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Human Exposure: The Key to Better Risk Assessment

For decades, the citizens of Libby, Montana, knew something was awry in their rural community. Every year, more and more residents were developing respiratory problems such as emphysema and mesothelioma. The problems often became fatal. In fact, by fall 2000, there were more than 190 such deaths by some estimates. Residents had long suspected a vermiculite mine, the town's chief employer for nearly 70 years, as the source of the maladies. Yet, no one knew for sure.

In November 1999, the federal government investigated. Besides vermiculite, the mine, which was shuttered in 1990, was found to have released tons of tremolite–actinolite into the environment during operations. Tremolite–actinolite, naturally occurring mineral fibers, are rare and highly toxic forms of asbestos, and exposure can manifest decades later in chronic respiratory diseases such as asbestosis, emphysema, and rare cancers.

As far back as the mid-1950s, state health officials had reported the presence of toxic asbestos dust in the mine, but no one had followed up to study possible exposures or health effects on the town's residents. According to investigators from the Agency for Toxic Substances and Disease Registry (ATSDR), the mine may be the most significant single source of toxic asbestos exposure in U.S. history.

Situations like the one in Libby reveal that there are serious flaws in the way the United States approaches environmental health. And monitoring of human exposure to environmental agents is often the weakest component of environmental health work, severely limiting risk assessment capabilities.

Across key government agencies, experts agree that current efforts to monitor human exposure to environmental agents are inadequate. Good data on the type, pattern, and magnitude of human exposures are in short supply. A series of recently released reports by private and public institutions support such assertions and, coupled with a rising incidence of chronic diseases from asthma to lupus, are spurring calls for systemic improvement.

Not Enough Data

"The bottom line in exposure tracking is that we know very little about what the public is being exposed to or the actual levels of the exposure." So concludes *America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network*, released in September 2000 by the Pew Environmental Health Commission at the Johns Hopkins School of Hygiene and Public Health in Baltimore, Maryland.

Exposure is the wasteland of risk assessment because we tend to rely on default assumptions when we don't have methodologies or information.

—Carol Henry
Vice President
of Science and Research
American Chemistry Council

Chemical exposures is one arena where data are sorely lacking. Together, the leading national exposure assessment surveys—run by the Department of Health and Human Services and the U.S. Environmental Protection Agency (EPA)—monitor exposure to a mere 6% of the 1,400 potentially hazardous high production volume (HPV) chemicals in common use, finds a May 2000 General

Accounting Office (GAO) report titled *Toxic Chemicals: Long-Term Coordinated Strategy Needed to Measure Exposures in Humans*. (With a total of 2,800 such chemicals, HPV chemicals are those that are produced or imported at volumes of one million or more pounds per year.) Moreover, states the report, the information obtained is often insufficient to identify smaller populations at high risk. To compound difficulties, no laboratory method has been developed for measuring concentrations of most chemicals in human tissues. Furthermore, even if measured accurately, would scientists know the significance of the measurement?

