
Prostate Cancer[b]	1998	$360,501	$400,000
Cervical Cancer[c]	1998	205,657	227,000
Ovarian Cancer[c]	1998	292,074	323,000
Uterine Cancer[c]	1998	126,178	140,000
Childhood Cancer[d]	1997	332,000	47,000
Child Lead Poisoning[d]	1997	43,400,000	6,031,000
Childhood Asthma[d]	1997	1,980,000	278,000
Neurodevelopmental Disorders[d]	1997	9,200,000	1,293,000
Birth Defects[e]	1988	1,087,054	1,829,000
Total Cost			10,568,000

Notes:
This list is not exhaustive, but includes only diseases for which reliable cost estimates are available.
a. Estimated by applying the percentage increase from the study year to 2000 in personal health-care spending for direct costs and in the index of compensation per hour for indirect costs. See Levit, K.L., et al., 2002. Compensation per hour from: U.S. Census Bureau. *Statistical Abstract of the United States.* U.S. Government Printing Office. Washinton, DC. Table 613, page 399.
b. Source: Max, W., et al., 2002. Costs are not available for environmental attributable fractions.
c. Source: Max, W., et al., 2003. Costs are not available for environmental attributable fractions.
d. Based on data for the United States assuming that 12% of costs are for California. Source: Landrigan, P.J., et al., 2002.
e. Source: Waitzman, N.J., et al., 1994; 33 (Summer): 188-205.

tracking system were able to decrease the burden of these environmentally related diseases by only 1%, the annual savings would exceed $100 million.

The foregoing analyses value life in terms of income lost and medical costs avoided, estimating a value of hundreds of thousands of dollars per life. An alternative economic approach looks at societal expenditures for various kinds of life-saving activities as well as the number of lives these activities save, and infers the "willingness to pay" to avoid a death (Tengs, 1995). Tengs shows that the average "willingness to pay" is in the millions of dollars. Using this approach, the cost to society for the diseases described above could easily be tenfold higher than the numbers we cite.

Environmentally Related Disease in Specific Populations or Groups

Some populations may face especially high risks from exposure to environmental hazards because of age, occupation, or place of residence. Here we identify some specific concerns regarding population groups and suggest how environmental health tracking can address them.

Diseases Among Workers

Workplaces pose unique risks because they may contain hazards in significantly greater concentrations than the general environment (Levy, 2000). Moreover, most adults in the United States spend almost one-fourth of their

Table 3.6
Percent of Disease Attributed to Occupation, California, 1992

Selected Cause of Death	Percent Attributed to Occupation
Cancers[a]	4–10
Heart and Cerebrovascular	5–10
Respiratory Disease[b]	10–20
Nervous System Disorders	1–3
Renal Disease	1–3

Sources: Leigh, 2001, except as noted.

Notes:
a. Ward, 2003.
b. Trupin, 2003.

time at work. The magnitude, duration, and potency of occupational exposures put workers at elevated risk for a number of diseases. Most candidate diseases are associated with occupational exposures, as illustrated in Table 3.1. Researchers estimate that 4% to 10% of all cancer deaths in California can be attributed to occupation (Leigh, 2001; Ward, 2003). One in five cases of chronic obstructive pulmonary disease may be attributed to occupational exposures (Trupin, 2003). Table 3.6 provides estimates of the percent of diseases attributed to occupation for selected diseases. The cost of occupational illness in California is estimated to be $2.9 billion annually (Leigh, 2001).

Tracking workplace exposures and related diseases helps prevent illness in groups of workers and alerts us to hazards that can affect the general population. For example, much of our current understanding of the relationship between chemical exposures and cancer is derived from studying the experience of workers exposed to such cancer-causing compounds as benzene, vinyl chloride, chromium, asbestos, and benzopyrene, among others. Occupational studies also have identified compounds that cause asthma and other respiratory disease. Nervous- and reproductive-system disorders resulting from exposure to metals, pesticides, and solvents were first identified in worker populations. Because of the inextricable relationship between work and health, it is imperative for California to strengthen and use existing occupational health surveillance systems as a key data source to help assess the threat of environmental sources of illness.

Children's Health

Children are particularly vulnerable to environmental disease because their bodies are still developing, because they are exposed to more contaminants than adults when adjustments are made for body weight, and because of behaviors that can increase their environmental exposures, such as crawling, putting objects in their mouths, and running. In addition, many childhood diseases require lifetime treatment, making them particularly costly to individuals and society. The most serious diseases confronting California children are asthma, birth defects, childhood cancer, neurodevelopmental and behavioral disorders, and congenital defects. A recent study attributed 30% of asthma exacerbations and 10% of mental retardation, autism, and cerebral palsy to exposure to environment hazards (Landrigan, 2002).

Approximately 743,000 children in California below age 17 suffer from asthma (Brown, 2002), which disproportionately affects school-age children and young adults. Lifetime asthma prevalence is high among this population compared to people of other age groups (Brown, 2003). Numerous studies have documented a rise in the morbidity, mortality, and prevalence of asthma in different populations.

Each year, about 1,100 children under the age of 15 in California are diagnosed with cancer (CCR, 2003). The most common cancers are leukemia and brain cancer, which together account for about 60% of cancers in this age group. Another 400 young adults from 15 to 19 years of age are diagnosed with cancer each year. The cancers in this age group are more diverse than they are among other children. Hodgkin's disease, leukemia, and brain and testicular cancer account for about 50% of cancers in young adults.

Researchers estimate that, between 1987 and 1994, the prevalence of autism in California was estimated to have increased from 5.8 to 14.9 per 10,000 (Croen, 2002). During the same period, the prevalence of mental retardation without autism decreased from 28.8 to 19.5 per 10,000. Although no links between autism and specific

environmental hazards have been identified, the apparently increasing prevalence of autism is cause for more systematic tracking of this outcome in order to evaluate potential environmental risk factors. Based on these trends, we believe tracking children's health should be an important focus of environmental health tracking.

Race, Ethnicity, Age, Gender, Geographic Area, and Income

Environmentally related disease is not equally distributed. Disease rates vary by race and ethnicity, age, gender, geographic area, and socioeconomic status. Similarly, environmental hazards are often concentrated in low-income communities and communities of color. Several studies have demonstrated that African-American and Latino residents in Southern California are more likely than whites to be living near many types of environmental hazards (Pastor, 2002). Figure 2.2 illustrates that African-American men have a higher rate of cancer than men of other races, and Figure 2.3 demonstrates that the asthma hospitalization rates of African-American children are nearly three times higher than the rates for children of all other races in the state. Segments of California's growing senior population may be at elevated risk for health problems because of long-term exposures, coupled with age-related reductions in physiological resistance to disease. Documenting factors relating to race, ethnicity, geography, gender, socioeconomic status, and variations in disease incidence and prevalence should be a fundamental part of environmental health tracking.

4
Tracking Health Outcomes

Tracking environmentally related disease is a vital part of an environmental health-tracking system. California has a number of health databases, surveys, and registries that would be part of such a network. However, some of these databases have been created for administrative and billing purposes rather than health surveillance. Generally, registry data provide the most complete and accurate health information, but are the most costly to collect. Surveys are done only once, or periodically, and depend on continued funding. The discussion below about measures available for health tracking addresses the strengths and limitations of each type of data source. (We have identified 14 potential California data sources for tracking environmentally related disease. A summary of the contents of these databases, as well as brief discussions of the strengths and weaknesses of each, is available on the California Environmental Health Tracking Program website in the section on SB 702 activities. See www.catracking.com.)

Characteristics of a Health-Tracking Database

Listed below are the recommended data elements that would be contained in an ideal health-tracking database, which, along with environmental data, would comprise an environmental health-tracking system. We recognize that it is impractical for all health-tracking databases to contain all of these categories of data, but this information should be seen as making these sources most useful for environmental health tracking. In addition, datasets could potentially be linked to other supplementary data sources (such as vital statistics) that could provide some of these data. The recommended data elements include:

- Unique diagnostic code for the health outcome (e.g., ICD-9 code)
- Name or unique identifier that could be linked to other databases
- Gender of individual
- Date of birth
- Date of diagnosis
- Race/ethnicity
- Residence address or latitude/longitude of residence address
- Residence history
- Occupational history, including occupation and industry (using the Standard Occupational Classification and North American Industry Classification System) for adults
- School name and location (for students)
- Smoking history

An *individual case name* can be used with probabilistic matching techniques to match a percentage of cases to another data source that also contains an individual's name, but will not be unique enough for more common names to allow for complete matching. Therefore, an additional common unique identifier such as Social Security number should be considered.

Individual gender and date of birth are critical variables, as disease rates vary by gender and age and are necessary to compute sex and age-specific rates of illness. For example, asthma incidence rates are higher for boys until puberty, and higher for girls after puberty.

Race/ethnicity is another critical data element, as disease rates also vary by these factors. In the context of environmental health tracking, such information is crucial to determine whether certain racial/ethnic groups experience disproportionate burdens of exposure.

Residence address (or latitude/longitude of address) is important so that linking health data to environmental hazard/exposure data can occur at a high level of spatial resolution. Misclassification of exposure for individuals increases as the geographic area increases; i.e., if only zip-code or census-tract geographic data are available for linkage, one may be limited to assuming that exposure is homogeneous for the entire area, which may not be true. Residence address may be a good proxy for exposures if suitably modeled or if actual levels of environmental exposures are available. However, depending on the exposure and population in mind, managers of health tracking data may also want to consider collecting other address information where additional exposures occur, such as school and work addresses.

Residence history is important in order to determine the duration of exposures and other locations where exposure may have occurred.

Occupational history, including occupation and industry, should be available, because the highest environmental exposures for many agents occur in the workplace.

Finally, *smoking history* would be useful to collect as it is an important determinant of environmentally related disease, such as chronic obstructive pulmonary disease.

In addition to these above variables, an ideal health-tracking system would provide ongoing data collected in a systematic fashion (ultimately culminating in "real-time" reporting), which would allow timely examination of trends and identification of environmentally related disease "hotspots." Ideally, data collection should be done statewide or should include a representative sample of the state. Whenever possible, tracking should use consistent criteria or definitions of disease, compatible with the goals of the surveillance system. To compute rates over time, definitions of such items as race/ethnicity in health-tracking databases need to match those in U.S. census data (for population denominators).

An environmental health-tracking system should also be compatible with other state and federal data systems by adhering to data standards, such as the National Electronic Disease Surveillance System standards. In addition, comprehensive security plans must be part of each system to ensure case confidentiality and privacy (see Chapter 7, Ethical, Legal, and Policy Issues). The DHS, through a cooperative agreement with the Centers for Disease Control and Prevention, will be assessing key health surveillance databases to determine data attributes, technological infrastructure, and hardware/software resources in place for integration in an environmental health tracking network. When their work is completed, we will have a more complete picture of the ability of current health data systems to meet our recommendations for common data elements.

Among current health data systems, none satisfies these recommendations completely. For example, the California Cancer Registry collects data on cancer incidence by age, race, sex, and residence address, but does not collect data on occupation or on smoking or residence history. Some items may not be available except by direct interview. Further discussion of these issues can be found in Chapter 8 (Recommendations).

Measures Available for Health Tracking

There are several ways to measure environmentally related disease. For health-outcome tracking, *incidence* and *prevalence* are the most important measures. *Incidence* is the number of new cases of illness over a specified period of time. *Prevalence* is a measure of the proportion of the population who have a disease at a given time.

Disease registries allow us to compute incidence. For example, with California Cancer Registry data we are able to compute the incidence rate of lung cancer in males, which would be the number of new cases of lung cancer occurring in a given year divided by the population at risk.

Disease registries represent the gold standard for tracking, as they are a standardized, ongoing method of systematically collecting disease data. However, they usually cover just one condition or disease.

Health surveys are another data-collection tool that allow us to compute disease prevalence for multiple conditions, but only at one point in time. For example, the California Health Interview Survey (CHIS) was first conducted in 2001, and the next survey is underway for 2003. If the CHIS continues to be conducted every other year, we will be able to analyze trends in disease prevalence, assuming that questionnaire content doesn't change. With the CHIS, we are able to compute the prevalence of adult diabetes in a specific county, which would be the number of cases of diagnosed diabetes divided by the number of adults in the county. By adding geographic weighting factors, it is possible to make the sample representative of the total population.

The CHIS and other state surveys are conducted by telephone, which typically yield response rates of less than 40%. Therefore, special attention needs to be given to potential nonrespondent bias, as nonrespondents are likely to differ from respondents in important characteristics.

Medical care encounter data from the California Medi-Cal program, Medicare program, and other public and private sources can provide useful information for tracking. Data are collected routinely on an ongoing fashion, which give information on diagnoses and procedures, race/ethnicity, gender, and age. With appropriate human-subject approval, specific address-level information is available. The main disadvantages of Medi-Cal data concern their incompleteness and representativeness, as Medi-Cal serves lower-income populations. Furthermore, both managed care and fee-for-service plans are included. As of the last analysis of the Medi-Cal database in 2000, the data collection in the managed-care plans was less complete than the fee-for-service plans (Klein, 2002). The California Environmental Health Tracking Project is conducting a pilot study utilizing the Medi-Cal database for asthma, and will analyze the completeness issue and the usefulness of these data for tracking.

Hospital discharge data are another source of routinely collected data available from the Office of Statewide Health Planning and Development (OSHPD). These data give us a picture of only the most serious effects of illness—hospitalizations—and do not enable us to estimate disease prevalence or incidence. OSHPD is planning to have detailed information about emergency-room visits included in their database in the near future.

From *vital statistics data* (available from the California Center for Health Statistics) we can estimate the rate of some adverse pregnancy outcomes, such as low birthweight, premature birth, and neonatal and infant mortality. We can also compute death rates from chronic diseases. However, for many chronic diseases, such as cancer, the death rates reflect incidence of the condition from many years earlier (e.g., when it was diagnosed) (Declich, 1994). Many other chronic diseases, such as lupus, asthma, and Parkinson's disease, are rarely fatal, so vital statistics data are of little use.

Most chronic diseases are not legally required to be reported by physicians, as are some infectious diseases, so we are unable to estimate incidence through physician case reporting. With the exception of pesticide-illness reporting and doctors' reports in the occupational setting, there are no physician-based reporting systems for

chronic disease in California. Physician case reporting has not generally proven to be fruitful or reliable outside the framework of infectious disease because of widespread underreporting and inconsistency of diagnostic criteria. Therefore, we do not envision a strong role for a physician-based surveillance system for environmentally related diseases in California.

Data Sources and Recommendations for Priority Environmentally Related Diseases

In Table 3.1 we listed the priority diseases for environmental health tracking for California. These diseases are conditions where some scientific evidence suggests environmental hazards influence the initiation, severity, and/or progression of disease. However, the working group recognizes that all human disease is multifactorial and that environmental factors may contribute to virtually all diseases. Therefore, this list is not meant to be exhaustive, but rather includes conditions that the working group assessed as important initial targets for tracking. Additional conditions should be added as new scientific data or community concerns arise.

Table 4.1 shows the priority environmentally related diseases and their data sources. Additional information about each data source, including the strengths and weaknesses of each system, can be found in the SB 702 section on the California Environmental Health Tracking Program website (www.catracking.com).

Data on Respiratory Diseases

Asthma

There is no statewide registry for asthma, but information about asthma is collected from a number of sources. The Behavioral Risk Factor Survey (BRFS) has collected asthma prevalence data on California adults since 1984, and now asks about lifetime asthma (clinician-diagnosed) and current asthma ("Do you still have asthma?"). The California Health Interview Survey in 2001 estimated the prevalence of physician-diagnosed asthma for each county in California. Most school districts participate in the California Healthy Kids Survey, which includes a question on physician-diagnosed asthma. However, most districts do not use an optional module on asthma symptoms. For the Medi-Cal population, asthma prevalence may be estimated by examining outpatient visit codes in Medi-Cal encounter data billing records. Besides outpatient visits, these records also include hospitalizations, emergency-room visits, and medication use.

Private data sources, such as Kaiser Permanente, also have data on their population that could be used for prevalence estimates. Statewide data on asthma hospitalizations are available through the Office of Statewide Health Planning and Development, which plans to add emergency-room visits for asthma. Data on work-related asthma is collected by the DHS Occupational Health Branch from physician reports to workers' compensation insurance carriers. This program is funded by the National Institute for Occupational Safety and Health for a limited period of up to five years. Finally, information on asthma deaths is available through California death certificates. More detailed information on these datasets and systems is available in the SB 702 section at www.catracking.com.

Chronic Obstructive Pulmonary Disease

Chronic Obstructive Pulmonary Disease (COPD) includes emphysema and chronic bronchitis. There is no statewide registry for COPD. For the Medi-Cal population, prevalence may be estimated using Medi-Cal encounter data billing records, which include codes for outpatient visits, hospitalizations, emergency-room visits, and medication use. Kaiser Permanente and other private data sources also have data on their population that could be used for prevalence estimates. Hospitalizations for COPD statewide are available through the Office of

Table 4.1

Data Sources for Candidate Environmentally Related Diseases

Candidate Diseases	**Information Sources**					
	Registry	Surveys	Encounter Data	Hospitalizations	Vital Statistics	Pharmacy Data/Other
Respiratory Diseases						
Asthma		√	√	√+	√+	–
COPD			√	√+	√+	–
Reproductive Outcomes						
Birth Defects	√		√	√+	√+	
Premature or Low Birthweight				√+	√+	
Early Menarche		√				
Infertility		√				
Endometriosis			√	√+		
Cancer (all types)	√+	√	√	√+	√+	
Dermatitis			√			
Developmental						
Autism	√	√				
Learning Impairments		√				
Diabetes	√		√	√+	√+	–
Heart Disease and Stroke		√	√	√+	√+	–
Autoimmune Diseases						
Lupus			√	√+	√+	
Multiple Sclerosis			√	√+	√+	
Kidney Disease			√	√+	√+	–
Neurological Diseases						
Alzheimer's				√+	√+	
Parkinson's			√	√+	√+	–
Lead Poisoning	√+					
Potential Environmentally Related Diseases						
Multiple Chemical Sensitivity		√				
Chronic Fatigue Syndrome			√	√+		

Notes:
√ = Incomplete and/or periodic reporting.
√+= Complete reporting.
– = Data available but no reporting mechanism exists.

Statewide Health Planning and Development, which plans to add emergency-room visits in the future. Mortality data are available through death certificates.

Limitations of Current Tracking

Asthma deaths are rare and do not give an accurate picture of the complete burden of this disease. Similarly, OSHPD's statewide hospitalization data do not give us an accurate estimate of asthma prevalence, as they miss those who are diagnosed with this illness and are not hospitalized. OSHPD hospitalization data are available only by patients' residential zip codes and lack more detailed geographic information. Prevalence data for the Medi-Cal population can be computed through the Medi-Cal encounter data billing records. These data are based on both fee-for-service and managed-care reports, and the completeness of managed care reporting varies by county. The Behavioral Risk Factor Survey collects data only on clinician-diagnosed asthma, and the sample size is too small to give prevalence estimates below the state level. The California Health Interview Survey relies on self-reports for asthma prevalence and collects data only on physician-diagnosed asthma. (CHIS 2003 will collect data on both physician-diagnosed and undiagnosed asthma.) As mentioned earlier, CHIS relies on telephone surveys, which yield low response rates; CHIS 2001 yielded a response rate of less than 40%.

The prevalence of chronic obstructive pulmonary disease cannot be estimated accurately from OSHPD's statewide hospitalization and mortality data for chronic obstructive pulmonary disease. Prevalence data for the Medi-Cal population can be computed through Medi-Cal encounter data billing records.

Recommendations for Tracking Respiratory Disease

- California officials should work with public and private data managers (e.g., Medi-Cal Encounter data managers and Kaiser Permanente's) to develop an ongoing asthma surveillance system for the state. The California Environmental Health Tracking Program (CEHTP) is currently evaluating the usefulness of this approach in one county, and the results of its evaluation should be forwarded to the Chronic Disease Branch and the Environmental Health Investigations Branch of DHS for further action. (The CEHTP was established after passage of SB 702, as a result of a three-year CDC grant to support California's development of the kind of environmental health tracking network we recommend. The program is described on p. 72.)
- The Department of Education should mandate all school districts to include the asthma symptom module in the California Healthy Kids Survey, instead of leaving it optional.
- The state should provide resources to the DHS Occupational Health Branch to continue surveillance of occupational asthma initiated under a federal grant, and to promote interventions targeting high-risk industries and occupations.
- The Office of Statewide Health Planning and Development should implement plans to collect data on emergency-room visits as well as patient street address and occupation to facilitate linkages to environmental hazards/exposures.
- DHS should evaluate pharmacy data from Kaiser Permanente, Medi-Cal, and other sources as potential indicators of asthma prevalence.
- The CHIS should add a question on COPD on its next survey.

Data on Adverse Reproductive Outcomes

Adverse reproductive outcomes encompass a number of conditions, ranging from birth defects to syndromes that are clinically apparent later in life (e.g., early age at menarche and infertility).

Birth Defects

The California Birth Defects Monitoring Program registry is the state's main source for monitoring data on birth defects (e.g., hypospadias—a male urinary-tract condition—Down syndrome, cerebral palsy). This is an active surveillance system, with abstractors reviewing medical-chart information from hospitals and diagnostic centers. The registry originally covered only five counties around the San Francisco Bay, but was expanded to cover the entire state in 1990.

In 1991, registry officials began limiting data collection to a sample of births in 13 counties (Fresno, Kern, Kings, Los Angeles, Madera, Merced, Orange, San Diego, San Francisco, San Joaquin, Santa Clara, Stanislaus, and Tulare). These counties represent rural (Central Valley), urban (Los Angeles, San Francisco, Santa Clara), and emerging minority populations in the state (Orange County). Selected counties also include university hospital treatment and diagnostic centers in order to facilitate more accuracy in ascertainment. Starting with births in 1999, monitoring focused on 31 groups of major birth defects, to mirror data collected by the Centers for Disease Control's National Birth Defects Prevention Study (in which California participates). There is an average lag of two years from the time of birth before researchers approved through the program's data-sharing protocols can access the baseline registry data. (The program's data-sharing protocols can be seen at www.cdbmp.org/pdf/collaboration.pdf. For information about confidentiality requirements and procedures, see www.cdbmp.org/pdf/confidentiality.pdf.)

Adverse Pregnancy Outcomes

There is no registry for adverse pregnancy outcomes per se, but some systematically collected data are available from vital statistics (linked certificates on birth and death) from the California Center for Health Statistics. These data include outcomes such as low birthweight, prematurity, and infant and fetal mortality. Starting in 1996, the mother's residential address has been available for geocoding into surveillance systems. Before that, it had to be manually abstracted from birth certificates. Outcomes such as spontaneous abortion (miscarriage) are not monitored routinely.

Early Age at Menarche

There is no registry for early age at menarche (onset of menstrual periods), but data on early menarche have been collected and are available from the 1997 California Women's Health Survey, a random-dial telephone survey of 4,000 women age 18 and older (see www.catracking. com for more information on the Women's Health Survey). Researchers asked a question about age at first period. The same question is also asked in the adult version of the California Health Interview Survey, a random telephone survey of approximately 55,000 adults.

Infertility

The state has no registry for infertility, but the California Women's Health Survey asked questions about female infertility in 1997, 1998, and 2001 ("ever told you're infertile" and "problems getting pregnant for 12+ months"). The Centers for Disease Control and Prevention (CDC) also published reports on Assisted Reproductive Technology Success Rates, from 1995—2000, where data are available by state and by clinic. Each clinic has a profile of patient diagnoses, such as ovulatory dysfunction, endometriosis, male contributing factor, etc.

Endometriosis

California has no registry for endometriosis, and existing data consist only of hospitalization and Medi-Cal encounter records. In addition, the CDC reports on Assisted Reproductive Technology Success Rates give patient diagnoses of endometriosis from assisted reproduction clinics.

Sex Ratio at Birth

Several environmental chemicals have been found to reduce the sex ratio at birth—i.e., to decrease in the ratio of male-to-female infants (Weiskopf, 2003). Since the sex ratio has shifted over the last several decades in industrial countries, it has been proposed as a sentinel health indicator of environmental contamination (Davis, 1998). The sex ratio at birth can be easily computed and monitored on an ongoing basis using the birth certificate records from vital statistics.

Limitations of Current Tracking

The California Birth Defects Monitoring Program was reduced from a statewide program to only 13 counties in 1991. Although these current counties represent a mix of urban and rural areas, several areas of the state with unique environmental exposures are not represented (e.g., Contra Costa, Riverside, San Bernardino counties).

California and South Dakota are the only states that do not record data on maternal smoking on the birth certificate. The California certificate has entry space for maternal and paternal occupation, but the data quality is poor.

Although there is no registry for early age at menarche, the California Health Interview Survey and California Women's Health Survey collect these data by population-based random telephone calls. However, the CWHS only included such a question in their 1997 survey rather than in all surveys. The limitations of these surveys include the small sample size of the CWHS and the low response rate of the CHIS.

California data on infertility are incomplete. At present, the state collects no survey data, and the CDC reports only document rates from women entering infertility clinics.

The surveillance data available for endometriosis are extremely limited. Hospitalization data are available, but only capture individuals who decide to use extensive surgery (laparotomy) to treat pain and reduce growths. (Laparoscopy is also used, but would not be captured because it is done on an outpatient basis.) Encounter data are available through Medi-Cal, private sources, or assisted-reproduction clinics, but only would be available for the special populations served by these facilities.

Recommendations for Tracking Birth Outcomes

- The state should restore resources to the California Birth Defects Monitoring Program (CBDMP) so that it covers all counties. Important environmental hazards/exposures are not represented in the currently covered counties, and statewide surveillance of birth defects would track trends that may be related to these hazards/exposures. Continued financial support for the CBDMP is in the public's interest.
- Any researcher (including CBDMP staff) using the birth defects registry to conduct special studies that include case interviews should be required to report back to the CBDMP additional standard data collected on cases (such as residential history, diet, smoking, occupation, etc.) to be added to its baseline

registry. This information would be important for environmental health surveillance and also for other researchers examining the same or related health-study questions.

- The DHS should add the 2003 U.S. Standard Certificate of Live Birth/Fetal Death maternal smoking question to California birth certificates as soon as possible.
- The department should also evaluate how it could improve the completeness and accuracy of parental occupation data on the birth certificate.
- The California Women's Health Survey should reinstate the question on infertility in its next survey.
- The California Women's Health Survey should add a question on physician-diagnosed endometriosis and on chronic pelvic pain in its next survey.
- California officials should work with public and private data managers (e.g., Medi-Cal encounter data managers and Kaiser Permanente's) to develop an ongoing endometriosis surveillance system for the state.
- The California Environmental Tracking Program should continuously monitor the sex ratio at birth as a sentinel indicator.

Data on Cancers

California has maintained a statewide, population-based, mandatory cancer reporting and surveillance system since 1988. The California Cancer Registry is the largest population-based cancer registry in the United States. CCR data are available for the first 14 reporting years (1988 through 2001) for the state's more than 30 million residents. By the time they became available, more than 94% of the cases had been microscopically confirmed by pathology laboratories. The California Health Interview Survey, the largest state health survey in the U.S., also collects information on cancer. The 2001 CHIS adult survey asked questions about cancer history (of respondent and family history), prevention, and screening (colon-cancer screening, PSA test for prostate cancer).

Limitations of Current Tracking

Currently, the California Cancer Registry takes 8–22 months after the end of a calendar year to achieve 95% completeness in reporting cancer cases, a rate that meets or exceeds national standards. Unfortunately, researchers studying rapidly fatal cancers often receive cases from the registry too late to be able to interview these patients. It would be useful for these researchers to be able to access cases that are not yet confirmed or whose records contain incomplete data. Smoking and residential history are not routinely available in the registry. Occupational data are collected, but the data are limited. This information is collected during hospital admission by an admissions clerk and at the time of death by the funeral-home director from the next of kin. The recorded information commonly reflects only the last occupation (e.g., approximately 25% percent of the data records "retired").

Recommendations for Tracking Cancers

- State funds should be provided to the California Cancer Registry to supplement its data by interviewing at least a representative subsample of cases to obtain data on smoking, residential, and occupational history.
- The CCR should continue its modernization efforts to create a centralized computer system where data continually stream in from reporting entities, while facilitating specific data use for medical-care research, surveillance, and public health purposes. Because the cost for this will be high (in the

millions), initially the CCR should work with the proposed Office of Environmental Health Tracking (see Chapter 8) on investigating the feasibility of using initial diagnoses for rapid case ascertainment, incidence reporting, and surveillance efforts. Rapid case ascertainment is necessary to respond to inquiries about cancer clusters, and to include people identified with cancers associated with short survival times in public health studies. (See Chapter 6 for a fuller discussion of cluster investigations.)

- Any researcher using the cancer registry to interview people with cancer should be required to report to the CCR additional standard data collected on cases (such as residential history, diet, smoking, occupation, etc.). This information would be important for environmental health surveillance and also for other researchers examining the same or related health-study questions.

Data on Diabetes

Diabetes, like many chronic diseases, is not a reportable disease, and no diabetes registry exists. Information on diabetes is available from death certificates, hospitalization records, and Medi-Cal encounter data. The DHS Diabetes Control and Prevention Program (DCPP) tracks the prevalence of diabetes through the Behavioral Risk Factor Survey (BRFS), which includes 14 questions regarding diabetes. These include physician-diagnosed diabetes, gestational diabetes, and medication use. The DCPP analyzes BRFS data using a variety of demographic variables, including age, education, income, and racial and ethnic background. In 2001, the California Health Interview Survey asked questions on the prevalence of adult and adolescent diabetes.

Limitations of Current Tracking

Because diabetes is a disease with a low fatality rate, mortality and hospitalization data are not sufficient to track the prevalence of this condition. Medi-Cal encounter billing data would give only a snapshot of the prevalence of diabetes in this special population, and completion rates may differ for fee-for-service and managed care plans. The BRFS has a limited sample size, so reliable estimates can be given only for the state as a whole (although the DCPP has estimated county-level prevalence rates using the BRFS sex/age/race-specific rates and applying them to county population estimates from the state Department of Finance). The 2001 CHIS, which could provide county-level estimates, has been plagued by a low response rate typical of random telephone surveys, and will have fewer questions on diabetes in the 2003 survey.

Recommendations for Tracking Diabetes

- The state should collect more data on diabetes risk factors and prevalence. The CHIS should restore all questions on the prevalence of diabetes in its next survey.
- The DHS Diabetes Control and Prevention Program should explore the utility of using the Medi-Cal encounter data, coupled with private sources (such as Kaiser Permanente), to create an ongoing surveillance system for diabetes that could capture diabetes prevalence in these large populations. These sources could provide data on medication use, which may be an important sentinel marker for diabetes prevalence.
- The DCPP also should explore the utility of developing a pharmacy-based surveillance program to collect data on insulin and oral hypoglycemic drug prescriptions. The California Legislature should develop regulations that require all pharmacies to transmit these data to the DCPP once a year.

Data on Neurodevelopmental Outcomes

Autism and Developmental Disabilities

The California Center for Autism and Developmental Disabilities Research and Epidemiology (CADDRE) of DHS is developing a surveillance system for autism. This system will link statewide Developmental Disability Services (DDS) files to birth records, enabling the unique identification of children with autism and mental retardation along with their complete birth-record information. DDS operates through a statewide system of 21 regional centers that coordinate services for people with developmental disabilities. The department maintains a centralized electronic database of diagnostic and identifying information on all clients, derived from information provided by the regional centers on a standardized, statewide reporting form. Based on CADDRE pilot studies, about 75% to 85% of children diagnosed with an autistic disorder are enrolled in the DDS system. The CADDRE program is planning to estimate the misdiagnosis rate for autism from the DDS files.

The Special Education Division of the California Department of Education also maintains files on children enrolled in special education with a primary disability code of autism who may not be in the DDS system. The division maintains an extensive database, and its website has an interactive report-generating engine. This is an administrative database for educational eligibility and not a clinical system, however, with data available on the state, county, district, and school levels. Conditions that determine eligibility for special education include mental retardation, hearing disorders, speech/language impairments, visual impairments, emotional disturbances, orthopedic and other health impairments, specific learning disabilities, multiple disabilities, autism, and traumatic brain injury.

The CHIS child survey also asks a question on autism and learning disabilities (i.e., "What behavioral or mental condition does the child have?," with answers including autism, learning disabilities, attention deficit disorder, mental retardation).

Limitations of Current Tracking

Currently, the CADDRE system can only capture approximately 75% to 85% of California children with autism-spectrum disorder. The autism misdiagnosis rate in DDS files is unknown. The CHIS child survey does not capture physician-diagnosed autism or learning disorders, as it only asks the parent if the child has the condition (see above question).

Recommendations for Tracking Neurodevelopmental Outcomes

- California should develop an autism surveillance system. Currently, the California Center for Autism and Developmental Disabilities Research and Epidemiology is linking birth-certificate data with data from the Department of Developmental Services, which can serve as a resource to investigate the role that perinatal factors may play in the etiology of autism-spectrum disorders. The maternal address from the birth certificate can be used to link environmental hazards at the time of birth. CADDRE should expand its database to link Department of Education special education files to both birth certificates and DDS files to create a more complete statewide surveillance system for autism and learning disabilities. Inclusion of the special education files in the autism surveillance system would increase the capture of these children born in California to an estimated 90%.
- The CHIS child survey should revise its behavioral/mental condition question to ask if a physician or other health practitioner has ever diagnosed the child with autism or learning disorders.

Data on Heart Disease and Stroke

California has no registry for heart disease and stroke. Information on these conditions is available for mortality and hospitalizations, and estimates of their prevalence are available from administrative encounter data, such as the Medi-Cal billing system and private sources such as Kaiser Permanente. The California Heart Disease and Stroke Prevention Program (CHDSP) tracks the prevalence for the major risk factors for heart disease and stroke based on estimates obtained from the Behavioral Risk Factor Survey. In CHIS 2001, questions were asked about hypertension (high blood pressure) and heart disease to estimate the prevalence of these conditions in the adult population.

Limitations of Current Tracking

Population-based surveillance for heart disease and stroke is only available for deaths and hospitalizations. Individuals suffering from these diseases who are not hospitalized are not tracked. Encounter data can give us prevalence estimates, but only for subpopulations such as participants in the Medi-Cal program and Kaiser Permanente. As with other conditions, BRFS data on major risk factors for heart disease and stroke can only give us statewide and not county-level estimates. Although the CHIS is large enough to provide county-level estimates, it suffers from low response rates typical of random telephone surveys.

Recommendations for Tracking Heart Disease

- The CHDSP should work with the California Environmental Health Tracking Program, the Air Resources Board, and the Office of Environmental Health Hazard Assessment to examine how mortality, hospitalization data, and administrative encounter data can be examined via time-series analysis or other methods to track heart disease.
- The CHDSP should consider looking at medication use from administrative encounter data as a feasible sentinel marker for the prevalence of hypertension and heart disease.

Data on Autoimmune Disorders

Autoimmune diseases are poorly tracked, relatively rare, and the overall epidemiology of these conditions is poorly understood. It is likely that environmental exposures contribute to these conditions.

Lupus

Currently, California has no surveillance system for Systemic Lupus Erythematosus. Information on lupus is available for mortality and hospitalizations. Administrative encounter data from the Medi-Cal billing system and Kaiser Permanente might also be a good source of data on the prevalence of lupus in selected populations. The BRFS optional "Arthritis" module asks a question: "Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?"

Multiple Sclerosis

California has no registry for multiple sclerosis. Information on this disease is available only from mortality data, hospitalizations, and administrative encounter data from such sources as Medi-Cal and Kaiser Permanente.

Limitations of Current Tracking

Mortality and hospitalization data are inadequate to track lupus and multiple sclerosis because of the low fatality rates of these diseases. Administrative encounter data could give us prevalence estimates, but only for these

special populations. The BRFS optional module is of little or no use because it fails to differentiate between widely disparate disorders, such as osteoarthritis, lupus, gout, and fibromyalgia.

Recommendations for Tracking Autoimmune Diseases

- The California Environmental Health Tracking Program (CEHTP) should pursue extramural funding sources, such as the National Institutes of Health and the Centers for Disease Control and Prevention, to develop community-based pilot studies to track autoimmune diseases such as lupus and multiple sclerosis so it can obtain prevalence estimates. These cases would need to be identified from records of neurologists and rheumatologists and other data sources, such as Kaiser Permanente. The surveillance studies should be conducted as partnerships between CEHTP and representatives from targeted communities.
- The BRFS should include a mandatory question on autoimmune diseases. This question should be better worded to more specifically capture current prevalence estimates of each of these conditions.
- The CHIS should include one or more questions on autoimmune disease to be able to track these conditions at the county level.

Data on Kidney Disease

California has mortality and hospitalization data for renal (kidney) disease because of the Medicare End Stage Renal Disease Program, a national insurance program for individuals with end-stage renal disease, which tracks the number of individuals on dialysis. In 2001, 36,577 Californians were on dialysis (ESRDP, 2001). These data include patient name and address, age, gender, race, medical coverage, employment status, comorbidity conditions, height, weight, laboratory values, and dialysis and kidney transplant data.

Limitations of Current Tracking

Since renal disease does not rapidly or necessarily lead to hospitalization, dialysis, or death, mortality and hospitalization data are of limited value for tracking the prevalence of this condition. In addition, the Medicare End State Renal Disease Program does not include data on occupation, smoking history, or residence history.

Recommendations for Tracking Kidney Disease

- The proposed Office of Environmental Health Tracking (see Chapter 8) and the Chronic Disease Control Branch of DHS should summarize and disseminate annually the Medicare End Stage Renal Disease Program data for health tracking.
- Funds should be provided for these programs to supplement the data by interviewing a representative subsample of cases to obtain data on smoking, residential, and occupational history.

Data on Neurological Diseases

California has mortality and hospitalization data for both Alzheimer's and Parkinson's disease. The Department of Health Services' Chronic Disease Control Branch has an Alzheimer's program that funds 10 treatment and diagnostic centers throughout the state, which has a database of 12,000–15,000 patients who have been evaluated at the centers. Information is collected on demographics, treatment, diagnosis, education, occupation, and comorbidity. Encounter data from the Medi-Cal billing system and such private sources as Kaiser Permanente are also available for prevalence estimates.

A study by the Kaiser Permanente Medical Care Program of Northern California estimated the overall incidence of Parkinson's disease among its insured (Van Den Eeden, 2003) as 13.4 per 100,000, adjusted by age and gender. Although the Kaiser-insured population is not representative of California's overall population, the study provides some insight into the occurrence of this devastating disease. Kaiser found that the incidence rapidly increased over the age of 60; only 4% of the cases were among members under age 50. The rate for men was higher than that for women. Occupation has been implicated as a potential risk factor for Parkinson's disease, which may explain some of the potential difference in gender-adjusted rates (Schulte, 1996; Gorell, 1999).

The study suggested that rates may be highest among Hispanics and lowest among blacks, but these results may be misleading because of the small numbers of cases among groups other than non-Hispanic whites. Commentators advocate the need to conduct carefully planned and focused environmental studies to explore factors such as gender, occupation, and ethnicity to attempt to determine the cause of Parkinson's disease (Rajput, 2001).

Limitations of Current Tracking

Because Parkinson's and Alzheimer's disease have a low fatality rate, mortality and hospitalization data do not capture the full prevalence of these illnesses. Examination of encounter data would generate prevalence estimates only for the populations covered by Medi-Cal and private insurance. The DHS Alzheimer's program only surveys patients who have been treated at one of their centers, who are likely to represent more severe patients than the general population with Alzheimer's disease.

Recommendations for Tracking Neurological Diseases

- Surveillance needs to be significantly improved for neurological diseases such as Alzheimer's and Parkinson's disease. Patients with these diseases could be identified through neurologists and clinics. To perform such surveillance it is critical to understand the distribution of these diseases by race/ethnicity, geographic area, age, gender, occupation, and socioeconomic status in a far more complete manner that current data allow. For this reason, we recommend that California develop statewide registries for both Parkinson's and Alzheimer's disease, consisting initially of a representative sample of patients limited geographically to one county, with the intention of expansion statewide. Public/private partnerships should be formed with the Department of Health Services, the University of California, and Alzheimer's and Parkinson's disease foundations to explore the feasibility of creating such registries.
- Parkinson's disease medications should be explored as a sentinel marker of disease prevalence.

Data on Lead Poisoning

Lead poisoning surveillance is well established in California, which has two systems run by the Department of Health Services to routinely collect data on blood-lead levels of both adults and children. The Childhood Lead Poisoning Prevention Branch maintains a surveillance and case-management system of child lead poisoning in its Response and Surveillance System for Childhood Lead Exposures (RASSCLE) database, and the Occupational Health Branch's Occupational Lead Poisoning Prevention Program (OLPPP) collects data on adult blood-lead levels in its Elevated Lead Visual Information System (ELVIS) database. RASSCLE is both a surveillance and case-management system, containing thorough demographic, exposure, and health-care utilization data. ELVIS contains demographic, employer, lab, and medical-provider information, as well as certain data elements from OLPPP's statewide case-management activities.

RASSCLE and ELVIS data previously did not capture all elevated blood-lead levels. Prior to January 2003, laboratories only were required to report blood-lead levels above 25 micrograms per deciliter (ug/dl), although

many laboratories reported lower values voluntarily. Some of these laboratories reported blood-lead levels at and above 10 ug/dl—the CDC definition of an elevated blood-lead level for children—while others reported all blood-lead testing results regardless of level. Researchers have found adverse health in children at levels well under 10 ug/dl (Canfield, 2003). Universal reporting to the DHS of all blood-lead tests began in January 2003, and all results must be reported electronically by January 1, 2005.

Limitations of Current Tracking

Although the Childhood Lead Poisoning Prevention Branch is working to establish a comprehensive electronic laboratory reporting system as part of its RASSCLE update (called RASSCLE II), database information on the prevalence of elevated blood-lead levels is still incomplete. The denominator data contained in the current RASSCLE system is limited (e.g., most children who were tested and were found to have blood-lead levels below 10 ug/dl are not currently being entered into the database due to resource limitations, though the presence of testing is being noted in many cases). A further limitation of the surveillance system is that not all high-risk children are tested for elevated blood-lead, so they are not captured by the system.

Adult blood-lead (ELVIS) data with respect to prevalence are also limited. Although the Occupational Lead Poisoning Prevention Program does enter into ELVIS the results of all blood-lead tests received, not all employers who are required to send adults for blood-lead testing actually do so, and prior to January 2003 not all laboratories were reporting adult blood-lead levels below 25 ug/dl to the state. In addition, many of the reports sent to OLPPP contain incomplete information on demographics and employers, and resource limitations prevent the follow-up that would improve data quality

Recommendation for Tracking Lead Poisoning

- ▶ The Childhood Lead Poisoning Prevention Branch should investigate how RASSCLEII might be linked with other environmental health surveillance systems to identify children at risk from exposure to multiple environmental agents.

Data on Potential Environmentally Related Diseases

Multiple Chemical Sensitivity

There are no data on hospitalizations for multiple chemical sensitivity. The only source of data is a 1995 question on the BRFS.

Chronic Fatigue Syndrome

Information on chronic fatigue syndrome is available from hospitalization and encounter data from Medi-Cal billing records and private insurers such as Kaiser Permanente. It was also included as a question in the 1995 BRFS.

Limitations of Current Tracking

There are no data to track the prevalence of multiple chemical sensitivity in California. Hospitalizations for chronic fatigue syndrome could be tracked, but would fail to capture the vast majority of cases of the disease. Similarly, encounter records of physician diagnoses would reveal some prevalence data, but they would not include undiagnosed cases. The epidemiology of these conditions is poorly understood, and the probability that they are associated with environmental exposures is currently being investigated. The number of Californians who have these conditions is unknown.

Recommendation for Tracking Potential Environmentally Related Diseases

- ▶ The BRFS and the CHIS should consider collecting data on these two conditions in their next survey.

Data on Occupational Illnesses

Occupational illness can be seen as early sentinels or warnings that chronic diseases are occurring in highly exposed populations. Workers often experience high doses of environmental contaminants for long periods of time, and exposure data are often more reliable and plentiful for workers than for the general public. For this reason, and in recognition that our definition of "environment" includes the work environment, occupational diseases should be tracked in an environmental health surveillance system.

In this section, we include three important occupational illnesses: dermatitis, asthma, and pesticide illness. Although dermatitis is an important disease that occurs in the general population, it is included here as an occupational disease because it is the most common workplace-related illness, and tracking it at this time would be impractical outside of the occupational setting.

The two most extensive statewide data sources of occupational health information are the Department of Industrial Relations (DIR) and the Workers' Compensation Information System (WCIS). All physicians are required to submit a Doctor's First Report of Occupational Illness or Injury to the DIR or the workers' compensation insurance carrier after seeing a patient whose illness/injury they suspect as being work-related, and workers' compensation carriers are required to submit them to the DIR's Division of Labor Statistics and Research. The WCIS, created in 1999, is a repository of information on workers' compensation claims, which insurers are required to submit to DIR's Division of Workers' Compensation. Other sources of occupational illness data include laboratory reports (e.g., blood lead or cholinesterase levels), the Cancer Registry, data on hospital admissions and emergency-room visits, death certificates, and administrative encounter data (e.g., from Kaiser).

Occupational Dermatitis

There is no registry for occupational dermatitis, nor do any surveys collect data on this condition. The only sources of data for dermatitis in California are doctors' first reports (DFRs) and administrative encounter data from such sources as the Medi-Cal billing system or private insurers like Kaiser Permanente.

Occupational Asthma

The DHS Occupational Health Branch maintains a work-related asthma surveillance system as a pilot project funded by the National Institute for Occupational Safety and Health. DFRs are its primary source of information, augmented by interviews with workers to identify conditions in the workplace (including specific chemicals) believed to be the cause of the illness. These surveillance data are analyzed to identify high-risk occupations and industries, and recommendations are made and disseminated for appropriate interventions.