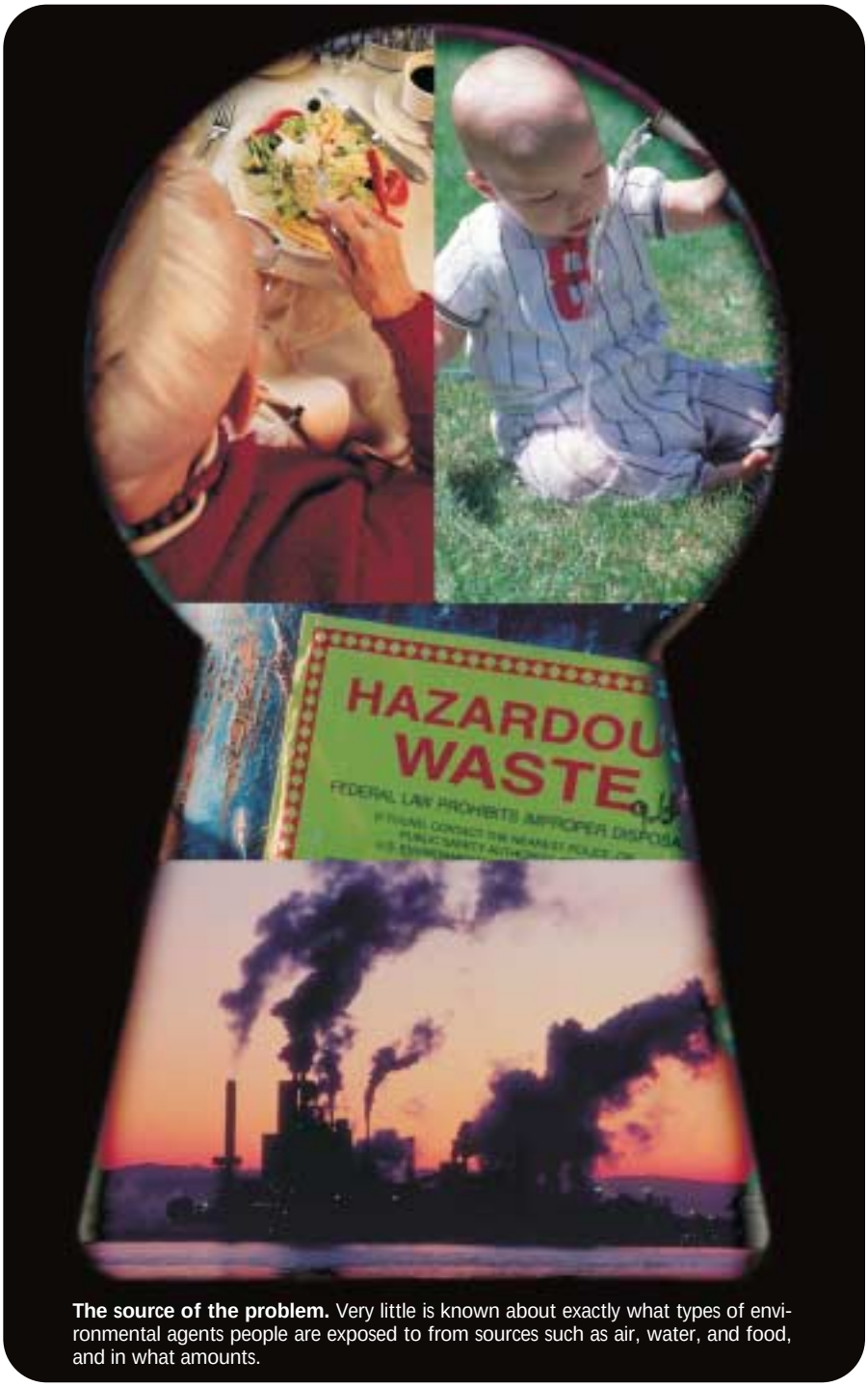
"Society spends an enormous amount of money on monitoring the environment—on water utilities alone we spend more than a billion dollars—but we have not adequately looked at exposures to the human population," says Richard Jackson, director of the National Center for Environmental Health at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.

Although some federal programs are seeing expansion, "there's a real lack of quality exposure information," says toxicologist Scott Masten, who heads the NIEHS Office of Chemical Nomination and Selection. "And without it, you can't put toxicology data in perspective, and thus you can't really say much about health risks."

Traditionally, estimates of human exposure to known or perceived environmental toxicants have been made on the basis of concentrations of agents found in air, water, and food. Assumptions are then made about how much gets into people's bodies. But such assumptions have often proven problematic. For example, explains Michael Kleinman, a professor of community and environmental medicine at the University of California at Irvine, "When we go from emissions data to exposure assessment, we are forced to use conservative assumptions and as a result are coming up with calculations that are alarming but are really only good guesses. In some cases," he says, "the actual exposures could be that high, but right now we could be alarming people unnecessarily."

The newly emerging field of exposure assessment strives to specifically determine who is exposed, how the exposure occurs—whether through inhalation, ingestion, skin contact, or other routes—and how much exposure occurs, and for how long and how often. Although the technology has not yet been widely applied, direct biologic monitoring of human exposure to chemicals has become increasingly accurate due to recent advances in molecular biology and analytic chemistry. "Today, unlike a decade ago, the technology has evolved to a point where researchers can do good exposure analysis," says Judith Graham, associate director of the EPA's National Exposure Research Laboratory in Research Triangle Park, North Carolina. But, she adds, "Exposure assessment is still tough to do." Adds EPA scientist Linda Sheldon, "We're somewhere between crawling and walking."

For starters, experts explain, the science of exposure assessment is complex. Multiple pollutant sources, pathways, time frames, and mixed and cumulative doses must all be factored in. And to do exposure assessment well, many disciplines must be integrated, including toxicology, epidemiology, and exposure analysis. Further complicating things, both financial and infrastructure resources are limited, as most U.S. environmental laws don't mandate exposure assessment. The number of people trained in exposure assessment is a limiting factor: Jackson's labs at the National Center for Environmental Health rely on roughly 70 scientists for their exposure assessment activities, and the ATSDR has only 9 investigators in its specialized exposure assessment unit.