Pesticide Illness

Physicians are required to report any suspected pesticide poisoning to the local health officer, who generates a pesticide illness report (PIR). For occupational as well as nonoccupational poisonings, the health officer transmits this report to the county agricultural commissioner, who provides copies to the California Department of Pesticide Regulation (DPR) and the Office of Environmental Health Hazard Assessment (OEHHA), both within Cal/EPA, as well as the DIR, which enforces reporting requirements. For occupational cases there is an

additional reporting requirement, in that the DFR is sent to the workers' compensation carrier, who is responsible for sending copies to the DIR.

The pesticide illness reports and doctors' first reports are two sources for the SENSOR Pesticide Illness Database, maintained by the Occupational Health Branch of DHS, which also include medical, demographic, residential location, occupation, industry, and exposure information. Selected cases receive a public health investigation, from which prevention recommendations are developed and disseminated.

The Department of Pesticide Regulation reviews illness reports submitted to the state workers' compensation system, as well as PIRs, and conducts surveillance for occupational as well as nonoccupational pesticide illness. Surveillance data are maintained in the Pesticide Illness Surveillance Program. California agricultural commissioners, in coordination with DPR, follow up each case of acute pesticide poisoning and conduct a more thorough investigation, primarily for enforcement of regulatory violations, such as noncompliance with field reentry intervals.

Limitations of Current Tracking Systems

Occupational Dermatitis: There are no routine tracking systems for dermatitis in California. DFR forms recording occupational contact-dermatitis are not routinely submitted accurately and completely.

Occupational Asthma: Work-related asthma surveillance is not complete, as the potential for underreporting is significant at each step of the process. For example, workers lack access to medical care, health-care providers underrecognize work-related asthma, and insurers fail to forward DFRs to the state.

Pesticide Illness: Reporting is likely to be incomplete. Physicians often do not report or delay reporting potential pesticide illnesses. For example, in 1997 only 30% of physicians reported cases that the Pesticide Illness Surveillance Program identified through the workers' compensation system. Other sources of underreporting include workers' lack of access to health care or failure to seek care because of fear of reprisal, health-care providers' underrecognition of the conditions, and lack of reporting to DIR by workers' compensation insurers. The reporting systems are biased toward acute rather than chronic effects of pesticide exposures.

Recommendations for Tracking Occupational Illnesses

Occupational Dermatitis

- California should provide the resources for the DHS Occupational Health Branch to pilot a project on the feasibility of using administrative encounter data (possibly coupled with telephone interviews) to develop an ongoing surveillance system for dermatitis.
- The OHB should also work with the Department of Industrial Relations to increase worker's compensation reporting of such conditions to DIR and DIR reporting to OHB.
- The CHIS should consider adding questions on dermatitis in its next survey.

Occupational Asthma

- California should provide resources to the DIR and the OHB to improve existing reporting systems by increasing insurance carriers' compliance in submitting doctors' first reports; increasing their capability to analyze electronic data on workers' compensation; performing outreach and education to health-care practitioners to improve the recognition of work-related asthma; and targeting interventions to industries and occupations at high risk for asthma.

Pesticide Illness

- DHS, the Office of Environmental Health Hazard Assessment, and the Department of Pesticide Regulation should collaborate on collecting data for pesticide illness surveillance. County agricultural commissioners' reports of pesticide-incident investigations should be routinely shared with DHS. The sharing of information on incidents, including field data and outcome, would ensure a cohesive pesticide illness surveillance system that incorporates a public health perspective in addition to ensuring compliance with regulatory requirements. The DHS, the OEHHA, and the DPR should also conduct a joint feasibility study on how this system could be enhanced to assess the chronic, not just acute, effects of pesticide exposure.
- The state should provide increased training to medical providers to improve the recognition and reporting of pesticide-related illness. Physicians need to be encouraged to fill out Pesticide Illness Reports and DFRs completely and accurately. Physician reporting to the workers' compensation insurance system needs to be increased, as well as the workers' compensation insurers' reporting to DIR.

General Recommendations for Occupational Illness Surveillance

- The state should provide sufficient resources to the Department of Industrial Relations and the DHS Occupational Health Branch to improve existing data systems (DFRs, Workers' Compensation Information System) so they can be fully utilized for surveillance and prevention. Data should be analyzed and disseminated routinely in reports to stakeholders statewide.
- Physicians should be required to receive continuing education about occupational illness to improve recognition, as well as education about the requirement to submit doctors' first reports.
- The Department of Industrial Relations should enforce the requirements for physicians and workers' compensation insurers to submit DFRs, and for workers' compensation insurers to submit required data to the WCIS.
- The state should explore the feasibility of creating a data system and requiring physicians to submit DFRs electronically.
- If provided additional resources, the DHS Occupational Health Branch should identify additional occupational conditions to place under surveillance using available data sources.

5
Tracking Hazards and Exposures

Environmental health tracking requires information about the exposure of human populations to harmful substances. A wide array of information can be used as indicators of potential and actual exposures, including data on chemical releases, levels of various substances in the environment, direct human exposures, and levels of chemicals in the human body (biological monitoring).

Hazard tracking and exposure tracking are conceptually distinct but often rely on similar information. A hazard is the potential for harm. Hazard tracking involves obtaining information about indicators that correlate with potential for exposure. Exposure is contact between an environmental hazard and an individual, group, or population through inhalation, ingestion, or dermal (skin) contact. In contrast to hazard tracking, exposure tracking must account for a level of contact (i.e., inhalation, ingestion, or dermal contact). Some databases are more appropriately characterized as hazard-tracking databases because they track the level of pollutant emissions or releases but lack information on contact. Others that are more directly relevant to tracking human contact with environmental chemicals can be considered exposure tracking.

Exposure tracking often relies on information from environmental hazard-tracking databases. For example, the distribution of arsenic concentrations in water supplies can be used to estimate a drinking-water hazard for various communities. But when these data are combined with information about how much an individual drinks, we estimate exposure. In California, population exposure to air pollutants is estimated using hazard-tracking information that includes emissions inventories, air-quality monitoring, and contact information that includes pollution dispersion and atmospheric chemistry modeling, combined with population time-activity data—information about where and how long an individual conducts his or her activities in a typical day.

Other methods of estimating exposure include survey questionnaires and biological monitoring. Surveys have been used to estimate exposure from smoking and dietary contaminants. Biological monitoring may be used to measure the amount of a chemical or its metabolite(s) in human specimens, such as blood, hair, or urine. Blood-lead testing is an example of biological monitoring. Biological monitoring provides a direct measure of body burden at a given point in time, depending on a compound's pharmacokinetics (i.e., the absorption, metabolism, and action of a compound). Because of the four factors below, however, biological monitoring does not necessarily capture all relevant information about human exposure. The four factors are: (1) variable excretion rates among populations; (2) the short retention period of certain chemicals; (3) the lack of a relevant or reliable biomarker for many types of pollutants; and (4) the inability to trace how a chemical actually entered a person's body.

Characteristics of a Hazard-Tracking Database

We recommend the following minimum data elements for an ideal environmental hazard-tracking database. Because these data elements apply differently to source/use, emission/release, and monitoring databases, all elements may not be applicable to each database:

Unique site or facility identifier (if applicable)
Accurate latitude/longitude of point or area emission/release source (if applicable)
Address or accurate latitude/longitude of monitoring station (if applicable)
Amount released/used, or ambient concentration
Minimum detection limits
Identification of laboratory method(s) used to determine concentration
Chemical identified by Chemical Abstracts Service or other unique identifier
Basic chemical properties—octanol-water partition coefficient and air-water partition coefficient, overall environmental half-life or medium-specific half-lives (if available)
Routine, and when possible, continuous monitoring
Fate and transport data on pollutant behavior in various media
Representative geographic coverage of state

A *unique facility identifier* will allow multiple hazard databases to be linked, and *address and/or coordinates* of a point or area emission source can be used for linkage to health-outcome databases on a specific geographic level. The same applies for the *address of a monitoring station*. Using *amount released, chemical used, or ambient concentration of a pollutant*, researchers and regulatory agencies can calculate emissions trends over time and determine whether facilities meet the appropriate standards and regulations. The information should be usable to estimate exposure levels for populations or individuals.

Having unique identifiers for chemical agents helps to link California data to national databases. For example, the Aerometric Data Analysis and Management System (ADAM) uses the same pollutant IDs as used in the U.S. EPA's ambient air-quality data-management system. *Basic chemical properties* are important for determining the persistence and "reach," or characteristic travel distance, of a chemical as well as likely pathways of exposure (inhalation versus ingestion). *Routine and continuous monitoring* or reporting by facilities is important in order to estimate pollutant levels over time. Trends in chemical releases or uses provide important information on potential human exposure to these hazards.

Characteristics of an Exposure-Tracking Database

We think an ideal environmental exposure database would contain the following data elements. As mentioned earlier with regard to the characteristics of a hazard-tracking database, because these data elements apply differently to source/use, emission/release, and monitoring databases, all elements may not be applicable to each database:

Subject name or unique identifier (if applicable)
Gender (if applicable)
Date of birth (if applicable)
Race/ethnicity
Residence address or latitude/longitude of residence address
Residence history (if applicable)
Occupational history, including occupation and industry (using the Standard Occupational Classification and North American Industry Classification System) for adults
School name and location (for students)
Smoking history and/or exposure to environmental tobacco smoke
Level of contaminant, including units
Unique identifier of any environmental exposure indicators that have been measured

Routine and, when possible, continuous monitoring data for the substance of interest
Statewide geographic coverage of exposure or a set of samples representative of the state
Pathway and/or route of exposure

Minimum detection limit and documentation of laboratory methods used should be either part of the database or properly referenced. Several categories listed above may not be applicable if the available exposure information contains data results based on modeled estimates of human exposure. Such information can be useful for estimating exposures of subpopulations of people, but generally are not precise enough to generate individual-level exposure estimates.

An *individual's name or unique identifier* (such as Social Security number) can be used to link an exposure database to a health-outcome database, such as one based on Medi-Cal or patient discharge data. As discussed in Chapter 4, an individual's *gender, date of birth, and race/ethnicity* are critical to examine patterns of diseases in different groups. Exposures may vary by those characteristics as well. For example, a recent scientific study using hazard databases to estimate human exposures showed that Latino and African-American children have a higher estimated risk of cancer associated with ambient air toxics exposures while at school (Morello-Frosch 2002). *Residence address* and *history* allow links to exposure data, hazard data, and health-outcome data on a more refined geographical scale. Knowing an individual's residence history also permits a retrospective analysis of a potential level and duration of exposure.

Occupation and *occupational history* will provide an important insight into an individual's level of exposure in the workplace, along with information on which industries pose the highest hazard for worker health. *Smoking* is an important factor in the relationship between an exposure and a potential health outcome, and needs to be accounted for in statistical analysis of the data. *Ongoing reporting* or *routine monitoring* will enable the examination of trends in exposure level. Finally, hazard and exposure tracking should be done on a *statewide basis* (or with representatives of the state's population) in order to accurately assign or estimate exposure to various population groups.

Ideally, all hazard and exposure databases, at a minimum, should meet all the criteria discussed above. Although several databases we evaluated do not contain all the necessary elements, they could provide useful supplementary information for the purposes of environmental health tracking. Many existing systems already provide data on the amount of some pollutants released in the environment. However, many important pollution sources are not tracked, and currently we have a limited ability to estimate or measure population exposures. These issues are discussed further Chapter 8 (Recommendations).

Measures Available for Tracking Hazards and Exposures

A number of measures could be used to track environmental hazards and population exposures, including use data, emissions data, modeling, and biological monitoring.

Use data describe the amount a potential hazard is used, For example, the Pesticide Use Report of the Department of Pesticide Regulation provides on a square mile resolution the total pounds of active ingredients that pesticide applicators or farmers apply to agricultural lands.

Emissions/discharge data measure or estimate the amount of a pollutant that is released into the environment. The Toxic Release Inventory, for example, is a compilation of self-reported estimates from point facilities of toxic air emissions. The U.S. EPA National Emissions Inventory, or NEI, contains information on stationary and mobile

sources that emit criteria air pollutants and their precursors, as well as hazardous air pollutants. The database includes annual estimates of emissions, by source, of air pollutants in each area of the country.

Modeling uses emissions data, along with meteorological data, atmospheric chemistry, and other information such as topography to estimate how a substance disperses in the environment. Modeling may include both stationary and mobile sources of pollution.

Biological monitoring measures the amount of a pollutant in biological samples, such as breast milk, blood, and urine. Although biological monitoring may best reflect the amount of an individual's true exposure, it may be difficult to determine all the sources of the pollutant.

The Need for Chemical Hazard-Tracking

During the past half-century, thousands of chemical substances have been developed, used in workplaces, and put into consumer products. Although the United States produces or imports more than 1 million pounds of nearly 3,000 chemicals per year (EPA, 1998), there is no systematic tracking of where these chemicals are used, what is contained in consumer products, and how much is released into the environment.

The limited information regarding use and distribution of chemical hazards in California represents a major gap for environmental health surveillance. Although data on chemical use do not necessarily provide the best indicator of exposure to the general public, such data would provide an important starting point for environmental hazard-tracking. Chemical use data would improve the accuracy of air pollution inventories and exposure models, alert public health authorities to emerging hazards in commerce, help in interpreting biological monitoring results, and enable targeted interventions. In addition, use data could assist in screening chemicals and establishing priorities for further assessment and potential risk management.

Limited data are available for some environmental releases. Inventories of hazardous materials are currently compiled by California's Certified Unified Program Agencies (CUPAs), which are local or regional consolidations of six state environmental programs: Hazardous Materials Business Plan/Emergency Response Plan, Hazardous Waste/Tiered Permitting, Underground Storage Tanks, Aboveground Storage Tanks, California Accidental Release Program, and the Uniform Fire Code Hazardous Materials Management Plan. CUPAs can be formed by a county, city, or joint powers authority. Along with pesticide use and toxic release inventory data, these data still cover only a fraction of priority environmental hazards.

In addition, limited data exist on the health effects of these chemicals. The U.S. EPA found that no basic toxicity information (concerning either human health or environmental toxicity) is publicly available for 43% of the high-production-volume chemicals manufactured in the U.S., and that a full set of basic toxicity information is available for only 7% of these chemicals (EPA, 1998).

Lack of information about the use and distribution of chemical hazards forces us to continually respond to problems rather than prevent them. For example, persistent and bio-accumulative flame retardants were not widely recognized as a problem until biological monitoring demonstrated high concentrations of these chemicals

Pesticide-use reports provide limited data on pesticide use, covering "active ingredients" not total volume of chemicals applied. The Toxics Release Inventory applies to approximately 650 listed chemicals. Businesses with 10 or fewer employees do not report. Facilities need to report if they manufacture or process over 25,000 pounds of at least one listed TRI chemical, or use more than 10,000 pounds of at least one TRI chemical. Facilities are not required to report if a listed chemicals is present at concentrations of less than 1.0% (or 0.1% if a toxic chemical is classified by the U.S. Occupational Safety and Health Administration as a carcinogen) in products received or manufactured by facilities.

in harbor seals and the breast milk of California women (She, 2002). A recent outbreak of nerve damage among automobile mechanics due to the use of brake-cleaning chemicals with a known neurotoxin may have been prevented had public health officials been aware of such use (DHS, 2001).

In addition, lack of information about where these chemicals were used resulted in difficulties alerting workers and employers about the risk of nerve damage once the problem became apparent. Lack of information about chemical use also makes it difficult to interpret the significance of exposure data. The CDC reports detecting concentrations of phthalates in children (chemicals widely used in plastics) (CDC, 2003a). In order to evaluate the significance of this finding, it would be useful to have phthalate use data to see how use over time corresponds to body-burden measurements.

Tracking the actual use of certain potentially harmful substances, rather than the estimated environmental release, would also improve existing environmental data systems. For example, the California Air Resources Board currently relies on estimated emissions to model exposure to air pollutants. Use reporting for the more than 8,000 gasoline stations and 5,000 dry-cleaning plants—both high-chemical-throughput businesses—would vastly improve existing emissions inventories (MarketPlace, 2002). Tracking of hazardous chemicals can also identify emerging hazards and prevent potential exposures, as the characteristics of chemicals that make them likely to result in human exposure are widely recognized (Pratt, 1993; Scheringer, 2001). If the use of chemicals with a high exposure potential is increasing, these chemicals should be identified as priorities for exposure tracking.

Priority Environmental Hazards and Exposures: Data Sources and Recommendations for Tracking

The Pew Environmental Health Commission's public-opinion survey found that the vast majority of registered voters in the United States believe that air pollution, contaminated drinking water, toxic waste, and pesticides have the greatest impact on public health (see http://pewenvirohealth.jhsph.edu/html/reports/pehc.pdf). In addition, in its report, the Pew Commission identified certain hazards and exposures that should be tracked by all 50 states: persistent organic pollutants such as PCBs and dioxin; heavy metals such as mercury and lead; pesticides such as organophosphates, pyrethroids, and carbamates; air contaminants such as volatile organic chemicals and fine particles; and drinking-water contaminants, including pathogens. Accordingly, we recommended that California track several priority environmental hazards, as outlined in Table 5.1. This list is not exhaustive. The most information currently collected in California pertains to air pollutants. Only limited information is available for the majority of other hazards and exposures.

Data on Air Pollution

Data on air pollution can be collected using a number of methods, including (1) ambient monitoring, (2) maintaining emissions databases, and (3) personal-exposure monitoring. California has systems in place that collect data on criteria and toxic air pollutants, both via emissions inventories and ambient air-monitoring. Criteria air pollutants are six common air pollutants in the United States—ozone, carbon monoxide, particulate matter (less than 10 microns), nitrogen dioxide, sulfur dioxide, and lead—for which the EPA has established National Ambient Air Quality Standards, which define the maximum legally allowable concentrations. Toxic air contaminants (or hazardous air pollutants) are chemicals that are associated with adverse health effects in humans or animals; no federal or state standards have been set.

Table 5.1
Examples of Environmental Hazards for Tracking

Persistent Organic Pollutants
PCBs and Dioxin
Polybrominated Flame Retardants
Phtalates
Metals
Chromium
Lead
Mercury
Pesticides
Carbamate
Organophosphorous
Organochlorine
Other Pesticides
Proposition 65 Chemicals
Air Pollutants
Criteria Air Pollutants
Hazardous Air Pollutants[a]
Water Pollutants
Chemical Pollutants
Pathogens
Hazardous and Solid Waste
Indoor Hazards
Environmental Tobacco Smoke
Molds
Radon
Asbestos
Volatile Organic Compounds
Occupational
Radiation
Lead
Other OSHA Hazards

Note: a. California must continue to evaluate compounds for inclusion as hazardous air pollutants. Research suggests that some compounds not listed as hazardous air pollutants meet the criteria for toxicity and thus should be included (see Lunder, in press).

There are many ways to categorize and prioritize environmental hazards for tracking. The working group recognizes that the categories in Table 5.1 are not mutually exclusive and may overlap. These categories are useful for making policy recommendations concerning environmental health surveillance.

Through its National Air Toxics Assessment system the EPA developed estimates of the ambient concentrations of 33 toxic air pollutants for every county nationwide. In addition, the EPA administers the Toxic Release Inventory (TRI) Program, which requires manufacturing facilities that meet certain minimum reporting thresholds to estimate their annual emissions for over 300 chemicals. The TRI does not include mobile sources of emissions.

The California Air Resources Board (ARB) maintains the Aerometric Data Analysis and Management System, a repository for data on criteria air-pollutants gathered from approximately 280 active monitoring stations distributed throughout the state. Currently these data are used to assess trends and conformity with state and national air-quality standards, as well as estimate population exposure through modeling.

ARB is also responsible for maintaining the California Emission Inventory Development and Reporting System (CEIDARS), which collects information on criteria and toxic air pollution from point, areawide, and mobile-source emissions. The CEIDARS database is used to develop state implementation plans and air-dispersion models, as well as set new regulations, assess risks, and analyze emission trends. Emission inventory data in CEIDARS is obtained annually from local air pollution control districts, ARB emissions models, and local councils of government. The Caltrans Highway Performance Monitoring System provides data on traffic counts that ARB uses to model traffic-related air pollution. ARB compiles emissions data from the various sources and checks them for errors. It also makes the data available for public use on the Internet and in a yearly Almanac of Air Quality and Emissions. (See www.arb.ca.gov/emisinv/emsmain/emsmain.htm.)

Annually ARB submits CEIDARS data to the U.S. Environmental Protection Agency, which compiles them as part of its National Emission Inventory (NEI). Some facilities submit total emissions of hazardous air pollutants directly to the EPA for the Toxic Release Inventory (TRI). These data bypass quality-assurance checks by the local air districts and the Air Resources Board. As a result, facility data reported to TRI may differ from those reported to CEIDARS and the NEI. In addition, TRI data do not provide emission process and release details necessary for dispersion modeling.

Limitations of Current Tracking Systems

These air-quality data systems have a number of limitations. Air-pollutant dispersion models are often used to estimate exposure levels. Although California's 280 air-monitoring stations are intended to measure public exposure to air pollution, some areas are quite far from monitoring stations and ARB must rely on

estimates of pollution levels. In addition, because no region has monitoring stations that track all air pollutants, levels of specific pollutants may be excluded from exposure analyses or must be modeled. Air pollution models operate under many assumptions. Uncertainties in these models may be large, depending on the accuracy and availability of the model inputs, such as meteorology and emissions, and the assumptions built into the statistical model. The amount of effort in creating these models is also large, and obtaining necessary input data can be a lengthy process.

Emissions data are also subject to reporting limitations. Only facilities that meet the threshold levels are required to report estimated data to TRI, and they are not mandated to monitor or verify their releases. Comparisons between reported releases and air-quality monitoring data have shown an underestimation of actual emissions. (Henry, et al., 1997) In addition, TRI does not cover all toxic chemicals or all industry sectors, is sometimes based on modeled emission estimates of questionable validity, and is limited to releases made under routine operating conditions. This means TRI does not include start-up, shut-down, and accidental releases. Air districts are required to report emissions data to CEIDARS within 10 months of the end of the inventory year.

Some data elements that are critical for dispersion modeling and risk assessment are currently not well reported in CEIDARS. The completeness of these data elements varies from district to district and reflects district resources and priorities. To ensure consistent and reliable modeling, all air districts should report information necessary for the most accurate modeling. Some of the data elements of particular concern are described below.

Not all point sources of pollutants—stationary locations or fixed facilities—have accurate coordinates for the facility or stack location, and not every district reports all the stack parameters needed for dispersion modeling, such as stack height and gas flow rate. For example, many fixed facilities have diesel-powered motors operating on site, and these emissions are not reported. Because diesel particulate matter is the primary air pollutant risk driver, it is especially important for districts to provide complete and accurate facilities inventories for diesel particulate matter. ARB also lacks toxicity data for many air pollutants (Kyle, et al., 2001; Lunder, Woodruff & Axelrad, in press).

Finally, although CEIDARS represents the toxic emissions of large sources reasonably well, it does not have data from small sources of toxic pollutants that are not required to report under the AB 2588 Air Toxics "Hot Spots" Program. Although these sources may pose little risk individually, collectively they may add significantly to an area's cumulative risk, especially if the facility emits potent toxic pollutants or if sensitive receptors are nearby. The cooperation of local air-pollution control districts is of critical importance, because they have authority to collect point-source emissions data.

Personal monitoring can provide a direct measure of individual exposure to air pollutants. Biological monitoring provides information about exposure to air pollutants by measuring chemical compounds in the human body. There is no routine personal monitoring in the state. Biological markers of air exposure are not available for all priority environmental hazards.

There is a critical lack of comprehensive and complete data on traffic counts in order to model traffic-related pollution in the state, which could be integrated with health outcomes associated with this hazard, such as childhood leukemia, respiratory problems, and adverse reproductive outcomes.

Recommendations for Tracking Exposure to Air Pollution

- The Air Resources Board is developing a Community Health Air Pollution Information System (CHAPIS) that will provide interactive maps of air-pollution emission sources and risk estimates based

on modeling, dispersion, and emissions. ARB should evaluate the air emissions data used in the CHAPIS risk models with field measurements or personal monitoring. Local air districts should improve the timeliness, validity, and completeness of their air pollutant emission inventory submissions, because inaccuracies undermine air pollution models. DHS should work with ARB to integrate health surveillance systems with CHAPIS.

- ARB should develop, evaluate, and improve models of exposure for specific populations exposed to volatile organic compounds, such as those living near gas stations and dry cleaners. Other sources, such as logs of gasoline use at gas stations, may be appropriate to validate the models.
- For the immediate future, the use of biological monitoring for markers of exposure or disease associated with air pollution is an emerging technology. However, the DHS Environmental Health Laboratory Branch should work with ARB to consider the feasibility of developing valid biomarkers for such pollutants as benzene in human populations.
- ARB and local air-pollution control districts should encourage the development and incorporation of personal monitoring strategies to assess exposure to air pollutants in the state, and the relationship between pollutants in outdoor air and personal exposures in representative or susceptible subgroups of the population.
- The California Department of Transportation (Caltrans) has statewide data on traffic counts for all major freeways and some major highways. However, data on all other roads are collected by local municipalities, usually are not recorded electronically, and are not synthesized on a statewide basis. The proposed Office of Environmental Health Tracking (OEHT) (see Chapter 8) should work with Caltrans and local transportation agencies to begin developing more complete estimates of traffic flow. The OEHT should seek funding to begin a pilot project to systematically collect and standardize traffic-count information from individual municipal jurisdictions to one agency or regional agencies (e.g., Association of Bay Area Governments).

Data on Pesticides

California collects a substantial amount of data on applications of agricultural pesticides. For instance, the Pesticide Use Report maintained by the California Department of Pesticide Regulation contains information on the poundage and type of application to the township, range, and section of approximately one square mile. Plans are under way to evaluate whether reporting can be done on a field level. About 15 characteristics of each pesticide application are collected, and DPR estimates that about 90% of actual pesticide use is reported. These data are not exposure data per se, but application data that can be used to determine proximity of populations to agricultural pesticide use. Although proximity may be a good proxy for inhalation exposures, this has not yet been fully confirmed (Lee, 2002).

As part of a project to evaluate the use of laboratory reports as a surveillance tool for pesticide-related illness, three participating clinical laboratories have voluntarily provided individual cholinesterase test results to the DHS Occupational Health Branch. Laboratory findings of abnormal cholinesterase test results may reveal pesticide exposure and illness even without a physician's diagnosis.

The joint pesticide air monitoring program of the California Air Resources Toxic Air Contaminant Program and the Air Resources Board is one of the few in the United States to monitor pesticides in community air (Baker, 1996).

Food is an important exposure medium for a number of substances, but pesticides are the only substances that are routinely monitored among broad categories of food products—fruits, vegetables, grains, meats, milk, eggs, fish, etc. Pesticides in food are routinely monitored through two programs, one federal and one state. The California Department of Pesticide Regulation's Pesticide Residue Monitoring Program targets 75 commodities and collects approximately 8,000 samples annually. These samples are tested for over 200 pesticides and breakdown products. Agricultural inspectors take samples from packing sheds, wholesale and retail markets, and ports of entry. Commodities such as those with a history of violations, high market volumes, and consumption by infants or children are targeted for testing.

Additionally, the U.S. Department of Agriculture collects and analyzes food samples from California distributors (not markets) to check for pesticide residues in both fresh and some processed commodities (e.g., peanut butter, apple juice). Accepted samples are prepared in a way that emulates consumer practices. The data include sampling results, type of commodity and place of origin, name of grower, name of packing distributor, and date of sample. The state monitors pesticide residues in food through the California Department of Food and Agriculture's Center for Analytical Chemistry.

There are clear advantages for tracking exposures to extend these food-residue analyses to substances other than pesticides. Once a residue laboratory is set up to monitor pesticides in food, there are no technical limits to extending these analyses to such selected substances as hazardous air pollutants, metals, perchlorate, PBTs, and biological toxins.

Limitations of Current Tracking Systems

Pesticide and air-pollution databases have similar limitations. First, the level of individual exposure is difficult to estimate. For example, the Pesticide Use Report (PUR) database covers a rather large geographical scale, which means assigning exposure to an individual would be imprecise (assuming uniform distribution of hazard in one square mile). The Department of Pesticide Regulation is moving toward instituting a web-based system so pesticide applicators could report agricultural pesticide use in "real-time," down to the field level. Lack of information on nonagricultural pesticide use makes exposures at home difficult, if not impossible, to estimate. Structural pesticide use is available only at the summarized county level. In the PUR, geographic identifier information is not available for some locations, such as golf courses and schools, which means we cannot identify specific applications at these locations. In addition, because PUR data concern only agricultural usage, the PUR provides limited information on the actual amount of pesticides in the environment. For example, approximately half of the pesticides used in California are applied to structures where people live, work, and go to school.

It is difficult to estimate actual pesticide exposures from air-concentration models because of volatization factors. Volatization complicates efforts to model environmental pathways because application methods, tillage practices, irrigation techniques, temperature, sunlight, rainfall, wind, and the physiochemical properties of the product mixture may all affect volatilization rate (the number of days the pesticides will take to become airborne), potential accumulation in air, and distance of volatilized drift (Bedos, 2000). Directly measuring pesticide concentrations through air monitoring, therefore, is preferable to basing exposure estimates on environmental distribution models.

Biological monitoring is another method for evaluating human exposure to pesticides. Biological monitoring of cholinesterase levels may provide sentinel event information for exposure to organophosphate and methylcarbamate pesticides. The Department of Health Services' current system of assessing exposure through laboratory testing is influenced by the voluntary nature of reporting. This limits both the number of clinical laboratories that report cholinesterase test results to DHS as well as the type of information that is reported.

Considerable effort is required to obtain information required for case follow-up because there are no mandatory requirements to ensure reporting at present.

Recommendations for Tracking Exposure to Pesticides

- Funding should be provided to county agricultural commissioners to monitor more closely grower adherence to reporting requirements concerning pesticide use, and also to the Department of Pesticide Regulation to develop and implement a web-based, field-level data-entry system that has error-checking protocols to disallow entry of obviously incorrect information.
- The DPR, in cooperation with the Exposure Assessment Section of the DHS Environmental Health Investigations Branch, should incorporate meteorological data to better model pesticide drift patterns, and should validate these models with measurements of pesticides in both air and dust. Both departments should jointly develop extramural funding proposals to achieve this goal.
- Funding should be provided to educate clinicians to recognize the signs and symptoms of pesticide poisonings, and know when to order cholinesterase testing.
- DPR should improve the Pesticide Use Report to include more information about pesticide applications, including application method, tillage, and irrigation practices. Improved reporting should include address and GPS coordinates for applications in public buildings or places, such as schools, parks, and golf courses.
- The DPR and the Air Resources Board should develop air models that take into account applications from multiple growers in an area, potential accumulation of pesticides in air over time, and volatization factors. Air monitoring should be implemented to validate these models.
- The DHS Environmental Health Laboratory should be encouraged to proceed with biological monitoring of exposure to organophosphates, pyrethroids, and organochlorines, as well as develop methods to detect carbamates and phenoxy herbicides.
- DPR should provide data about structural pesticide use in two different formats—for restricted as well as public use—at a smaller geographic level of detail, which would allow environmental tracking of this exposure while protecting the confidentiality of people affected. Restricted data, which would be available only to qualified researchers who have obtained approval to study human subjects, would include address-level information, while the public-use file would only have data summarized to the zip-code or census-tract level.
- More data are needed on pesticide use in the home environment. Cumulative intake data are needed on home use, food residues, and proximity to agricultural areas. As state laboratories are developing methods and increasing capacity to detect more pesticides, researchers should be funded to use these methods to examine exposure to home use.
- In cooperation with the Office of Environmental Health Hazard Assessment and the Department of Pesticide Regulation, the Department of Health Services should introduce legislation to require clinical laboratories to report to the state the results of cholinesterase and other pesticide-related testing. DHS should use the reported data to enhance current surveillance of pesticide illness, and also examine the data for tracking other issues related to environmental and occupational health.

- California's Department of Food and Agriculture should examine the potential for extending its food-residue monitoring efforts to include detection and monitoring of hazardous air pollutants, metals, perchlorate, PBTs, and biological toxins.

Data on Water Pollution

The Water Quality Monitoring Database maintained by the DHS Office of Drinking Water collects data on more than a hundred different substances, primarily in public drinking-water systems. Chemical pollutants include such substances as arsenic, naphthalene, trihalomethanes, benzene, MtBE, and trichloroethylene. State regulations also require monitoring for microbiological contaminants and radionuclides. The State Water Resources Control Board operates GeoTracker, the Internet interface to the Geographic Environmental Information Management System (GEIMS), a data warehouse that tracks regulatory data about leaking underground fuel tanks (LUFT), fuel pipelines, and public drinking-water supplies. GEIMS stores extensive data related to LUFT sites or other contaminant releases, information on water quality and use, as well as infrastructure data needed to assess both water supplies and contaminant sites.

The Department of Water Resources, regional water quality control boards, and Department of Toxic Substances Control analyze the water quality of surface water (in lakes, reservoirs, rivers, streams) and groundwater basins. These agencies assess water for such contaminants as heavy metals, pesticides, volatile organic chemicals, bacteria, and pathogens. Finally, both the DHS Division of Drinking Water and Environmental Management and the Department of Pesticide Regulation monitor pesticide levels in wells used for drinking water. Since 1985, DHS has monitored approximately 20,000 wells for agricultural pesticides.

Limitations of Current Tracking Systems

At present California has no method for determining which water sources serve a given home address. These data are crucial for statewide water quality surveillance and, in the case of accidental or nonaccidental contamination, would be important information to limit the contamination of water sources. Assigning specific waterborne exposures to individuals is not possible with existing databases. The Department of Pesticide Regulation's well-inventory program only monitors a small number of wells, has inconsistent monitoring, and is unable to directly link this information to individuals. The Department of Water Resources, regional water quality control boards, and the Department of Toxic Substances Control have not consolidated or standardized their data on water quality. In addition, recent discoveries of contaminants that were not tracked previously, such as perchlorate, MtBE, and hexavalent chromium, have shown that California needs to be more alert to potential and emerging water contamination problems.

Recommendations for Tracking Water Quality

- The Department of Water Resources, regional water quality control boards, and the Department of Toxic Substances Control should standardize and consolidate their water-quality monitoring and site-assessment data.
- Water providers should be required to provide their billing addresses to the California Environmental Health Tracking Program or another state entity to establish a statewide geographic information system that describes the service area of public water systems.
- Water providers should also cooperate with the state in characterizing the multiple-source contributions and treatments for water systems, so that sampling information obtained by the state Office of

Drinking Water could be used to better describe the quality of water that reaches households. The models developed should be validated by sampling household tap water.

- The state Water Resources Control Board (WRCB) should investigate the feasibility of establishing an historical database of local well-drilling and drill/pumping logs.
- The California Environmental Health Tracking Program should work with the WRCB to determine how GEIMS can be integrated into an environmental health-tracking system.
- A systematic approach is needed to attempt to identify in advance chemicals that are likely to contaminate drinking water. Such chemicals may be predicted on the basis of use patterns, water solubility, and persistence in water. These chemicals should be prioritized for developing methods of detecting low levels of their presence in water, and should be added to California's Water Quality Monitoring Database.

Data on Tracking Hazardous Waste, Solid Waste, and Radiation

Several data sources provide information on hazardous and solid waste in California. State law requires a report on any spill or release of hazardous material. That database is maintained by the Office of Emergency Services. For hazardous solid waste, Cal/EPA's Integrated Waste Management Board maintains the Disposal Reporting System, which collects annual tonnage data for each waste-management jurisdiction. These data are fed into a Solid Waste Information System database, which contains information on solid-waste facilities, operations, and disposal sites statewide. The types of facilities in this database include landfills, transfer stations, material-recovery facilities, composting sites, transformation facilities (which burn solid waste to produce heat or electricity), waste-tire sites, and closed disposal sites.

In addition, the U.S. EPA maintains information on state sites that are on the Superfund National Priorities List (NPL), and a number are in California; these sites are defined as uncontrolled or abandoned places where hazardous waste is located and targeted for cleanup. The EPA's Environmapper computer program maps the locations of all NPL sites in the United States. As a result of the Resource Conservation and Recovery Act of 1976, the EPA also manages a comprehensive national information system (RCRAInfo) that manages and inventories hazardous-waste sites. RCRAInfo allows tracking of many types of information about RCRA-regulated hazardous-waste handlers. It also characterizes facility status, regulated activities, and compliance histories; captures detailed data on the generation of hazardous waste from large-quantity generators; and captures data on waste-management practices of treatment, storage, and disposal facilities.

Finally, the Sanitation and Radiation Laboratories branch of DHS, whose mission is to protect Californians "from harmful effects that may result from drinking water and environmental radiation," performs limited radiation monitoring in the state.

Limitations of Current Tracking Systems

The EPA's Superfund NPL Assessment Program has no information about the actual amounts of chemicals on the National Priority List sites, and the EPA's off-site measurements (environmental samples taken to evaluate whether chemicals have migrated from the NPL site into the surrounding environment) associated with NPL or RCRA sites are not available in any database. Information about hazardous-waste spills pertains only to a local area of a spill or release. Although the Cal/EPA Disposal Reporting System measures hazardous wastes by pounds per person per day, it does not enable assessment of individual waste generation or exposure to waste. Moreover, because the state's Solid Waste Information System (SWIS) has no data on the actual release of

specific hazardous substances, misclassification of exposure to waste in general and emitted toxics is likely. Quality control is also questionable with SWIS, resulting in data of questionable reliability. Historic radiation data from the Sanitation and Radiation Laboratories are largely unavailable, and current data are kept primarily in paper form; only limited information is available electronically.

Recommendations for Tracking Exposure to Hazardous Waste, Solid Waste, and Radiation

- California's Integrated Waste Management Board should investigate the validity and reliability of the state's solid-waste systems by performing quality-control assessments.
- The U.S. EPA should make available to the State of California off-site measurements (e.g., of soil and surface water) associated with RCRA and NPL sites, which could provide a tracking program with important information about normative (background) levels of such compounds as metals, PCBs, and polycylclic aromatic hydrocarbons. The EPA should attempt to make historical off-site data available electronically; if this is not possible, at a minimum the agency should start entering all current measurements into a database.
- Cal/EPA should explore the feasibility of obtaining information on accidental releases of environmental hazards, underground storage tanks, above-ground storage tanks, and hazardous-waste generation through collaboration with state Certified Unified Program Agencies (see above section, The Need for Chemical Hazard Tracking). The legislature should fund Cal/EPA to implement regulations in CCR T-27 Section 15185, which define minimal data-collection requirements. These requirements include the establishment of a data dictionary for collecting information about hazardous materials.
- The Sanitation and Radiation Laboratories should make their radiation data more usable by entering it into an electronic format.

Data on Tracking Exposure to Metals

Information about various metals, including but not limited to arsenic, cadmium, chromium, lead, and mercury is collected through air-emissions inventories, ambient-air monitoring, and testing of drinking-water sources. The DHS Drinking Water Quality Monitoring System contains data on many metals, as reported by testing laboratories. Air databases such as CEIDARS also provide this information.

The state has no program for systematically monitoring metals in fish. In 1976 the State Water Resources Control Board initiated a Toxic Substance Monitoring Program (TSMP), but it was discontinued last year because of funding cuts. The TSMP provided a uniform, statewide approach to detecting and evaluating the occurrence of toxic substances (including metals) in fish.

At present, most fish monitoring is done by nongovernmental programs, such as the San Francisco Estuary Institute, the Sacramento River Watershed Program, the Santa Monica Bay Restoration Project, and by academics.

The DHS Childhood Lead Poisoning Prevention Branch maintains a surveillance and case-management system of child lead poisoning in its RASSCLE database, and the Occupational Health Branch collects data on adult blood levels in its ELVIS database. (See Chapter 4 under Lead Poisoning for more information.)

Limitations of Current Tracking Systems

None of the existing databases allows for adequate estimation of individual exposure to metals. The nongovernmental programs that monitor fish for metals are location-specific and do not focus on the entire state.

Recommendations for Tracking Exposure to Metals

- The DHS Environmental Health Laboratory Branch should seek extramural funding to develop laboratory methods to biologically monitor for exposure to priority metals, such as hexavalent chromium and mercury, and to study the feasibility of establishing current exposure levels.
- There are many gaps in our understanding of the locations and species of fish with elevated levels of metals. California needs a comprehensive fish-monitoring program for to protect human health.

Data on Persistent Organic Pollutants

Persistent Organic Pollutants (POPs) include such chemicals as polychlorinated biphenyls (PCBs), dioxin, and polybrominated diphenyl ethers (PBDEs), as well as organochlorine insecticides (like DDT). These compounds are resistant to degradation, can be transported over long distances, travel easily through the food chain, and accumulate in the fatty tissues of humans. A number of negative health effects, such as immunosuppression, hormone disruption, reproductive abnormalities, and cancer, have been linked to long-term, low-dose exposures to POPs (Schmidt, 1999).

The CEIDARS emissions inventory contains limited information about some persistent organic pollutants, such as PCBs and dioxin. However, no specific database contains information on most POPs at the state level. The only POP that is consistently monitored (by the state Office of Drinking Water) is dioxin in drinking water, and no detections of dioxin have been reported (reporting limit [5 ppq] below the standard). The state has measured levels of dioxins in human serum levels, soil, and eggs from residents of an area contaminated by a fire at a wood-treatment plant (Harnly, 2000; Goldman, 2000). In addition, serum DDT was measured in 559 community members living near the Del Amo/Montrose hazardous-waste sites in 1995 through 1998 in order to identify public health interventions and preventive actions (Baker, 1999).

The CDC has analyzed national biological samples from the National Health and Nutrition Examination Survey (NHANES) for reference-range data on persistent compounds such as dioxins, DDT, and mercury. The U.S. Food and Drug Administration is also investigating levels of POPs, such as PCBs and dioxins, in the U.S. food supply (Jensen, 2001).

The California Air Resources Board is developing a comprehensive air-quality monitoring and testing program to collect ambient data for dioxins, furans, PCBs, and PBDEs. The program's components include: development of the California Ambient Dioxin Air Monitoring Program (CADAMP) at nine locations (five in the San Francisco Bay Area and four in the South Coast Air Basin); testing of potential dioxin-emitting facilities; and estimating the contribution of dioxins emitted by motor vehicles.

Limitations of Current Tracking Systems

Except for dioxin in drinking water, no ongoing monitoring systems currently exist for California-specific information on PBDEs and other POPs, even though the Centers for Disease Control and Prevention has reported that levels of PBDEs are increasing and other POPs are being detected in human tissues.

It makes no sense to look for POPs, including dioxin, in drinking water, because these chemicals do not dissolve in water but accumulate in sediment and food. The resources wasted by testing for POPs in drinking water would be better spent testing for these chemicals where they are likely to be found.

Recommendations for Tracking Exposure to Persistent Organic Pollutants

- The Department of Health Services should secure funding to develop an environmental and biological monitoring program to track Californians' exposure to POPs. These substances could be monitored in house dust, food, adult serum, urine, infant cord blood, and breast milk.
- Because the sources of contamination by PBDEs and some other POPs in food and other media are unclear, the state should work to identify how these compounds are disseminated in the environment.
- Data on POPs in food—including meat and fish—should be collected systematically. When The California Department of Food and Agriculture tests food for pesticide residues, the samples could also be tested for POPs at minimal additional cost. An improved monitoring system for POPs in fish is also needed.
- The Office of Environmental Health Hazard Assessment should develop or adopt a method to identify chemicals that are likely to persist in the environment and to accumulate in biological systems. This methodology should be applied to all high-production-volume chemicals, and to as many chemicals as possible that are known or suspected to be used or created in California. Any chemicals that are suspected POPs should be automatic priorities for tracking hazards and exposures.
- The state Office of Drinking Water should cease testing for dioxin and other POPs. Instead these resources should be used to test food for these contaminants, or to perform biological monitoring studies.

Data on Indoor Hazards: Tobacco Smoke, Radon, Mold, Asbestos, and Volatile Organic Compounds

Surveys, such as the Behavioral Risk Factor Survey, the California Adult Tobacco Survey, and the California Youth Tobacco Survey, offer a qualitative estimate of environmental tobacco smoke (ETS) exposure in the state. Project Baby's Breath will analyze blood and urine samples for cotinine to provide a quantitative snapshot of the potential ETS exposure in study participants.

To examine residential radon concentrations, the DHS Environmental Health Laboratory Branch conducted a statewide study in 1988–89 and a focused area study in 1991. In the first study, radon monitors were placed in 310 residences throughout the state and measurements were carried out for a full year to obtain an accurate estimate of exposure. The focused survey of residential radon levels was carried out in 862 residences of Ventura and northwestern Los Angeles.

At this time, no state routinely collects data on the occurrence of indoor fungal growth (mold). County health inspectors and city building-code inspectors in California maintain nonelectronic files or electronic databases of building inspection reports (usually public buildings, leased offices, or rental residences) when occupants register complaints about these buildings.

Similarly, the state does no routine indoor-air monitoring of asbestos. The Cal/OSHA Enforcement Unit enforces state Asbestos Standards in construction, shipyards, and general industry.

California does routine monitoring of outdoor air for volatile organic compounds (VOCs), but does no routine monitoring of indoor environments—despite previous research indicating that these chemicals occur at higher levels indoors than outdoors. VOCs are emitted from many types of building materials, carpets, and household products, as well as from contaminants in soil pore spaces and groundwater whose vapors intrude into buildings.

Limitations of Current Tracking Systems

Information on hazards and exposures in the indoor environment is exceptionally poor. Despite the fact that people spend most of their time indoors, there are no data available to track exposures in this setting. Surveys on environmental tobacco smoke have limitations, such as underreporting of negative behavior (smoking), participants' inability to recall facts from the past (recall bias), and small sample size. Project Baby's Breath was a one-time biological monitoring assessment done only in several California locations, so the results may not generalizable to the whole state. The radon studies were of limited scope and duration, and ongoing monitoring is being done at present.