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The source of the problem. Very little is known about exactly what types of environmental agents people are exposed to from sources such as air, water, and food, and in what amounts.

Today, exposure assessment is of interest to the public, industry, and researchers alike, especially as recognition grows that environmental factors—both chemical and socioeconomic—play a stronger role in cancer and other illnesses than previously thought. "Exposure assessment is very difficult, very complex, and very expensive, but probably what we should be doing more of," Masten says. Paul Lioy, deputy director of the Environmental and Occupational Health Sciences Institute in Piscataway, New Jersey, adds, "When we develop new regulations or call on current regulations, we need to invoke the concept of not only monitoring the environment but also trying to monitor exposure."

Sheldon acknowledges the steep price of good data, but notes that policies based on good exposure assessments can save billions of dollars. One the one hand, she says, harmful exposures can be minimized, preventing illnesses and reducing health care costs; on the other, knowledge that an exposure is not harmful can prevent unnecessary and expensive mandates for revising industry practices.

The CDC's Role

As one of the leaders in the field of exposure assessment, the CDC manages the National Health and Nutrition Examination Survey (NHANES), a broad-based snapshot of nutrition and health that now examines a new, nationally representative sample of 5,000 Americans each year. Exposure assessment is only one component of NHANES, however, accounting for about $5 million of the study's annual budget, Jackson explains.

NHANES has come a long way since 1960, when researchers at the CDC began periodically conducting interviews and making physical assessments of cohort participants, including collecting blood and urine samples for detecting everything from hypercholesteremia to diabetes. In 1976, researchers began measuring exposure to selected chemicals and banking the samples for future reference. In 1999, NHANES became an annual survey.

Previous iterations of NHANES ran 4–6 years, and researchers sometimes had to wait up to 10 years after data collection to gain access to results for the entire 6-year sample. Now that NHANES will be conducted on a yearly basis, researchers plan to release data annually beginning in 2002.

NHANES has already successfully helped policy makers create and evaluate intervention policies. For example, early survey data on blood lead concentrations provided the first clear-cut indication that Americans had too much lead in their blood, prompting Congress to enact policies to remove lead from gasoline. In turn, blood lead data gathered between 1976 and 1990 indicated that the ban on leaded gasoline had proven effective, Lioy says. NHANES data have also helped profile exposure to environmental tobacco smoke in support of smoking reduction measures.

The current NHANES effort tracks a broader range of environmental exposures than ever before. The results will offer new insights into individual exposure levels to over 100 substances, including metals, pesticides, and dioxins. Also on the NHANES agenda will be a broad range of contaminants from consumer products, dietary exposures, and industrial emissions. Yet, many public health practitioners would like to see NHANES expanded even more, according to Jim O'Hara, executive director of Health-Track, a new Georgetown University–based Pew Commission project to help establish a national tracking and monitoring system for environmental health.

NHANES has only limited utility for tracking exposures at the state and local level, however. The September Pew Commission report reveals that most public health practitioners are unable to address fundamental community concerns because of their limited means for measuring and evaluating actual levels of exposure. Many have outmoded equipment and information systems, and lack technical and lab support. Although 75% of public health practitioners do track blood lead concentrations, biomonitoring for other substances, including hazardous pesticides, is minimal. Only about one-quarter can measure human exposure to environmental contaminants by monitoring the air in a person's breathing zone, the Pew Commission report finds. And even when officials can collect data on internal exposures, says the GAO report, they often lack the knowledge and resources needed to interpret those data.

As part of the latest NHANES study, the CDC's National Center for Health Statistics is developing a smaller, more targeted survey called the Defined Population National Health and Nutrition Examination Survey. This survey will collect information that will be directly useful at the local and state level by offering feedback that can guide communities in protecting their residents. The survey will be conducted using small mobile examination centers to visit areas of interest and monitor a total of 2,000–3,000 participants.

At present, much of the CDC's work on exposure is focused on developing robust testing methods for detecting exposures in humans. The process for developing a test method for even a single chemical can be tedious and costly. "Sometimes it takes six months to figure out [a detection method]," Jackson says. And usually there is no help from the commercial sector, as there is little industrial need or economic incentive to develop these types of tests, which can often detect concentrations in the parts-per-billion, -trillion, and even -quadrillion range in small samples of less than 10 milliliters. "The ability to measure many toxic agents in extremely small specimens is not merely an acrobatic feat of technical virtuosity but in fact critical," Jackson says—otherwise, actual exposures may go undetected.