Existing data sources on mold are very limited. In California, there are no public databases of information generated from inspections of damp or moldy buildings. Fungi are not a single biological agent, and there is no collection or analytical technique that identifies all that may be present in an indoor environment. In addition, because there is no standardized protocol for identifying fungal growth in buildings, researchers have used a variety of different methods, which makes it difficult or impossible to compare results across studies. A major factor that limits assessment of occupant health effects associated with indoor fungal growth is the absence of a biomarker that can correlate such exposure to health symptoms.

Recommendations for Tracking Indoor Hazards

- California should conduct its own version of the National Human Exposure Assessment Survey (NHEXAS-CA) to collect comprehensive data on multiple exposures, including those indoors. NHEXAS-CA should examine exposures to metals, pesticides, solvents, and persistent organic pollutants, among other environmental hazards, using such methods as dust wipes, water samples, and randomly collected soil samples. One goal of the study should be to estimate how different exposure pathways (e.g., breathing, skin contact, and swallowing) contribute to cumulative dose.
- The DHS Genetic Disease Branch, along with the Maternal and Child Health Branch and the Environmental Health Investigations Branch, should investigate the feasibility of using banked Maternal Serum Alpha-Fetal Protein samples to systematically measure cotinine, a major metabolite of nicotine, and other indoor contaminants.
- Future efforts to develop a tracking system for indoor fungal exposure could utilize the expertise and authority of city building-code and county health inspectors. With assistance to facilitate coordination and revision, their standardized inspection forms could be modified to include sampling results and fungus-specific data, such as location and size of visible fungus growth. These data, perhaps with additional information about the health of building occupants, could be maintained locally and transmitted to DHS for multijurisdictional analysis.

6
Community and Stakeholder Contributions and Needs

Through Senate Bill 702, the State of California declared its intent to make information about environmental impacts on health available to the public in an accessible and useful format. In order to best understand the public's information needs, we included members of the public and representatives of community-based organizations in our deliberations. Public comment sessions combined with structured presentations enabled us to learn about the issues, questions, and challenges facing individuals and organizations. Environmental health disparities are a major concern among community-based organizations and the public. Members of the public consistently cited the need for scientifically valid and personally relevant information about health and the environment. In this chapter, we document the needs articulated by these participants, relate these issues to other aspects of public health and environmental policy, and discuss our observations regarding the confluence of purpose among researchers, policymakers, and the public on information about health and the environment.

Needs of Community-Based Organizations

We identified organizations engaged in community-based research and health-promotion activities in order to understand their motivations, methods, barriers to conducting their work, and opportunities for collaboration with the tracking system. Representatives from seven organizations made presentations about their activities at our meetings. The working group requested presenters to provide information including:

- Priority public health and/or environmental hazard concerns in their community.
- Health surveys or other data-collection activities regarding environmental health/environmental justice issues in which their organization is involved.
- Barriers or lessons learned while engaging in this process.
- Resource needs that would help organizations to better understand and communicate their community's priorities and concerns regarding environmental health issues.

Three case studies found in this chapter summarize some of these presentations in order to provide a more complete description of community activities related to environmental health. Several common themes related to health tracking are discussed further below.

Information Access

Community representatives described how improvements in the quantity and quality of environmental information have supported their efforts. For example, the West Oakland Environmental Indicators Project (WOEIP) utilized a variety of public data sources to develop a community health report. Despite these improvements, however, presenters expressed concerns that important information gaps remain and that existing sources are not always relevant to their communities. West Oakland residents identified the need for better information about the local impacts of traffic, especially diesel trucks, on health in their community, and reported that lim-

ited information about chronic health conditions in their community is a major concern. In order to develop an asthma indicator for the community, WOEIP representatives reported that they had asked the Office of Statewide Health Planning and Development for discharge data on children hospitalized with asthma. They informed our working group that they had to pay for the data in order to obtain the information in a timely manner, but found the cost burdensome because of the community-based project's limited funds.

Besides the need for new information, presenters expressed the desire for sharing existing data. For example, the Healthy Homes Collaborative in Los Angeles County is engaged in a variety of lead-poisoning prevention and abatement activities. In order to provide abatement services, the collaborative needs to know where lead-poisoned children are living. Although providing the group access to these cases would be an opportunity to use exposure data from a tracking system to guide prevention strategies, health departments keep residential information confidential to protect privacy, and sharing such data would conflict with this duty. This example illustrates the need to balance the legitimate needs of both community groups and information providers, and hence the need for data-sharing agreements (see Chapter 7) and other collaborative mechanisms to support public/private partnerships in public health. A health-tracking system can be conducive to developing uniform approaches to data-sharing.

Receiving data in a timely manner is also important, particularly in situations like lead exposure, where a timely public health intervention may have a significant impact on the long-term health of exposed children and their families' living situations. The tardiness of data-sharing has been an issue for the Healthy Homes Collaborative. Six-month delays in receiving data on the locations of children identified as having been exposed to lead has prevented the organization from taking immediate action, thereby increasing the risk of continued exposure or permanent neurological damage for any unidentified children at these locations. Such delays have also left some tenants vulnerable to unwarranted evictions, harassment, and other violations of tenants' rights initiated as a result of either the original identification or abatement events.

Information Consolidation

The information needs of community groups are also becoming more complex and demanding as they become increasingly involved in research and intervention activities. Several presenters identified the issue of past contaminant releases and exposures as very important to local communities. Understanding past exposures can be important for performing retrospective assessments when investigating potential disease clusters. Historic pollutant-release information is important for determining the extent of potential site-specific contamination. Existing contamination can be an important factor when deciding how to redevelop a site.

Generally, the information on a specific locality is limited and not centralized. At an SB 702 meeting, The Concerned Residents Initiative, a community advocacy group in Sacramento County, discussed the difficulty of canvassing various state agencies to obtain information about hazards in their community. Similarly, representatives of Pacoima Beautiful in San Fernando Valley discussed the lack of centralized information as a major barrier to informed community action. Each organization recommended that information about health and the environment be accessible in a user-friendly format. A major function of a health-tracking system would be to consolidate existing information regarding chronic health conditions and environmental hazards to enable simplified access for community stakeholders.

Case Study

Pacoima Beautiful

Issue

Residents of Pacoima, located in the northeast San Fernando Valley, have identified environmental concerns that include freeways, a railroad, a nearby airport, abandoned trash, oil drums, hazardous-waste sites, and land-use conflicts, as well as mold, dust mites, and peeling paint in homes. Health concerns include asthma, lead poisoning, and impaired children's learning. Pacoima residents want to identify which environmental hazards contribute to health roblems and the specific steps that can be taken to improve their health. "We can't move the freeway, but we want to know what kind of impact does it have when it is 100 to 300 feet from the school?"

Community Action

Pacoima Beautiful (www.pacoimabeautiful.org) is a community-based organization that provides environmental education, leadership development, and advocacy to create a clean, healthy, and safe environment to improve the quality of life for more than 97,000 residents of Pacoima.

Community members are taking steps to prioritize environmental hazards and health concerns in Pacoima. Staff and community members recognize the value of having accurate, relevant data. They have conducted limited health surveys and sampled air, water, and soil, and recognize the need for ongoing help in locating and interpreting community-specific data and comparing them to other communities.

Barriers and Limitations

"We need time to review, time to process, time to understand," states Kristin Aldana-Taday, associate director of administration for Pacoima Beautiful. "Environmental health tracking sounds great—the more information you have the better. But not if you don't know how to read it . . . [How do we know] what to do next as a community group? What do I do with the information as a resident? How can we use the information to improve our environment and the health of our children?"

How Environmental Health Tracking Can Help

- Provides opportunities and resources for collaboration between scientists, researchers, and community members to address local environmental and health concerns.
- Increases accessibility to local (e.g., by zip code) relevant environmental and health data ("a centralized place to access the data; the simpler the data comes out, the easier it is for us to work with").
- Trains community members on how to access and interpret the data.
- Develops a standardized data-collection tool for local communities that will allow aggregation of locally collected data.
- Trains health-care providers on environmental health issues that will help improve services like lead-testing and also improve data collection.
- Provides residents with a better understanding of potential links between health effects and environmental hazards.

Information Interpretation, Capacity-Building, and Training

Community groups often have limited capacity to interpret health and environmental information, and need both technical assistance and training to build their capacity to contribute to or use an environmental health-tracking system. Presenters described the challenge of determining whether information on environmental hazards presents a health concern, or if the levels of pollution or the prevalence of specific diseases in a community are unusually elevated. They expressed their need to be able to translate tracking information so they could interpret it meaningfully for community members. Specifically, communities need health educators who can work with researchers to translate health and environmental information for both policymakers and community audiences, stressing the need for user-friendly visual tools such as maps and geographic information system resources, and also work with communities to facilitate community training and capacity-building.

In addition, the working group discussed the importance of state and local health agencies' use of guidelines developed by the National Association of County and City Health Officials to involve their communities in setting environmental health priorities. *The Protocol for Assessing Community Excellence in Environmental Health* (PACE EH) (NACCHO, 2002) uses a collaborative approach to identify existing data and data gaps, develop locally appropriate environmental health indicators, and integrate technical information about environmental health with community concerns to improve decision-making. PACE EH and other community-based assessment tools enable communities to better understand and prioritize their environmental health concerns, produce high-quality data, and build trust between local governments and their communities. A community that understands its environmental health priorities will be better able to contribute to and utilize data from an environmental health-tracking system.

Policy-Relevant Information About Health and the Environment

During our deliberations, community presenters and working-group members associated with community-based organizations repeatedly emphasized the value of having locally relevant information about the distribution of environmental hazards and chronic disease to inform the development of effective policies. For example, one working group member related the experience of the Long Beach Alliance for Children with Asthma and its attempts to improve the lives of children with asthma in the community. With the help of a device called a "P-Track monitor," which enables community groups to measure particulate matter on a geographically detailed scale, the alliance uses information about the distribution of particulate matter to advocate for re-routing roads with high volumes of traffic away from schools.

Distribution data alone can provide enough resolution to detect potential problems and inform interventions. Documentation of inequality in environmental-hazard exposure in Los Angeles has resulted in policy recommendations intended to influence zoning and land-use decisions (Pastor, 2001). Information about exposures supports precautionary action because it often will allow policymakers to focus on the sources of exposure. Once sources are identified, protective actions may be undertaken. Protective actions, based on a reasonable threat of harm, are often feasible without requiring community members to prove a link between specific exposures and diseases.

Partnerships to Facilitate Community-Based Research

Many communities have demonstrated the capacity and desire to collect community-level health and environmental data, and often have residents who can generate knowledge about public health status and issues in their localities. In some cases, community groups may be the most capable of implementing culturally sensitive research.

Case Study

Healthy Homes Collaborative

Issue

The neurological effects of lead exposure appear to be long-lasting and irreversible. Lead levels for children in low-income, urban communities of color continue to be above the national average. Much of the housing in these communities was built before the residential use of lead-based paint was banned in 1978. Residents in such housing, particularly in poorly kept properties, are at an increased risk for lead exposure. In Los Angeles, where about 80% of the housing was built before 1978, household lead exposure is a major environmental health concern.

Community Action

The Healthy Homes Collaborative (HHC) is an association of community-based organizations and community leaders in Los Angeles County who are dedicated to improving housing conditions that affect health. HHC is involved in a variety of activities related to data collection, community education, and capacity-building, and emphasizes the importance of community input during policymaking and implementing strategy. HHC is currently engaged in lead-poisoning prevention and abatement activities, including monitoring before and after abatement efforts, organizing to obtain building repairs, and sampling for lead in dust, paint, and soil. It recently received funding from the Los Angeles County Department of Health Services (LADHS) to provide community outreach and education about childhood lead poisoning.

Barriers and Limitations

Due to limited medical services for low-income and non-English-speaking residents, lack of access to screening for blood-lead levels may contribute to undetected cases of lead poisoning. Even when services are available, physicians may not comply with lead-screening guidelines because of a misconception that lead-poisoning is an East Coast problem. Poor interagency communication also has been a barrier to prevention and treatment efforts. Until recently, the LADHS was not informed of the housing department's lead-abatement activities, and missed opportunities to identify potentially poisoned children.

Difficulty in obtaining data in a timely manner is a major barrier to HHC's efforts. Because medical confidentiality prevents the county from providing the exact addresses of poisoned children, HHC receives block-level addresses to target children who are or may be poisoned and their families for screening, treatment, and tenant support services. However, six-month long delays in receiving addresses prevent HHC from taking immediate action, which increases the risk of continued lead exposure for children who live in the same housing complex as a poisoned child but have not been screened by the county. Delays in receiving data also prevent HHC from providing tenant support services, leaving some tenants vulnerable to eviction, harassment, and other violations of tenants' rights by landlords reacting to the initial lead identification event.

How Environmental Health Tracking Can Help

- Encourages and improves interagency communication.
- Provides state and local health department data that are timely and useful.
- Provides data that can demonstrate that the problem exists.

For example, we were impressed by the California Body Burden Campaign, a thoughtful effort launched by several community-based organizations, including the Breast Cancer Fund and Commonweal, to develop a statewide biological monitoring program. The proposed legislative initiative, SB 1168 (Ortiz, 2004), the Healthy Californians Biomonitoring Program, calls for the design and implementation of biomonitoring pilot projects, to be designed collaboratively by state agencies, scientists, public health professionals, and community groups. Program supporters want data from biological monitoring to be accessible to community groups interested in using this information to guide personal action and to inform community-based initiatives—emanating from people living in a particular geographical area, or "communities" of people affected by a particular disease or interested in a particular chemical or cluster of chemicals.

Community representatives would take part in developing model protocols that address the science and practice of biological monitoring of breast milk, blood, and urine, or other biological specimens. The program is intended to develop dynamic, community-based processes that fully involve representatives of affected communities in the design, implementation, evaluation, and communication of findings.

California Communities Against Toxics, a statewide environmental-justice network, presented yet another community-driven initiative to conduct a body-burden monitoring study using breast milk from 120 first-time mothers in four geographic regions in California. The study will be looking at levels of PBDEs (polybrominated diphenyl ethers, a class of widely used flame retardants), PCBs (polychlorinated biphenyls, mixtures of chlorinated compounds used as coolants in electrical equipment, which have not been manufactured in the U.S. since 1977 because of evidence that they build up in the environment and can cause harmful health effects), and some pesticides in breast milk.

Local study coordinators are trained to work with women to collect samples and educate them about the importance of breast-feeding despite the presence of chemicals in breast milk. Environmental health scientists at UC Berkeley and California State University, Los Angeles, are partnering with the communities and will help the local study coordinators analyze and interpret the lab results. Forums are planned to inform community members about the results and to start conversations about actions the communities want to take to reduce the chemicals that members are carrying in their bodies.

The tracking network we recommend should facilitate community-based research by fostering communication among stakeholders to promote high-quality and culturally sensitive tracking and research data. Communities should be seen as partners in this system to the maximum feasible extent.

Community organizations also mobilize members of the public to support health research and policy action. In some situations, divergent expectations between communities and researchers may present challenges to a health partnership. In the context of scientific studies, community members are often unable to access information collected by researchers. Further, during the course of a scientific study, researchers may add new information to health and environmental datasets. In an asthma study, for example, an investigator may add information about participants' proximity to roadways. Because studies are generally supported by public funding or performed by public agencies, there is a widely held view that communities and other researchers should have the right to access data drawn from a particular community. However, access may be conditional because of privacy and confidentiality concerns. Working-group members and community presenters provided examples where such "value added" information was not made available to communities or other researchers.

A tracking system could play a variety of roles in supporting community partnerships with researchers. For example, model partnership agreements could be developed between researchers and communities to facilitate information sharing concerning studies relevant to the communities involved. In addition, the tracking network

we propose should develop the capacity to inventory, archive, and facilitate access to past research (particularly information about exposure assessment) relevant to communities and researchers.

Community Resource Needs

In order for communities to be effective partners in environmental health tracking and research, funding and/or other resources are required. There are many examples, in California and elsewhere, of state and local health and environmental departments supporting community-based research. These departments can also support community-based efforts by providing laboratory testing, data analysis, and other resources.

Related Initiatives and Programs in Public Health and Environmental Policy

Communities and their constituents are increasingly interested and involved in issues affecting their personal health. Communities are also becoming more aware of environmental conditions that may have negative impacts on their well-being. This intense interest and the community-based activism it engenders have resulted in several recent efforts to assure active and balanced participation by various stakeholders in the state's decision-making with regard to environmental policy and public health.

Cal/EPA Advisory Committee on Environmental Justice

During the past decade the environmental-justice movement has been a catalyst in bringing higher standards for community involvement to the development of environmental regulations and health policy as well as promoting discourse on community-based participatory research. Senate Bill 89 (Escutia, 2000), reflecting this involvement, charged the Secretary of Cal/EPA to convene a working group to assist the agency in developing a strategy for identifying and addressing gaps in existing Cal/EPA programs, policies, or activities that may impede the achievement of environmental justice. The bill also directed the Secretary to convene an advisory group of external stakeholders to help the agency and the working group develop this strategy. In September 2003, the advisory group finalized its recommendations. Their report (Cal/EPA Advisory Committee on Environmental Justice, 2003) is of great interest to us because it reinforces knowledge that we gained during our deliberations and amplifies our recommendations.

Goal One from the advisory committee report is to ensure meaningful public participation and promote community capacity-building to allow communities to be effective participants in environmental decision-making processes. Specific recommendations are organized into four categories: (a) guidelines and staff training, (b) availability of information, (c) capacity-building, and (d) relationship-building. These categories reinforce themes that emerged during the structured presentations by community-based organizations to our working group.

Goal Three from the advisory committee report is to improve research and data collection to promote and address environmental justice related to the health and environment of communities of color and low-income populations. The report acknowledges that Cal/EPA is already mandated to improve research and data collection for all of its programs to protect Californians, but notes that ensuring environmental justice requires more information that specifically addresses the health and environment of communities of color and low-income communities. Specific recommendations focus on ways to augment existing data collection to better address environmental-justice issues.

We believe our recommendations in chapters 4, 5, and 8 are consistent with those of the Cal/EPA advisory committee, and that full implementation of our recommendations would effectively support the data-collection objectives of the Cal/EPA advisory committee. We encourage Cal/EPA, DHS, and other state agencies to adopt

and implement the recommendations proposed in the advisory-committee report to support improved data collection.

Lessons Learned from Community-Based Participatory Research

Ensuring meaningful public participation and capacity-building are equally valued by proponents of community-based participatory research. In adhering to the values of this kind of research, not only do communities benefit, but the research does as well. The contributions of community-based participatory research that can enhance an environmental health-tracking network include: improved data quality and quantity by earning a community's trust; better definition and direction of research; enhanced translation and sustainability of research findings; and improved health education within the community through the sharing of knowledge obtained from research projects (O'Fallon, 2000). The effort to establish an environmental health-tracking system can benefit from engaging, mobilizing, and utilizing indigenous, community-based health workers throughout the state. Not doing so may ultimately impair the success of any tracking system.

The California Environmental Health Tracking Program

As part of its goal to establish a national environmental public health tracking network, in 2002 the Centers for Disease Control and Prevention (CDC) awarded California a three-year grant to participate in this effort. The California Environmental Health Tracking Program (CEHTP) was established as a result of collaboration between the DHS Environmental Health Investigations Branch and the Cal/EPA Office of Environmental Health Hazard Assessment, along with partners in academia, state government, and local agencies, as well as nongovernmental stakeholders. The outcomes and evaluation of CEHTP's efforts will inform the development of an environmental health-tracking network.

The CEHTP intends to build on the recommendations of this expert working group, and will provide additional recommendations to the CDC in fall 2005 on implementing a network. Specifically, objectives 1, 2, and 4 of the California Environmental Health Tracking Program will help to address the issues outlined in this chapter.

The first objective is to involve stakeholders by convening a planning consortium composed of technical experts from the U.S. EPA, DHS, Cal/EPA, the University of California, local public health and environmental officials, community-based and nongovernmental organizations, and environmental advocacy groups. The planning consortium has been operating and is currently facilitating effective planning, program implementation, and evaluation of CEHTP's proposed programs.

The second objective is to identify and prioritize state and local needs for developing an environmental health tracking network (EHTN) as well as assess current state and local capacity, resources, and skills to both utilize and contribute to a network.

The third objective is to develop plans for a standards-based EHTN. This includes testing protocols for data transfer and modeling; data refinement, augmentation, and linkage; security; dissemination and accessibility tools; and integration with other systems.

The fourth objective is to develop an outreach and education strategy for communicating information generated by an EHTN.

The fifth and final objective is to conduct a demonstration project on linkage that will track asthma prevalence and adverse pregnancy outcomes and link these data to environmental hazard data on exposure to traffic exhaust.

Meaningful Community Involvement

Throughout our deliberations we were reminded that information needs vary by stakeholder groups. At least three distinct stakeholder voices were evident: (1) researchers, (2) policymakers, and (3) communities/the public. Researchers need information that is consistent, valid, and systematic. Policymakers need policy-relevant information that is validated by experts. Communities need relevant information that reflects their situations and that can be used in discourse with policymakers and researchers. They require information to be accessible and to inform issues of age, ethnicity/race, gender, and socioeconomics. Communities may put a high premium on information that can be put to immediate, practical use in developing protective measures to influence the public-policy process or for community organizing purposes.

Members of the working group have observed situations in which these different needs and forms of knowledge can result in conflict between stakeholder groups. In reality these stakeholder groups are mutually dependent, and in the case of a health tracking system we believe they share a confluence of purpose grounded in the desire to understand the relationship between environment and health. A health tracking system can be structured to encourage useful interaction and dialogue between all entities. Given the interdependence of these stakeholder groups, it may be useful to consider three different approaches to viewing community involvement.

In the first, an "expert" approach (Ward, 2003), researchers often see communities and the public as passive consumers of research. Further along the continuum is a "transactional" model, which recognizes that community trust must be earned by researchers who depend on community members for data. In this view, researchers see communities as both passive generators and consumers of data, and in return for information researchers give communities data they presumably can use. Although the communities are valued for the data they may reveal in surveys or other methods, they are not seen as experts on par with others, such as researchers or government officials. The third approach might be called the "voice" approach, which recognizes communities as experts and as generators of knowledge, not merely as passive consumers of data. This recognition of the value and power of communities in turn shapes the research (and the environmental health-tracking system and its operation).

An example of communities as experts can be found in the Barrio Logan community in San Diego. In an attempt to respond to community concerns about asthma and other adverse health outcomes in the Barrio Logan community, the California Air Resources Board (ARB) began collecting air-pollution monitoring data there. Residents expressed concerns that the air monitoring was not being conducted in the appropriate locations, and recommended better locations for air monitoring stations. After moving their air monitoring equipment, ARB discovered high levels of hexavalent chromium emissions in the community. As a result, the source of the emissions was shut down and ARB has committed to revising its hexavalent chromium emissions regulations to provide greater public health protections.

In addition, because residents of Barrio Logan were knowledgeable about potential hazard sources, exposures, and health outcomes in their community, they were able to advocate for further research and now partner with the Environmental Protection Agency as the only federal interagency environmental-justice demonstration project in the EPA's Pacific Southwest Region. This project will provide the community with air monitoring results, clinical investigations funded by the National Institutes of Environmental Health Sciences, the EPA's

evaluation of environmental inspection and enforcement issues, pollution prevention programs, and training for students and staff in local schools.

Another example of how research has been improved through community knowledge and expertise is the West Oakland Environmental Indicators Diesel Truck Study (Pacific Institute, 2003). Community members provided input on the study design and recommended sites for counting trucks passing through the neighborhood illegally. Researchers had proposed evaluating certain truck routes. However, because the volume of truck traffic and routes through the neighborhood can change daily, the residents' knowledge of their own neighborhood was essential to the researchers' ability to gather useful and representative data for the study.

Historically, public health surveillance systems have been developed with the view that researchers and government officials are the primary consumers of information. Consequently, there has been a tendency to favor the expert and transactional approaches over the voice approach. The emergence of community right-to-know and other policies has demonstrated the value of providing environmental-hazard information to the public.

In recognition that a broader constituency has emerged, with an interest in environmental health, we believe California should embrace the voice approach in developing an environmental health-tracking system. The voice approach fosters mutually respectful relationships among all stakeholder groups and upholds the right to know, the principles of prevention and precaution, and environmental justice (Lambert, 2003). Our recommendations support such relationships by including a governance structure with an advisory body (see Chapter 8) comprised of communities affected by environmental hazards, local government, environmental advocacy groups, regulated businesses, and other nongovernmental organizations.

Findings and Recommendations Regarding Community and Stakeholder Needs

Relevant Information

Community groups can play a pivotal role in identifying public health problems in their neighborhoods, although they often have limited information about hazards and health outcomes in their communities. Community researchers have identified important information and gaps in needed data, and also have indicated that existing data sources are not always relevant to their communities. There is no centralized repository for information about pollution hazards and health outcomes that can be made available for specific areas and facilities.

- The proposed Office of Environmental Health Tracking (OEHT; see Chapter 8) should develop and inventory past research results as well as research samples (e.g., banked biological specimens) and methods relevant to communities and researchers. The office should facilitate data- and sample-sharing agreements. The tracking system should provide timely, detailed, cost-free, and locally relevant data on environmental hazards and health outcomes for use by community groups and residents. The OEHT should consolidate existing information on environmental hazards and health outcomes with the goal of providing simplified access for stakeholders. Data access should be limited only to the extent necessary to protect confidentiality.
- Information consolidation and dissemination should be consistent with the recommendations of the Cal/EPA Advisory Committee on Environmental Justice, specifically goal one (*to ensure meaningful public participation and promote community capacity building to allow communities to be effective participants in environmental decision-making processes*) and goal three (*to improve research and data collection to promote and address environmental justice related to the health and environment of communities of color and low-income populations*) (Cal/EPA, 2003).

Case Study

West Oakland Environmental Indicators Project—Diesel Truck Study

Issue

Passage of diesel trucks through the West Oakland neighborhood in Oakland, California, is a major health concern for neighborhood residents. The nearby Port of Oakland contributes to about 10,000 truck trips through the neighborhood every day. Highways, U.S. Postal Service activities, and other truck delivery-based businesses further contribute to diesel-truck pollution in West Oakland. The illegal passage and idling of trucks in the neighborhood also contribute to noise, threaten the safety of residents (especially children), block streets and driveways, and create a general nuisance.

Community Action

The West Oakland Environmental Indicators Project (www.neip.org) is a partnership between the Pacific Institute, a research institution, and the 7th Street/McClymonds Corridor Neighborhood Improvement Initiative, a West Oakland community organization. WOEIP conducted a study to characterize the diesel-truck inventory in West Oakland, estimate emissions from trucks traveling through and idling in the neighborhood, and identify and evaluate feasible mitigation options (Pacific Institute, 2003). Between the time of their presentation and publication of our report, they finished their study. (See www.pacinst.org/diesel/index.html.)

The organization undertook a community-driven process for the study, enabling West Oakland residents to determine study questions and goals and to select a contractor to undertake the data-collection process. Having reviewed and summarized existing information and identified gaps, WOEIP then conducted a limited truck count and idling study at key intersections and streets. Tasks included developing study methods, collecting survey-location profiles, collecting and analyzing data, and determining emissions estimates. The study also contributed to community capacity and development by hiring and training community members to perform the truck counts.

NICK CAIN, PACIFIC INSTITUTE

Barriers and Limitations

The study barriers WOEIP encountered include incomplete counts of trucks traveling through West Oakland, lack of data on residential exposure to diesel emissions, difficulties obtaining existing data, and limited resources. For example, WOEIP identified gaps in data on diesel particulates and indoor air, which are currently not monitored, and limitations in available data, including absence of information regarding the age, structure, and characteristics of trucks, and absence of truck counts for the I-880 connector. The Environmental Indicators Project also encountered difficulties in accessing data from the Port of Oakland.

How Environmental Health Tracking Can Help

- Provides consistent, reliable, no-cost, and routinely collected data (on mobile diesel pollution, especially around thoroughfares for transporting goods).
- Builds community capacity and provides trainings on how to collect data to contribute to the network.
- Provides a mechanism for using community-based research to enhance data routinely collected by the community or by local and state health agencies, with the goal of providing more complete information for health research and community planning.

Use of Data to Address Community Concerns

Community groups often lack the capacity and means to obtain the technical assistance that would enable them to better analyze and interpret relevant environmental and health data, and help them to address priority environmental health concerns in their communities. Moreover, community-based research can improve the quality and quantity of environmental health-tracking data as well as benefit communities.

- The proposed Office of Environmental Health Tracking (Chapter 8) should provide technical assistance (e.g., environmental epidemiological analyses), training, and health education for county health departments and communities. In addition, the office should promote the collaborative process developed by the National Association of County and City Health Officials *(The Protocol for Assessing Community Excellence in Environmental Health*) to help prepare local health departments and communities to better utilize data from a tracking system.
- The tracking network should facilitate community-based research. Model partnership agreements should be developed to support high-quality, consistent approaches to environmental health tracking and research. Such agreements should specifically address standardized approaches to data collection. The OEHT or its partners should have the capacity to provide technical assistance for community-initiated studies.
- The California Air Resources Board has the capacity to perform air monitoring field studies and interpret the results for community groups. This capacity includes mobile air-monitoring equipment that has been used in air pollution studies. This resource should be maintained and expanded to enable other forms of environmental sampling (e.g., soil and water sampling). A rapid-response capacity should be available to communities experiencing unusual exposures incidents involving environmental hazards (e.g., fires or chemical releases).

Cluster Investigations

Communities throughout California are struggling with high rates of various diseases, including cancers and birth defects. A disease cluster is a greater-than-expected number of cases that occurs within a population in a geographic area over a period of time. Disease can cluster in geographic space, in time, or both. These clusters often are cause for significant concern in communities, and people are eager to identify a source for such clusters. The working group was asked to provide an opinion as to whether tracking data could be used to identify communities or workplaces where previously unrecognized disease clusters may exist. We reviewed information on the history of cluster investigations and arrived at the findings and recommendations below.

Health-tracking information can be used to identify disease clusters when an association between a specific exposure and health outcome has been established. For certain health outcomes, a specific association between exposure and disease (the *etiology of the disease*) has been established. Acute poisonings (e.g., by lead, mercury, and pesticides) are common examples. Other examples include mesothelioma, which is specifically associated with exposure to asbestos, and angiosarcoma, which has been linked to vinyl chloride exposure. Identification of such clusters may indicate an exposure that requires preventive action.

- When there is a known association between a specific hazard and a health outcome, a cluster investigation could determine if that environmental hazard is present. Conversely, if a known hazard is present, tracking could determine whether the exposed population has an elevated rate of the health outcome associated with the hazard. In either case, the overarching public health objective should be to identify effective means of preventing exposure. Health officials need to respond appropriately when

community members raise concerns about disease clusters. Preliminary responses should include risk-communication activities and providing information about resources and the availability of data and services from other agencies.

Linkage

Linkage of separate data on hazards and on health outcomes may help in developing hypotheses related to disease etiology that will need to be explored by epidemiologic and/or case-control studies. State resources are best spent supporting research studies that make use of the health and environmental tracking information to design epidemiologic studies exploring associations between environmental hazards and diseases. Well-designed epidemiologic studies hold the promise of affording new insight into links between health and the environment.

- ▶ Tracking information should be made available to researchers to support epidemiologic studies.

Use of Tracking

Health and environmental tracking can provide helpful information to communities that have concerns about local environmental exposures or disease clusters. An established environmental health-tracking system could be used to conduct low-cost preliminary analyses to determine whether there are unusual environmental exposures in a community known to have an elevated rates of a particular disease, or whether other communities with similar environmental exposures also have elevated rates of the disease in question.

- ▶ Tracking data should be used to perform preliminary investigations (as described by Bender et al., 1990) of exposures or clusters when they come to the attention of public health agencies. This information may also help to decide which (if any) exposures or clusters may require additional investigation. If a community requests a preliminary analysis, the OEHT should first reach out to the community to describe the work to be performed and the strengths and limitations of using such an approach.

Consistent Response

When communities raise concerns about perceived exposures or local disease clusters, the state needs to respond consistently. The absence of a health-tracking network clearly hampers a coordinated state response to community concerns. In conjunction with the development of a tracking network, the OEHT should formalize response guidelines consistent with Bender et al. (1990).

- ▶ State response guidelines should include: (a) outreach and education to concerned community groups; (b) a preliminary review of the available health-tracking data to ascertain whether there is a statistically elevated rate of the disease in the community over a significant period of time; (c) a preliminary review of the readily available environmental-tracking data to ascertain whether any unusual hazards or exposures overlap the geographic area of the cluster; (d) a decision, based on scientific considerations, as to whether this cluster should be investigated on its own, or whether the cluster raises a general issue (e.g., about pesticides and a specific type of birth defect) that could best be investigated by a broader, well-designed epidemiologic study, or whether the cluster should not be investigated further; and (e) if the decision is to not investigate the cluster, a state health educator should help the community understand the problems and pitfalls of cluster investigations, and assist its members in identifying how they may be able to improve environmental health in their community even in the absence of clear answers about their local disease cluster.

7
Ethical, Legal, and Policy Issues

The need to provide information about environmental hazards and disease while ensuring the protection of individual privacy became a consistent theme throughout our deliberations. Community presenters (see Chapter 6) frequently emphasized the desire to obtain detailed information about hazards and health concerns in their community. Working-group members and other presenters identified challenges that emerge when trying to balance the communities' right to know and individuals' desires to protect personal health information. On balance, the goals of health tracking can be achieved in accordance with existing ethical standards and privacy laws, but new policies authorizing the collection of specific data may be needed. This chapter describes existing laws, programs, and policies related to the exchange of health and environmental data in a tracking network.

Privacy Rules and HIPAA

New national privacy standards concerning health information have been issued by the U.S. Department of Health and Human Services, pursuant to the Health Insurance Portability and Accountability Act of 1996 (HIPAA). The new regulations provide protection for the privacy of certain individually identifiable health data, referred to as protected health information. Balancing the protection of an individual's health information with the need to protect public health, the privacy regulations expressly permit disclosures of health information to public health authorities. The law authorizes public health authorities (e.g., DHS) to collect or receive the information for the purpose of preventing or controlling disease, injury, or disability, including but not limited to public health surveillance, investigation, and intervention (CDC, 2003b).

Tracking environmental health requires acquiring, using, and exchanging protected health information in order to conduct public health activities (e.g., public health surveillance, program evaluation, terrorism preparedness, investigations of disease outbreaks, direct health services, and public health research). Such information enables public health authorities to monitor disease and disability among populations. Public health authorities have a long history of respecting the confidentiality of health information they collect, and the majority of states as well as the federal government have laws that govern the use of, and serve to protect, an individual's identifiable information.

Consider, for example, the California Cancer Registry. By law, health-care providers are required to report cancer cases to the state's cancer registry. Names are included to prevent duplicate reporting and counting. The Cancer Registry may use and further disclose this information consistent with applicable state law. Some registry functions (data processing, management, and dissemination activities) are performed by a private foundation. Nongovernmental organizations can be given a grant of authority from DHS to disclose and re-release information in accordance with HIPAA regulations. (Re-release refers to the reporting of health information by state health agencies.) In general, HIPAA permits re-release of health information between health-care providers and public heath departments or their agents for public health surveillance or tracking. Programs within health departments are also allowed to exchange information between programs, pursuant to legally authorized public health activities.

HIPAA is a new law whose final implementation occurred in 2003, so regulated entities have had minimal experience with the new rules. Observers suggest that regulated entities appear to be taking extremely defensive positions, apparently developing very restrictive policies regarding the disclosure of protected health information (Lucido, 2003). As a result, states need to evaluate their information needs against what health outcomes are required to be reported. Because California health-care providers are legally required to report cancer cases to the registry, HIPAA does not pose a barrier to tracking cancer. However, reporting is not required for all health outcomes, and regulated entities may choose not to report based on HIPAA concerns.

California Laws Governing Personal Privacy

Several California Codes address medical privacy. For example, all patient information in the California Cancer Registry (CCR) is protected by the requirements of California Health and Safety Code Sections 100330 and 103885, as well as by Civil Code Sections 1798–1798.70. Medical information is further protected by Government Code Sections 6250–6265 and Section 56.05. These codes would also apply to other personal information collected for tracking health outcomes.

In addition to legal requirements, California's public health programs have a tradition of taking active steps to protect individual confidentiality. The CCR continually evaluates and imposes operational and programmatic procedures to maintain and review data security and confidentiality measures. Because of this priority, the CCR has never had a breech of confidentiality of patient records. The CCR makes vital contributions to our understanding of cancer. Researchers using CCR data may contact cancer patients to obtain additional information. Individuals with cancer usually find it rewarding to participate in these studies, which offer an opportunity to personally engage in the fight against cancer.

The CCR will release information to researchers only under tightly controlled circumstances, where the qualified researcher has first obtained approval from the program's Committee for the Protection of Human Subjects. Researchers are strictly prohibited from pressuring patients into participating, and cancer patients may decline participation at any time, and for any reason. Furthermore, cancer patients may request that their contact information be withheld from researchers. In its pursuit to improve the health of Californians, the CCR maintains that the protection of individual privacy is its highest priority (CCR, 2000).

Re-Release of Health Information for Tracking

One goal of health tracking is to document the incidence and prevalence of environmentally related diseases, and this obviously requires sharing of health information. Because of HIPAA and basic ethical considerations, there is a need for policies to govern the re-release of health information. Generally health information is provided to the state by health-care providers, so a given state agency must aggregate information from multiple sources before it re-releases it for reasons related to protecting public health. Because re-releases of information must not compromise individual privacy, generally the pertinent information is stripped of identifiers before re-release. For example, aggregate information about the incidence of childhood lead poisoning in different California counties is re-released to inform the allocation of resources to support prevention activities. In this example, "de-identified" information is sufficient for determining resource allocation. Releasing only the minimum amount of information necessary to achieve the public health objective is a guiding principle of HIPAA. Generally, summary statistics on the prevalence of a disease can be generated using de-identified information, which can be reported in "public-use" datasets. Such summaries are routinely produced by the California Cancer Registry.

Another goal of health tracking is to link outcome data with exposure data. Linkage may require the use of identifiable or potentially identifiable data. For example, geocoding and the use of geographical information systems is now a widely used method in environmental health research. In some cases, geocoding is performed at the address level. Address-level information cannot be routinely released because it contains identifiable or potentially identifiable information, which would compromise individual privacy. At the same time, health researchers may require address-level information in order to study potential relationships between environmental hazards and disease.

For a health tracking network to facilitate such research, investigators would need this kind of "restricted-access" data. Restricted-access data would only be released under a data-sharing agreement, which would include provisions restricting the use and dissemination of health information to ensure individual privacy. In general, data-sharing agreements would be made with individuals and organizations performing institutional review-board approved research and health interventions. The working group believes it is a fundamental right for individuals to have access to information about their own personal exposure to environmental hazards.

In all cases (restricted or public-use datasets), a number of procedures can be employed to reduce risk of disclosure, including data aggregation, limiting geographic detail, and limiting the number of variables in individual records. We recognize that CDHS has routinely applied these methods in the past, and should continue to do so. We are also aware that the CDC, the Agency for Toxic Substances and Disease Registry, and the Council for State and Territorial Epidemiologists are developing guidelines for the re-release of state data through an intergovernmental working group. The goals of a health-tracking network, as articulated in Chapter 2, are compatible with HIPAA and existing ethical principles. Some goals may be achieved by using public-use data, thereby requiring minimal data re-release.

Environmental Data

Information collected by environmental agencies is generally less sensitive with regard to privacy concerns than that obtained by health agencies. Pollution release and emissions data are routinely reported by industrial facilities under existing environmental laws, and the results of ambient air pollution monitoring are generally available. All of the databases described in Chapter 5 are available for public use. Cal/EPA is developing information-exchange protocols through its Integrated Data Environmental Assessment (IDEA) program. The program is developing a standards-based system to allow the exchange of environmental data, and make California compliant with EPA's national standards for information exchange.

In Chapter 8, we recommend utilizing inventory data on hazardous materials for tracking purposes. We recognize that some information about chemical use and inventories may be considered proprietary and/or that disclosure may raise public safety concerns. Right-to-know laws have successfully provided information to the public about environmental hazards while protecting proprietary information and public safety. Hazard tracking can be performed without compromising proprietary business information or public safety by using methods similar to those designed to ensure the privacy of health information. Detailed information that would otherwise not be available publicly can be contained in restricted-use datasets with summary aggregate data provided for basic hazard-tracking purposes.

8

Priority Findings and Recommendations

In order to establish an environmental health-tracking system for California, it is essential to create an ongoing program for collecting, integrating, analyzing, maintaining, and disseminating data on environmental hazards and environmentally related diseases. Previous chapters describe the data sources that are available on specific hazards, exposures, and disease outcomes, and analyze the limitations of California's current tracking systems. In this chapter we present nine priority recommendations for the most-urgent legislative actions and agency activities that are needed to establish this surveillance system.

1. Need to Coordinate Databases

There is an urgent need for a coordinating office for all California health-tracking databases. Chronic diseases and injuries account for 75% of all deaths in California. In 2000, the medical costs and income lost as a result of chronic diseases were estimated to be $107 billion. Researchers have strong scientific evidence showing that many of these diseases (such as respiratory illness, cancer, and developmental disorders) are associated with environmental exposures. If preventable environmental hazards account for even 1% of the cost of all chronic diseases in California, identifying and reducing these environmental exposures would save the state hundreds of millions of dollars per year.

The state's surveillance system is inadequate to describe trends in environmental hazards/exposures and environmentally related diseases. The system also has inadequate resources to conduct studies to explain the trends or to explore their policy implications. Surveillance systems are necessary to monitor the frequency and geographic distribution of these illnesses/exposures and to protect public health. Ongoing surveillance of environmentally related diseases and priority environmental hazards should be the function and responsibility of the state government.

Multiple California agencies collect and manage health and environmental data; those databases, which could be used for tracking, need to be updated and made uniform. Furthermore, these data are not systematically analyzed. A coordinating body is needed to promote collaboration among these agencies and set the priorities for updating these databases and systems. The cost to integrate, coordinate, and analyze the data is only a fraction of the cost that is spent on collecting them.

Recommendations

- DHS and Cal/EPA should establish and oversee an interagency Office of Environmental Health Tracking (OEHT), which would be authorized under HIPAA to receive protected health information. We recommend housing this office in the DHS Division of Environmental and Occupational Disease Control (DEODC). Cooperative agreements for staffing would need to be developed with Cal/EPA boards, departments, and offices (such as the Office of Environmental Health Hazard Assessment, the Air Resources Board, and the Department of Pesticide Regulation), as well as with the DHS Division of Chronic Disease and Injury Control. Strong liaisons should be maintained with the California

Department of Transportation and the Governor's Office of Planning and Research. At a minimum, the state should fund 50%-time of two research scientists in the DHS Environmental Health Investigations Branch (one of whom would direct the OEHT), and 50%-time of two research scientists in Cal/EPA's Office of Environmental Health Hazard Assessment, as well as a staff support position.

- The OEHT director would be selected by and report to the DEODC division chief, who in turn would report to the DHS director and the Cal/EPA Secretary.
- The Office of Environmental Health Tracking would have the following functions, to be phased in as funding becomes available:
  - Coordinate the multiple data-collection activities involved in tracking across various state agencies, and work to update and integrate databases on priority environmentally related diseases into the California environmental health-tracking system.
  - Oversee implementation of the recommendations in this report.
  - Act as stewards of hazard, exposure, and chronic disease data in formats that would include both restricted-access and public-use data files. The OEHT should facilitate the dissemination of surveillance data to researchers and the public, and provide technical assistance on how to interpret the data. In addition, the OEHT should develop data-sharing agreements, and develop procedures to protect individual privacy.
  - Develop a strategic plan that would include a mission statement, critical issues/core priorities for research/surveillance, identification of internal and external stakeholders, and a work plan describing future program development.
  - Collate and analyze the data (i.e., identify trends and geographic patterns of disease and environmental hazards/exposures; track trends in environmentally related disease among different racial and ethnic groups; and provide baseline data and present descriptive information relevant to policy formation).
  - Conduct intramural research and issue extramural research requests for proposals on possible linkages between diseases and hazard/exposure data. The OEHT should develop a protocol for protecting against potential conflicts of interest when conducting intramural research, and should provide opportunities for public participation when making decisions about research priorities.
  - In cooperation with the UC California Policy Research Center, the OEHT should produce a biennial report to the legislature on the status of surveillance and research programs and activities.
- The OEHT would have an advisory group composed of members selected from communities affected by environmental hazards, local governments, environmental advocacy groups, regulated businesses, labor, and other nongovernmental organizations. The advisory group's role would be to review and comment on the office's findings, provide input on the OEHT's future directions, comment on the biennial report, and ensure public accountability. Members would be nominated by OEHT staff, approved by the DHS director and Cal/EPA Secretary, and serve three-year staggered terms.
- The UC Center for Occupational and Environmental Health (north and south) would form a scientific panel composed of state and national experts in environmental health, public health surveillance, chronic diseases, biological monitoring, occupational health, and environmental hazards. This panel

would review and comment on the OEHT's strategic plan; review and comment on the OEHT biennial reports; and provide health policy recommendations biennially to the director of DHS, the Secretary of Cal/EPA, and the legislature.

Costs: The initial cost for establishing the OEHT is estimated to be $380,000. The annual cost of the OEHT, once it is fully staffed after three years, would be $1,063,000. The state should provide continued funding at least at this level in future years to ensure the quality and utility of the system. A detailed strategy for the OEHT's three-year implementation is presented in the final section of this chapter.

2. Data Sharing, Integration, and Communication

Environmental health-tracking data need to be shared and integrated in a standardized manner and communicated to researchers and the public in a timely way. The state legislature has made a commitment to ensuring that the public is provided with quality information on environmental hazards and health outcomes (e.g., pesticide-use reporting, the California Cancer Registry, the Tanner Act, etc.). State agencies have developed data systems to collect and disseminate this information.

Unfortunately, there are often delays in collecting and or reporting of data, so researchers and the public often do not obtain important information until it is years old. Some of the data are collected in paper form and have to be entered into computers. In other cases, databases are not user-friendly and are not configured so they can be linked. These weaknesses make it difficult for researchers and communities to obtain relevant data on multiple environmental hazards in their communities. Access to data should be limited only to the extent necessary to protect confidentiality.

Recommendations

- The environmental health-tracking system should work toward timely and complete reporting of health and environmental data.
- The OEHT should have a goal of disseminating information on the web, using visual tools, to make environmental hazard data timely, accessible, and useful for communities, researchers, and the general public.
- The OEHT should investigate emerging web-based geocoding and address validation technologies, and work toward assisting and providing resources to suppliers of primary data to enable them to integrate these technologies in their existing reporting applications.

  Costs: These were included in the cost of establishing an Office of Environmental Health Tracking.

3. Eroding Resources for Addressing Health Concerns

The 2001 Pew Environmental Health Commission Transition Report ("Strengthening Our Public Health Defense Against Environmental Threats: A Transition Report to the New Administration") claimed that states' local infrastructure for environmental health tracking has been neglected, lacks strong leadership, and suffers from a serious lack of trained personnel dedicated to responding to environmental health threats.

California's public health and environmental agencies lack the resources to address health issues related to environmental exposures. Budget cuts made during the past decade have resulted in the elimination of many highly trained and experienced scientists, health educators, and data managers in all of our health and environmental

agencies. The state government spends many times more on treating disease through its Medi-Cal program than on preventing disease through its Prevention Services.

The Cancer Registry and Birth Defects Registry are essential to maintain the state's ability to serve public health needs and are critical to continuing to monitor environmentally related diseases. In 1991, the California Birth Defects Monitoring Program had an annual budget of $7.4 million, and now is only $3.6 million. The Cancer Registry's budget has remained stable in recent years, despite an increasing number of cancer cases and increased costs of doing business.

The DHS Division of Environmental and Occupational Disease Control is facing (along with all DHS divisions) significant budget cuts this fiscal year and the next. From January 2002 to March 2004, the Cal/EPA Office of Environmental Health Hazard Assessment suffered an overall 40% budget reduction. The loss of state-agency expertise in environmental health undermines California's ability to conduct environmental health surveillance to protect public health.

Recommendations

- The legislature should restore funds to allow the California Birth Defects Monitoring Program resume statewide coverage. It should also continue to increase the state's commitment to complete surveillance, which will save millions of dollars in health-care and special-education costs.
- State government must commit funding to implement an effective environmental health infrastructure in California, which an environmental health-tracking system requires. Unless the state can address environmental health threats, the collection of environmental health-tracking data is meaningless.
- The state should restore lost positions to the Division of Environmental and Occupational Disease Control and the Office of Environmental Health Hazard Assessment and increase California's capacity to respond to environmental health threats by establishing the joint Office of Environmental Health Tracking. (See our first conclusion.)

4. Need for More Complete Hazard Data

The state needs more complete data on chemical, biological, and physical hazards. During the past half-century, thousands of chemical substances have been developed, used in workplaces, put into consumer products, and released into the environment. Of the 3,000 chemicals that the United States imports or produces at more than 1 million pounds per year, the EPA found that 43% have no test data on basic toxicity, and only 7% have a full set of basic test data.

This absence of information compromises the public's right to know about the chemicals that are found in their environment, their homes, their workplaces, and the products they buy. There is an urgent need to ensure that basic information is available on every high-production-volume chemical (EPA, 2003c). Currently, there is no systematic tracking of where hazardous chemical are used, the substances contained in consumer products, and how much is released into the environment.

Limited information on the use and distribution of hazardous chemicals in California represents a major gap for environmental health surveillance. Although data on chemical use do not necessarily provide the best indicator of the public's exposure, they would provide an important starting point for environmental hazard tracking. Data on chemical use would improve the accuracy of air-pollution inventories and exposure models, alert

public health authorities to emerging hazardous products, help in interpreting biological monitoring results, and enable targeted interventions. The data could assist as well in screening chemicals and establishing priorities for further assessment and potential risk management.

Recommendations

- Businesses that produce, import, or store chemical, biological, or physical agents in California should be required to develop and provide essential information to the state, including: (1) basic chemical and toxicologic properties to allow evaluation of hazard and environmental persistence; (2) location and quantity of manufacture, use, or storage; and (3) laboratory methods for measuring the chemical, its environmentally degraded products, and metabolites in environmental media and human samples.
- The legislature should grant authority and funding to the DHS Occupational Health Branch (OHB) to implement a pilot project to collaborate with one or more Certified Unified Program Agencies (CUPAs—see Chapter 5 for more information) to assess the feasibility of using inventory data on hazardous materials to track chemical hazards. The objectives of this pilot project should not be limited to determining whether these inventory data can (1) provide a useful and/or accurate measure of chemical use in California and (2) facilitate establishing a hazard-alert system designed to inform employers of risks to workers and communities from specific hazards.

  Cost: The cost for the pilot project is estimated to be $377,000.
- The proposed OEHT, along with OHB and in cooperation with the California Air Resources Board, should develop extramural proposals for funding a pilot effort to collect data on the use of chemicals from common facilities that handle high volumes of toxic materials, such as gasoline stations and dry cleaners.

5. Limited Ability to Monitor Exposure

There is limited monitoring of environmental concentrations of and human exposure to toxic chemicals and biological agents in California. Consequently, we know very little about where chemicals concentrate in the environment and what the public is being exposed to. Because there is no statewide environmental and biological monitoring program in place, laboratory capacity for detecting and measuring exposure of concern is limited.

The National Health and Nutrition Examination Survey (NHANES) tracks health and diet information on a sample of people across the United States, and combines participant interviews with biological monitoring. The NHANES, conducted by the Centers for Disease Control, has been successful in guiding health policy and providing information on the amount, distribution, and effects of chronic illness and disability in the United States. The NHANES is based on demographic probability sampling, and although it includes data from a sample of Californians, state-specific data are not being released because the CDC believes that the data are not representative of each state.

Another survey, sponsored by the EPA, demonstrated that high-quality data on exposure to high-risk chemicals could be collected and used to identify routes of exposure and suggest ways of reducing human exposure to these compounds. The National Human Exposure Assessment Survey (NHEXAS), which collected source-to-dose data on multiple exposures, examined a sample of households and asked them to provide time-activity

questionnaires, food diaries, and personal environmental monitors. They also collected environmental, food, and biological samples. This survey was not conducted nationwide nor in California, and is no longer in use.

A California Biomonitoring Planning Project (CBPP) survey of local health and environmental health officials, as well as nongovernmental and tribal organizations, found in 2002 that pesticides, heavy metals, environmental tobacco smoke, persistent organochlorine compounds, and volatile organic compounds were the leading toxic substances of concern. The report concluded that present testing capacity and sample throughput in state governmental laboratories is extremely limited. The CBPP also recognized the need for providing statewide normative (background) data for levels of compounds of concern, particularly among children and pregnant women.

Recommendations

- California needs to initiate its own Health and Nutrition Examination Survey (Cal-HANES), which would work with CDC to collect health and diet information for a sample of the population. Cal-HANES should include a health interview, physical/medical evaluations, environmental monitoring, and biological monitoring. In the short term, we recommend that the proposed Office of Environmental Health Tracking seek support to develop study protocols, and to conduct a pilot Cal-HANES in one county. In the long term, the state should provide funding to support an ongoing Cal-HANES survey

  Cost: We estimate that the cost to conduct a pilot Cal-HANES study would be $500,000, and that a full Cal-HANES would cost $5 million over a three-year period.

- The state should also conduct a California Human Exposure Assessment Survey (CalHEXAS), modeled after the EPA's NHEXAS program. CalHEXAS would collect comprehensive data on sources, pathways, and exposures to metals, pesticides, environmental tobacco smoke, volatile organic compounds, solvents, and persistent organic pollutants, among others. It should examine the variability of exposure data and should conduct environmental sampling such as dust wipes, indoor air sampling, and random soil samples. As with Cal-HANES, we think the state should support such studies in the long-term, after OEHT obtains support to develop study protocols and to conduct a pilot CalHEXAS in a small area. Alternatively, OEHT should seek support to augment current cohort studies that other researchers are conducting on monitoring personal exposures.

  Cost: We estimate it will cost $500,000 to conduct a pilot CalHEXAS, and $5 million to conduct a full Cal-HEXAS over a three-year period.

- California has emerging capabilities for biological monitoring, and there is an urgent need to further develop the state's laboratory capability. Biological monitoring capabilities need to be developed for rapid assessment of metals such as mercury, polybrominated diphenyl ethers, persistent organic pollutants, phthalates, organophosphates, and pyrethroids. In addition, the program should make it a priority to develop biological monitoring methods to identify emerging chemical contaminants (such as perfluorinated chemicals, polychlorinated diphenyl ethers, and musk xylenes). Methods that are developed in the State of California's environmental laboratories should be used to support research studies that further our understanding of how exposures affect communities. Expansion of biological monitoring capabilities at these laboratories would also help establish an estimate of body-burden levels

Labs performing biological monitoring should be certified under the Clinical Laboratory Improvement Act Amendments of 1988.

of toxic chemicals in exposed communities, which may lead to public policy actions to prevent or abate exposures.

Cost: We estimate that approximately $1 million per year is needed for five years in order to increase state governmental laboratory capabilities for biological monitoring of chemical agents.

- The CDC should release the California-specific NHANES data. Although not representative of the California population, they would nevertheless be useful for California's decision-makers in prioritizing which hazards and exposures to track via biological monitoring. (Dr. Paul Schulte did not concur with the rest of the working group on this recommendation.)

6. New and Augmented Surveillance Systems

Surveillance systems need to be developed for priority environmentally related diseases, existing systems require adequate resources, and additional information is needed to augment existing systems, such as the California Cancer Registry and the Birth Defects Monitoring Program. Among environmentally related diseases, priority tracking systems are either being developed or need to be developed for neurodegenerative disorders (such as Alzheimer's and Parkinson's disease), childhood neurodevelopmental disorders, and asthma.

Tracking Neurological Diseases

Alzheimer's and Parkinson's disease are important chronic neurological diseases of aging for which no surveillance systems have been developed. These disorders result in significant morbidity for Californians, and environmental factors may play a significant role in causing or aggravating them. Tracking Parkinson's disease may be more feasible than tracking Alzheimer's, and some medications used by Parkinson's patients are specific to this disease.

Recommendations

- The Department of Health Services should take the lead in developing a Parkinson's and Alzheimer's tracking system of a representative sample of the state population, initially limited geographically to one county but with statewide expansion envisioned. Parkinson's Disease medications should be explored as a sentinel marker of disease prevalence. We suggest starting by forming public/private partnerships with the University of California, foundations combating Alzheimer's and Parkinson's disease, and health-care providers/insurers to explore the feasibility of creating disease registries for Parkinson's and Alzheimer's disease based on medication utilization.

  Cost: The estimated cost for creating a registry for Parkinson's and Alzheimer's disease limited to one county is approximately $816,000. The estimated cost for expanding this registry statewide would be $8.2 million. One reason for exploring the use of medication as a marker or indicator of disease prevalence is to reduce the costs associated with the development of a statewide registry.

Augmenting Occupational Data

Occupational history is important information that is absent or insufficient in several registries or surveillance systems, such as the California Cancer Registry and the Birth Defects Monitoring Program. Occupational data are not reliably recorded on medical charts, the main data source for such programs, and many doctors are unaware of reporting requirements for occupationally related illnesses.

Recommendations

- The Office of Environmental Health Tracking, the DHS Occupational Health Branch, the Department of Industrial Relations, and Cal/OSHA should work with the California Health Information Association—a nonprofit association that provides leadership, education, resources, and advocacy for California's information-management professionals in the health-care industry—to assess the feasibility and cost of establishing an employer-based reporting system for occupational history or some other means of improving information on occupation and industry for use in environmental health surveillance.

  Cost: None.

- The state should provide resources to the Department of Industrial Relations to work jointly with the Occupational Health Branch to improve insurer submissions of doctors' first reports of occupational injury or illness (DFRs), enforced by the DIR. The Occupational Health Branch and the Cal/EPA Office of Environmental Health Hazard Assessment should also be given the resources to reach out to and educate health-care practitioners about work-related illness.

  Cost: The estimated annual cost to implement this recommendation is $360,000.

- The legislature should empower local health officers to enforce the requirement to submit DFRs. Enforcement should be coupled with continuing education to raise clinicians' awareness of the usefulness of DFRs.

  Cost: The estimated annual cost to implement this recommendation is $136,000.

- The state should explore the feasibility of creating a data system and requiring physicians to submit DFRs electronically.

Tracking Asthma

Asthma is the most common environmentally related disease in California. An estimated 3.9 million adults and children—11.9% of the population—report that they have been diagnosed with asthma at some point (i.e., "lifetime asthma prevalence"). Current telephone surveys for asthma, although useful, suffer from low response rates.

Recommendation

- California officials should investigate whether combining patient encounter data from public and private sources on hospitalizations, emergency-room visits, physician visits, and medication use for asthma can be integrated to develop an asthma surveillance system. The officials should work with public and private data managers (e.g., Medi-Cal and Kaiser Permanente) to investigate this approach and construct a pilot demonstration project. The California Environmental Health Tracking Program is currently evaluating the usefulness of this approach in one county, and the results of its evaluation should be forwarded to the Chronic Disease Branch and the Environmental Health Investigations Branch of DHS for further action.

  Cost: The estimated cost to conduct an asthma surveillance pilot project is $200,000.

7. Providing Information to Communities

Health-tracking information can be used to identify disease clusters when a specific causal association has been established between exposure and health outcome. When communities raise concerns about perceived exposures or local disease clusters, the state response should be consistent.

Recommendations

- DHS should establish specific protocols for when and how cluster investigations should take place, and develop a uniform set of guidelines for state and county health authorities. Cluster response guidelines should include:

  1. outreach and education to concerned community groups;
  2. a preliminary review of the available health-tracking data to ascertain whether there is a statistically elevated rate of the disease in the community over a significant period of time;
  3. a preliminary review of the environmental tracking data that are readily available to ascertain whether any unusual exposures overlap the geographic area of the cluster;
  4. a decision, based on scientific considerations, as to whether this cluster should be investigated on its own, or whether it raises a general issue that could best be investigated by a broader, well-designed epidemiologic study, or whether the cluster should not be investigated further; and
  5. if the decision is to not investigate the cluster, the agency should have a health educator on staff to help the community understand the problems, limitations, and pitfalls of cluster investigations, and to assist the community to identify ways that they may be able to improve environmental health even in the absence of any clear answers about their local disease cluster.

  Cost: DHS should absorb the cost for implementing this recommendation.

8. Disparities in Hazards, Exposures, and Diseases

Environmental hazards, exposures, and diseases are disproportionately distributed by racial and ethnic groups as well as by gender, income, and geographical location. Economic, social, and cultural factors significantly determine or qualify the distribution and relative concentration of hazards, exposures, and diseases. For example, African Americans and Latinos are more likely to live in a census tract with toxic air releases than white residents in Southern California (Pastor, 2001). People in low-income and nonwhite racial and ethnic groups, who are disproportionately exposed to environmental hazards, may also be more vulnerable to the effects of these contaminants because of the cumulative impacts from multiple exposures and lack of access to health care.

Recommendation

- In attempting to alleviate disproportionate distributions of environmentally related diseases, public health authorities and partners in the environmental health surveillance system should be alert for and carefully monitor disparities in concentrations of hazards, exposures to contaminants, diseases, interventions, and other public health responses. The proposed OEHT needs to collect hazard, exposure, and health-outcome data categorized by race, ethnicity, income, and other factors to enable examination of environmental justice and racial and economic disparities in environmentally related disease. Disparities

in environmentally related disease continually need to be monitored by public health authorities in order to inform public policies that will decrease the incidence of such diseases.

Cost: The cost of implementing this recommendation is covered under the cost of establishing an Office of Environmental Health Tracking. (See our first conclusion.)

9. Providing Technical Assistance to Communities

The State of California has given inadequate resources over the years to fund health education staff qualified to deal with environmental justice issues, especially in relation to chronic-disease clusters. An intensive, long-term, and consistent commitment to community outreach and education is required to address issues related to environmental justice. Communities and community groups need information, training, and other technical assistance to build their capacity to access data and information so they can participate meaningfully in public health policymaking and decision-making. Such access and capacity will help communities obtain important hazard and exposure information, understand the strengths and limitations of investigating chronic-disease clusters, and continue to address concerns about how environmental hazards may be related to chronic disease in their neighborhoods.

Recommendation

- The OEHT should have at least one full-time health educator to represent community interests and serve as a liaison between affected communities and environmental epidemiology staff in DHS. This individual would work closely with community members, the California Cancer Registry, the Division of Environmental and Occupational Disease Control, the California Birth Defects Monitoring Program, the Chronic Disease Control Branch, and the Cal/EPA's Office of Environmental Health Hazard Assessment. This individual should report directly to the director of the OEHT.

  Cost: The cost for implementing this recommendation is covered under the second-year OEHT implementation plan.

Detailed Strategy for Three-Year OEHT Implementation

Although the cost of an environmental health-tracking system ultimately should be fully funded by state revenues, we recognize the current economic situation for California's state and local government agencies. We therefore recommend that a fully implemented Office of Environmental Health Tracking be phased in over three years, and that the OEHT seek extramural funds for pilot projects.

Year 1 Activities

1. DHS and Cal/EPA would establish a state-funded interagency Office of Environmental Health Tracking, housed in the DHS Division of Environmental and Occupational Disease Control (DEODC), with two 50%-time research scientists in the Environmental Health Investigations Branch, DHS, and two 50%-time research scientists in the Office of Environmental Health Hazard Assessment, Cal/EPA, along with a staff support position. One of the functions of these research scientists would include assisting local communities by providing technical assistance to obtain and interpret needed environmental health data.

2. The OEHT would develop and sign cooperative agreements for data sharing between the OEHT, the DHS Division of Chronic Disease and Injury Control, and Cal/EPA boards, departments, and offices (such as the Office of Environmental Health Hazard Assessment, the Air Resources Board, and the Department of Pesticide Regulation). These agreements are to be modeled after the recent MOU signed by the U.S. EPA and the U.S. Department of Health and Human Services to coordinate collection of health and environmental data (see Appendix C).

3. The OEHT director, one of the contributed DHS research scientists, would be selected by and report to the DEODC division chief, who in turn would report to the DHS director and the Cal/EPA Secretary.

4. OEHT would develop a strategic plan, to include a mission statement, identification of both critical issues/core priorities for research/surveillance and internal and external stakeholders, as well as a work plan describing future program development.

5. OEHT would develop extramural proposals to seek federal and foundation funds to establish pilot tracking projects, fund additional staff positions, and develop solid cost estimates and proposals for a tracking function.

6. The cost for Year 1 activities is estimated to be $380,000.

Year 2 Activities

1. The state would provide funding for four additional 50%-time research scientists (two from the Environmental Health Investigations Branch and two from the Office of Environmental Health Hazard Assessment), along with one full-time office technician and one full-time health educator.

2. With the cooperation of the UC California Policy Research Center, the OEHT would produce its first biennial report to the legislature on the status of surveillance, research programs, and activities.

3. The OEHT would form an advisory group composed of members selected from communities affected by environmental hazards, local governments, environmental advocacy groups, regulated businesses, labor, and other nongovernmental organizations. Its role would be to review and comment on OEHT findings, provide input on the OEHT's future directions, comment on the biennial report, and ensure public accountability. Members would be nominated by the staff of the OEHT, approved by the director of DHS and the Secretary of Cal/EPA, and serve three-year staggered terms.

4. The University of California Center for Occupational and Environmental Health (north and south) would form a scientific panel composed of state and national experts in environmental health, health surveillance, chronic diseases, biological monitoring, occupational health, and environmental hazards. This panel would review and comment on the OEHT's strategic plan; review and comment on the OEHT biennial report; and provide health policy recommendations biennially to the DHS director, the Cal/EPA Secretary, and the legislature.

5. The OEHT would continue to develop extramural proposals to seek federal and foundation funds for pilot projects.

6. The estimated cost for Year 2 (excluding costs to UC) would be $826,000.

Year 3 Activities

1. The state would supplement the OEHT staff with two full-time database administrators/programmers, and a full-time geographic information system specialist.
2. The OEHT would oversee implementation of the recommendations of the SB 702 working group.
3. The OEHT would begin to analyze tracking data and produce reports (i.e., identify trends and geographic patterns of disease and environmental hazards/exposures; track trends in environmentally related disease among different racial and ethnic groups; and provide baseline data and present descriptive information relevant to policy formation).
4. The estimated cost for Year 3 activities is $1,063,000. The State of California should provide continued funding at least at this level in future years to ensure the quality and utility of the system.

Final Goals of the OEHT

In addition to the activities above, the OEHT would have the additional following responsibilities as its capacity expands:

1. Develop a surveillance network that would communicate with the Centers for Disease Control and Prevention, and would conform with the standards of the National Electronic Disease Surveillance System and the EPA's National Environmental Information Exchange Network. The OEHT should ensure privacy and confidentiality of the data, and develop data transfer, linkage, and security protocols. For more information, the OEHT should refer to the California Environmental Health Tracking Program's standards-based plan for a tracking network.
2. Act as stewards of hazard, exposure, and chronic disease data in formats that would include both restricted access and public-use data files. The OEHT should facilitate the dissemination of surveillance data to researchers and the public, and provide technical assistance on how to interpret the data. The OEHT also should develop data-sharing agreements, and develop procedures to protect individual privacy.

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Appendix A
Text of Senate Bill 702

CHAPTER 538

An act to add Chapter 8 (commencing with Section 104324) to Part 1 of Division 103 of the Health and Safety Code, relating to environmental health.

[Approved by Governor October 4, 2001. Filed with Secretary of State October 5, 2001.]

LEGISLATIVE COUNSEL'S DIGEST

SB 702, Escutia. Chronic disease: environmental determinants.

Existing law makes various provisions for the prevention of disease, including chronic diseases, and the promotion of health, and imposes various requirements on the State Department of Health Services in this regard.

This bill would declare legislative intent to establish an Environmental Health Surveillance System, in accordance with the recommendations of the working group created pursuant to the bill and described below.

This bill would provide that the purpose of the EHSS shall be to establish an ongoing surveillance of environmental exposures and the diseases afflicting Californians. The bill would require the division and the office, in cooperation with the Regents of the University of California, to create a working group of technical experts with specified duties, including the development of possible approaches to establishing the EHSS, and would express legislative intent that legislation be enacted adopting one of these approaches.

The people of the State of California do enact as follows:

SECTION 1. The Legislature finds and declares all of the following:

(a) In its fight against chronic diseases, including birth defects, that are related to the environment, California must give communities and public health professionals solid, reliable information, which is the most basic tool to undertake the prevention of these diseases.

(b) Data generated by tracking and monitoring chronic diseases are critical to all of the following:

(1) Knowing where and how to put in place the most effective strategies to prevent diseases.

(2) Assessing the contribution of diseases to disabilities and premature mortality.

(3) Measuring the effectiveness of prevention strategies.

(4) Generating hypotheses that may lead to new scientific knowledge about the causes of, and most effective ways to fight, chronic diseases.

(c) To examine the relationships between chronic diseases and the environment, the state should do all of the following:

(1) Survey a cross section of the overall population in California, including chronically ill patients, and their environmental exposures.

(2) Conduct biomonitoring to measure pollutant levels in blood and urine samples for a cross section of the population.

(3) Link data created by the survey to other health and environmental data bases, such as birth certificates, neonatal blood tests, hospital admissions, emergency room visits, and mortality.

(4) Require state government agencies and universities to examine whether, and the extent to which, past environmental exposures might increase the risk of several chronic diseases, including birth defects, heart disease, cancer, asthma and other respiratory conditions, Parkinson's disease, Alzheimer's disease, and other neurological degenerative diseases.

(d) The initial investment to establish this type of a data collection and analysis infrastructure to develop preventive strategies would constitute a small fraction of the annual costs of controlling chronic diseases in California.

(e) It is the intent of the Legislature in enacting this act to form a public-private partnership to create an environmental health and chronic disease surveillance system to do all of the following:

(1) Provide a data base, with linkages to the survey, biomonitoring, and disease type, to assess the impact of environmental contaminants on the human body and, to the extent possible, regional data to assess geographic variability.

(2) Track and evaluate a variety of chronic diseases in relation to environmental exposures, including state and local data on actual incidences of chronic disease.

(3) Make data available to the public in an accessible and useful format.

(4) Ultimately provide information to the relevant board, department, or office within the California Environmental Protection Agency and to the relevant branch or division within the State Department of Health Services for the development of appropriate preventive strategies.

SEC. 2. Chapter 8 (commencing with Section 104324) is added to Part 1 of Division 103 of the Health and Safety Code, to read:

CHAPTER 8. ENVIRONMENTAL HEALTH SURVEILLANCE SYSTEM

104324. (a) It is the intent of the Legislature to establish an Environmental Health Surveillance System (EHSS) in accordance with this chapter. The purpose of the EHSS shall be to establish ongoing surveillance of the environmental exposures and diseases affecting Californians, with a focus on prevalence and determinants of chronic diseases. The Regents of the University of California are requested to cooperate with the division and the office in establishing the EHSS.

(b) The objectives of the EHSS are as follows:

(1) To track and evaluate a variety of chronic diseases in relation to environmental exposures.

(2) To allow both government and university investigators and public health officials to assess the impact of environmental contaminants on the human body.

(3) To provide information to the relevant board, department, or office within the California Environmental Protection Agency and to the relevant branch or division within the State Department of Health Services for the development of appropriate preventive strategies.

104324.2. (a) On or before July 1, 2002, the Division of Environmental and Occupational Disease Control in the State Department of Health Services, in consultation with the Office of Environmental Health Hazard Assessment, shall create a working group of technical experts, including experts who have knowledge of the sensitivity and exposure of children, women of child-bearing age, seniors, and disparately affected populations to environmental hazards, to do all of the following:

(1) Develop possible approaches to establishing the EHSS, including an estimated cost for each approach.

(2) Prepare and submit a report to the State Department of Health Services and, the Office of Environmental Health Hazard Assessment, and appropriate legislative committees, by July 1, 2003, on the possible approaches to establishing the EHSS, including an estimated cost of each approach, and the recommended approach to establishing an EHSS for California.

(3) Develop the health and environmental measurements needed to do both of the following:

(A) Obtain an ongoing picture of the health of Californians.

(B) Establish a data base that may facilitate the examination of the relationship between chronic diseases, including birth defects, and the environment.

(b) The Regents of the University of California are requested to cooperate with the division and the office in creating the work group described in this section.

104324.3. It is the intent of the Legislature to enact legislation that would require the adoption and implementation, by specified dates, of one of the approaches recommended by the working group pursuant to Section 104324.2.

104324.5. This chapter shall only apply to the University of California to the extent that the Regents of the University of California make it applicable by appropriate resolution.

Appendix B

Meetings of the California Environmental Health Tracking Expert Working Group

Sponsored by the California Department of Health Services, Environmental Health Investigations Branch, in Partnership with the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, and the University of California.

No RSVP is required to attend.

Written comments may be submitted in addition to or in lieu of attendance at meeting.

For individuals with disabilities, the department will provide assistive services such as sign-language interpretation, real-time captioning, note takers, reading or writing assistance, and conversion of training or meeting materials into Braille, large print, audiocassette or computer disk.

To request such services or copies in an alternate format, please call or write:

Mimi Johnson, Program Coordinator
CEHTP/EHIB
1515 Clay Street, Suite 1700
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California Relay
711/1-800-735-2929

Partially funded by the Centers for Disease Control and Prevention and the California Wellness Foundation.

First Meeting: Elihu Harris State Building, Oakland, California
October 17, 2002

8:30–8:40 **Welcome and Introductions**
Richard Kreutzer, MD, Chief
Environmental Health Investigations Branch
California Department of Health Services

8:40–9:10 **Letter to the Expert Working Group**
Senator Martha Escutia

Welcome
Joan Denton, PhD, Director
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

Phone Address
Raymond Neutra, MD, DrPH, Chief
Division of Environmental and Occupational Disease Control
California Department of Health Services

9:10–9:20 **Introductions of Expert Working Group**
Mimi Johnson, MPH, CHES, Program Coordinator
Environmental Health Investigations Branch

9:20–9:40 **Review Meeting Agenda and Binder**

9:40–10:45 **Overview of Environmental Health Tracking Issues & Discussion**
Paul English PhD, MPH
Environmental Health Investigations Branch
Overview of (1) Pew Environmental Health Commission Report; (2) Senate Bill 702 which establishes the mandate for the working group; (3) Health Resources and Health Indicators for California; and (4) CDC cooperative agreement activities.

10:45–11:30 **Overview of Environmental Resources in California & Discussion**
Carmen Milanes, MS, Project Manager, EPIC
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency
Overview of Environmental Data and Environmental Protection Indicators for California

11:30–12:00 **Overview of Future Expert Working Group Meetings**

12:00–1:15 **Break**

1:15–2:00 **Process for Developing Final Report and Demonstration of Research Tool**
Geoffrey Lomax, DrPH, Research Director
Environmental Health Investigations Branch

2:00–3:15 **Some Challenges of Developing a Tracking System for California**
Geoffrey Lomax
(1) How should we define environment for the purpose of reporting back to the legislature? (2) Is there public health value to improve hazard and disease tracking even if links between specific exposure and disease outcomes cannot be established?

3:15–4:00 **Public Comments/Q and A**

4:00–4:30	**Elect Chair**
4:30	**Closing Statement/Adjourn** Paul English

Second Meeting: Preservation Park, Oakland, California
December 18, 2002

8:30–8:40	**Welcome** Richard Kreutzer, MD, Chief Environmental Health Investigations Branch California Department of Health Services
8:40–9:00	**Welcome and Introduction of Members Not Present at First Meeting** Chair
	Update of Public Comment Protocol
9:00–9:10	**Review Meeting Agenda and Binder Additions**
9:10–10:00	**Discussion of Proposed Framework for Categorizing Hazards and Disease Outcomes** Geoffrey Lomax, DrPH, Tracking Research Director Environmental Health Investigations Branch
10:00–10:10	**Break**
10:10–11:25	**Morning Working Session** *Adopting Framework for Categorizing Hazards*
11:25–11:55	**Public Comments/Questions**
11:55–12:00	**Morning Summary** Richard Kreutzer
12:00–1:15	**Break**
1:15–2:15	**Presentation on Environmental Hazard Databases and Q and A** Presenter TBA
2:15–3:15	**Afternoon Working Session** *Utility of Specific Data Sources for Health Tracking in California*
3:15–3:45	**Identify Process for Obtaining Public Input**
3:45–4:15	**Public Comments/Q and A**
4:15–4:30	**Closing Comments/Adjourn** Richard Kreutzer

December 19, 2002

8:30–8:45	**Review Meeting Agenda**

8:45–10:00	**Presentation on Prioritizing Health Outcomes** Presenter TBA
10:00–11:00	**Morning Working Session** *Adopting Framework for Categorizing Health Outcomes*
11:00–11:30	**Public Comments/Q and A**
11:30–12:30	**Break**
12:30–1:45	**Working Session** (continued)
1:45–2:00	**Closing Comments/Adjourn** Richard Kreutzer

Third Meeting: LA Department of Water and Power, Los Angeles, California March 19, 2003

9:00–9:15	**Welcome** **Review of Meeting Agenda** Richard Kreutzer, MD, Chief Environmental Health Investigations Branch California Department of Health Services Joyce Lashof, MD, Chair Expert Working Group Professor Emerita, School of Public Health University of California, Berkeley
9:15–10:00	**CDC's National Report on Exposure to Environmental Chemicals** Larry L. Needham, PhD Toxicology Branch National Center of Environmental Health, CDC
10:00–10:45	**Update from Environmental Health Lab on Biomonitoring** C. Peter Flessel, PhD, Chief Environmental Health Laboratory Branch California Department of Health Services
10:45–11:00	**Break**
11:00–11:30	**Update on Biomonitoring Bill** Sharyle Patton, Co-Director Collaborative on Health and Environment Project, Commonweal
11:30–12:00	**Public Comments**
12:00–1:30	**Lunch**
1:30–2:15	**Community Presentation** Jane Williams, Executive Director California Communities Against Toxics Cynthia Babich, Executive Director Del Amo Action Committee
2:15–2:30	**Break**

2:30–3:15 **Review of Tracking Frameworks/Revision Based on Work Group Comments**
Geoffrey Lomax, DrPH, Research Director
Environmental Health Investigations Branch
California Department of Health Services

3:15–3:45 **Review of Hazards/Disease Matrix**
Paul English PhD, MPH
Environmental Health Investigations Branch
California Department of Health Services

3:45–4:00 **Closing Comments/Adjourn**
Richard Kreutzer

March 20, 2003

9:00–9:15 **Review of Meeting Agenda**
Joyce Lashof, Chair

9:15–10:30 **Morning Working Session**
Review Categorization and Prioritization of Diseases/Hazards
Geoffrey Lomax

10:30–10:45 **Break**

10:45–11:30 **Review of Draft First Chapters of Report**
Geoffrey Lomax

11:30–12:45 **Lunch**

12:45–1:15 **Community Presentation**
Pacoima Beautiful
Kristin Aldana-Taday, Project Coordinator

1:15–2:00 **Use of California Health Interview Survey (CHIS) for Tracking**
Ying-Ying Meng, DrPH, Senior Researcher
UCLA Center for Health Policy Research

2:00–2:30 **Public Comments**

2:30–3:15 **Use of Environmental Public Health Indicators**
Paul English

3:15–3:30 **Break**

3:30–4:00 **Community Presentation**
Healthy Homes Collaborative
Linda Kite, Project Coordinator

4:00–4:30 **Closing Comments/Adjourn**
Richard Kreutzer

Fourth Meeting: Elihu Harris State Building, Oakland, California
May 21, 2003

9:00-9:15	**Welcome** **Review of Meeting Agenda** Joyce Lashof, MD, Chair Professor Emerita, School of Public Health University of California, Berkeley
9:15–10:15	**Review of Report Chapters 1–4** Geoffrey Lomax, DrPH, Research Director Environmental Health Investigations Branch California Department of Health Services
10:15–10:30	**Break**
10:30–11:30	**Review of Pesticide Use Reporting System Limitations and Strengths** Larry Wilhoit Department of Pesticide Regulation
11:30–11:45	**Public Comments**
11:45–1:00	**Lunch**
1:00–3:00	**Panel Discussion of Limitations/Strengths of Key Health and Environmental Systems** Will Forest: *Hazardous Pollutants in the Workplace* Bob Gunier: *HAPS data* Robert Schlag: *Cancer Registry* Craig Wolff: *Drinking Water/Traffic* Louise Mehler: *Pesticide Illness Surveillance* Jennifer Flattery: *Occupational Asthma Surveillance*
3:00-3:30	**Expert Working Group Discussion**
3:30-4:15	**Feasibility of Using Physician Billing Database for Health Outcome Tracking** Lucy Johns, MPH Independent Consultant, Health Care Planning & Policy
4:15-4:30	**Public Comments**
4:30	**Adjourn**

May 22, 2003

9:00–9:15	**Review of Meeting Agenda** Joyce Lashof
9:15–10:15	**Community Presentation** Meena Palaniappan The Pacific Institute for Studies in Development, Environment, and Security
10:15–10:30	**Break**

10:30–11:30	**Presentation on Hazardous Air Pollutant Modeling and Community Exposures/CHAPIS** Todd Sax Air Resources Board California Environmental Protection Agency
11:30–11:45	**Public Comments**
11:45–1:00	**Lunch**
1:00–2:30	**Review and Discussion of Draft Recommendations for Report**
2:30-2:45	**Public Comments**
2:45–4:00	**Continued Discussion of Draft Recommendations**
4:00	**Adjourn**

Fifth Meeting: CAL/EPA Headquarters, Sacramento, California
July 16, 2003

10:00–10:15	**Welcome/Opening Remarks** Assemblymember Wilma Chan (Invited)
10:15–10:30	**Review Meeting Agenda** Joyce Lashof, MD, Chair Professor Emerita, School of Public Health University of California, Berkeley
10:30–11:00	**Environmental Health Challenges for California Tribes** Captain Paul Young Director, Environmental Health Services, Indian Health Service
11:00–12:30	**Final Report Discussion**
12:30–1:30	**Lunch**
1:30–2:00	**Environmental Public Health Tracking and Health Policy** John Balmes, MD UC Berkeley Center for Occupational and Environmental Health
2:00–3:30	**Expert Working Group Discussion**
3:30–3:45	**Public Comment**
3:45–4:30	**Final Report Discussion**
4:30–6:30	**Break**
7:00–8:30	**Final Report Discussion**

July 17, 2003

9:00–9:15	**Agenda Review**

9:15–9:45	**Cancer Concerns in South Sacramento County** Dee Lewis, Sacramento Resident Concerned Residents Initiative
9:45–11:00	**Final Report Discussion**
11:00–11:15	**Break**
11:15–11:45	**The National Electronic Disease Surveillance System (NEDSS) and its Impact on Data Access** Jeff Sanchez, Health Information Systems Section Chief California Lead Poisoning Prevention Branch California Department of Health Service
11:45–12:30	**Data Sharing and Data Release: Administrative Controls and Technical Methods to Reduce Disclosure Risk** Steven Macdonald, PhD, MPH Washington Department of Health
12:30–1:30	**Lunch**
1:30–3:00	**Final Report Discussion**
3:00–3:15	**Public Comment**
3:15–3:30	**Wrap–Up/Adjourn**

Appendix C

MOU Between the U.S. Department of Health and Human Services and the U.S. Environmental Protection Agency

I. Purpose

This Memorandum of Understanding (MOU) serves to set forth the authorities, responsibilities, and procedures under which the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Health and Human Services (HHS) will seek jointly to advance efforts to achieve mutual environmental public health goals and, in doing so, strengthen the bridge between the environmental and public health communities. In achieving that goal, an expected outcome will be a better understanding of the linkages between environmental hazards, ensuing human exposure, and potential health outcomes so as to better inform environmental and public health policies/decisions and improving the ability to assess the efficacy of such policies and decisions.

As a cornerstone of this collaborative commitment, EPA and HHS will take advantage of ongoing, cross-institutional initiatives to develop and link environmental health information sources, namely the EPA National Environmental Information Exchange Network (NEIEN) and the Centers for Disease Control and Prevention's (CDC) National Environmental Public Health Tracking Network (NEPHTN). The linkage of these two systems will utilize and enhance information technology tools to advance the analysis and dissemination of information obtained to various audiences. This joint effort between EPA and HHS also has the potential to increase environmental and health infrastructure and capacity at the local, state, and national level by coordinating and integrating electronic reporting of hazard, exposure, and health data. These collaborative efforts will also help define critical data gaps, accelerate research to develop, validate, and apply environmental and public health indicators to fill those gaps, and promote training and education opportunities, all of which will lead to further improvements in the linkage of networks.

HHS and EPA will work to share timely and reliable environmental and public health data to ensure informed decision-making and appropriate response to emergency situations. EPA and HHS will make every effort to ensure that activities conducted under this MOU and those conducted through other mechanisms are coordinated, non-duplicative, and supportive of a comprehensive environmental and public health program. This MOU is intended, therefore, to establish a substantive partnership between HHS and EPA by increasing interaction and enhancing collaboration between the organizations to best serve and maintain the public's health.

II. Background

There is no doubt that the environment plays a role in human development and health. Some links between environmental exposures and disease, such as asbestos and lung cancer or lead and impaired cognitive development in children, are well-documented. Others, such as a possible link between aluminum exposure and Alzheimer's disease are suspected, but still not proven.

The 1988 report of the Institute of Medicine on *The Future of Public Health* highlighted the separation of environmental health activities from public health, which has led to "fragmented responsibility, lack of coordination, and inadequate attention to the health dimensions of environmental problems." More recently, the need for a national environmental public health tracking network was documented by the Pew Environmental Health Commission in its January 2001 report *America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network*. The "gap" that this report describes is the lack of basic information that could document possible links between environmental pollutants and chronic and other diseases. The Pew report also indicates that the nation's preparedness against biological and chemical terrorism underscores the need for a strong tracking infrastructure that can rapidly detect and respond to disease outbreaks associated with terrorist acts.

Congress provided $17.5 million in the fiscal year (FY) 2002 budget for CDC to begin development of NEPHTN, including the development of environmental health capacity at state and local health departments. The goal of environmental public health tracking is to develop a surveillance system that can integrate environmental hazards data with human exposure and health effects data that have possible links to the environment. This system will allow ongoing monitoring and dissemination of information on environmental contaminant levels and health effect trends, facilitate research, and measure the impact of regulatory and prevention strategies. An incremental approach is necessary to develop a standards-based environmental public health tracking network that allows direct electronic data reporting and linkage within and across health effect, exposure, and hazard data. CDC will fund up to 15 states and two to three Centers for Excellence in Environmental Public Health Tracking in FY2002 to begin the steps necessary to develop the network. To achieve a nationwide network, CDC will need to work with all 50 states in developing environmental health capacity and comprehensive tracking programs.

For the last four years, EPA and the Environmental Council of the States have conceived and initiated development of NEIEN to improve the way that EPA, states, tribes, and territories exchange and manage environmental data. NEIEN promotes access to and exchange of quality environmental data while reducing reporting burden and increasing the efficiency of data exchanges. With the use of specified templates, exchange agreements, and common standards, NEIEN establishes a means for states and others to manage data to meet their needs while also meeting EPA's reporting requirements. NEIEN is expected to ultimately replace the traditional approach to information exchange that requires states to feed data directly into multiple EPA national systems. NEIEN will also facilitate transparent and secure data exchanges that support specific analyses, such as the use of indicators for measuring environmental results.

HHS and EPA recognize the importance of basing public health decisions on the best available science and increasing the science knowledge to address gaps that could influence public health decisions. Also, HHS and EPA recognize many benefits of interaction and collaboration that promote the exchange of scientific information, help identify science needs, and help direct scientific resources to the highest priority problems and opportunities.

III. Agreement

This MOU will serve to create a framework for developing and improving HHS and EPA's cooperative working relationships by taking collaborative action in support of both CDC's NEPHTN and EPA's NEIEN.

Focus of Collaborative Activities

HHS and EPA share a mutual interest in the following issues and will use this agreement to expand their cooperation. HHS, acting through CDC and the Agency for Toxic Substances and Disease Registry, and EPA will:

- Work together and with other federal, state, and local entities in partnership for collecting, developing, and interpreting interagency environmental and public health data.
- Collaborate on emerging e-commerce practices in an effort to share environmental and public health data between their networks. They will meet quarterly to discuss issues related to building, supporting, and maintaining NEPHTN and NEIEN.
- Collaborate on the development and validation of additional environmental public health indicators to better reflect environmental hazard, human exposure, and health outcomes and the linkages between these indicators.
- Work to share timely and reliable environmental and public health data from their respective networks to ensure informed decision-making and appropriate response to emergency situations.
- Consult and inform each other about the dissemination of results obtained through work carried out under this MOU to interested and affected parties.

IV. Programming, Budgeting, Funding, and Reimbursement Arrangement

A. All commitments that EPA and HHS undertake in this agreement are subject to the availability of appropriated funds.

B. This MOU is neither a fiscal nor a funds obligation document. Any transfer of funds between parties can take place through existing authorities.

C. Generally, any endeavor involving the federal funding of specific projects and activities will support activities at the state or local level following normal financial assistance, procurement, or other appropriate processes and shall be effected in writing by the representatives of the organizations involved.

D. This MOU in no way restricts HHS or EPA from participating in similar activities or arrangements with other entities or federal agencies.

E. Nothing in this MOU shall obligate HHS or EPA to expend appropriations, obligate funds, or enter into any grants, cooperative agreements, interagency agreements, contracts, or other agreements.

V. Authorities

A. The U.S. Department of Health and Human Services:
The Secretary of HHS has legislative authority under Section 301(a) of the Public Health Service Act (42 U.S.C. Section 241). the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9604(i), to cooperate with EPA regarding activities covered by this MOU.

B. The U.S. Environmental Protection Agency:
The Administrator of EPA has the legislative authority to cooperate with HHS regarding coordination of environmental activities between U.S. government agencies for EPA by EPA's general program cooperation and technical assistance authorities, e.g., Section 103 of the Clean Air Act, 42 U.S.C.

Section 7403; Section 104 of the Clean Water Act, 33 U.S.C. Section 1254; and Section 3001 of RCRA, 42 U.S.C. Section 6981, supplemented as appropriate by Section 102(2)(F) of the National Environmenta1 Policy Act 42 U.S.C. Section 4332 (2)(F).

VI. Administration of the MOU

HHS designates the following individual as the official point of contact for this MOU:

Name:	Julie Louise Gerberding, M.D., M.P.H.
Title:	Director, Centers for Disease Control and Prevention, and Administrator, Agency for Toxic Substances and Disease Registry
Address:	1600 Clifton Road, N.E., Mailstop D-14 Atlanta, Georgia 30333
Telephone:	(404) 639-7000

EPA designates the following individual as the official point of contact for this MOU:

Name:	Ms. Kim Nelson
Title:	Assistant Administrator, EPA Office of Environmental Information
Address:	Ariel Rios Federal Building 1200 Pennsylvania Avenue, N.W., Room 5000 (MC 2810A) Washington, DC 20460
Telephone:	(202) 564-6665

VII. Effective Date

This MOU will become effective upon signature by the Secretary of the Department of Health and Human Services and the Administrator of the Environmental Protection Agency and shall remain in effect through June 30, 2007, unless amended by mutual written consent of both parties, or canceled. This agreement, or any of its specific provisions, may be revised by signature approval of both parties. Either party may terminate this MOU upon 90 days written notice to the other party.

VIII. Other MOUs

There are no other superseding MOUs on this topic between the parties hereto.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

By: _____

Tommy G. Thompson
Secretary

U.S. ENVIRONMENTAL PROTECTION AGENCY

By: _____

Christine Todd Whitman
Administrator

Date: SEP 30 2002