The CDC is also developing methods to detect exposures in real time, to evaluate evanescent exposures (those that wash out of the body relatively quickly), and to handle high volumes of samples efficiently. Currently, researchers must often rely on subjects' memory—which is frequently inaccurate—to gauge exposures. Better human exposure assessment will bring new precision and power to environmental studies, Jackson says, and help public health practitioners get services to the individuals who need them most.

In winter 2000, the CDC plans to release the first National Exposure Report Card. The report card will list levels of different toxicants in the population at large, measured either directly or through study of metabolites. The first report card will assess 25 substances in 3,000 individuals enrolled in the current NHANES. Blood concentrations of metals such as lead, mercury, and cadmium, as well as cotinine, a marker of exposure to tobacco smoke, will be measured. In a smaller group of about 1,000 study participants, urine concentrations of organophosphate and phthalate metabolites and other substances will be studied. By 2003, the report card will be expanded to 100 chemicals and could eventually monitor even more, says Julie Fishman, a CDC health policy analyst.

The CDC's National Institute for Occupational Safety and Health (NIOSH) is also planning a new initiative to better characterize occupational exposure through a national, cross-sectional, on-site survey of establishments and workers. The new survey will include industry sectors covered by the Occupational Safety and Health Administration and the Mine Safety and Health Administration. (For example, worker exposure to cellulose insulation and to asphalt fumes are two areas already under evaluation in an interagency collaboration between NIOSH and the NIEHS.) With input from the NIEHS and other federal agencies, the survey will build upon NIOSH projects such as the National Occupational Exposure Survey and the National Occupational Health Survey of Mining to develop an occupational exposure database.

The EPA and Exposure Assessment

While the CDC uses NHANES to tell researchers whether exposure to a particular chemical has occurred and how many people have been exposed, the EPA strives to understand the population distribution of exposure

for environmental pollutants, with a focus on susceptible populations, through a variety of exposure measurement studies. The EPA is also working to identify the sources and pathways of excessive exposures so that the sources can be controlled.

The National Exposure Research Laboratory has been working for over a decade to develop the tools and framework for the National Human Exposure Assessment Survey (NHEXAS). NHEXAS is a geographically based exposure measurement program designed to provide information on the magnitude and extent of populations' exposures via air, water, soil, and food, and to inform the risk assessment and risk management processes established to protect public health.

In the early 1990s, to evaluate the feasibility of such a survey and generate data on the levels and determinants of exposure, an interagency pilot study program for NHEXAS that included the EPA, the CDC, and the Food and Drug Administration was begun. The pilots are population-based surveys of some 460 people in three geographic areas in the United States. Exposure monitoring data have been collected for metals, pesticides, volatile organic compounds, and other chemicals—about 46 agents in all. Researchers have measured the agents in the air people breathe, the foods and beverages they consume, and the soil and dust in and near their homes, Graham says. Blood and urine samples have been scrutinized for trace chemicals, and the participants have also filled out questionnaires to identify exposure sources and behaviors that could affect exposure. To date, the NHEXAS pilots have cost about $20 million.

The NHEXAS pilots have clearly advanced the nation's ability to measure individual exposures to environmental pollutants. They provide the largest multimedia, multipathway, multichemical database of its kind, Graham says. But the project, intended only as a pilot, naturally falls short of current demands. By design, the NHEXAS pilots are cross-sectional, not longitudinal, which means they can't track trends in population exposure, the GAO report observes. Moreover, the project only covered certain pollutants in three geographic areas.

Perhaps the most important limitation of NHEXAS, the GAO report says, is that initial funding was inadequate to complete a full analysis of findings and make data available to researchers, policy makers, and the public. Finally, NHEXAS is not linked to any ongoing health surveillance because steps to establish a direct linkage between environmental exposures and health were not included in the design. To complete a national exposure survey that would include such links, the EPA estimates a cost of $30 million a year for a decade or more.

NHEXAS is just one of the EPA's tools to better understand the exposures faced by the American public. The agency's Border XXI studies seek to quantify hazardous exposures for children living along the U.S.–Mexico border, placing an emphasis on pesticide exposures. The Children's Total Exposure to Pesticides and Other Persistent Organic Pollutants study, the first large multipollutant, multimedia study of young children, is characterizing exposure pathways in more than 250 children ages 2–5 in homes and day care centers. The Pesticide Exposure Study, a large interagency epidemiologic collaboration, is assessing pesticide exposure factors among men and women in agriculture participating in the Agricultural Health Study. And the Particulate Matter Exposure Studies are looking at sources and variability of exposures to particulate matter in different subpopulations, including the elderly, those with cardiopulmonary disease, and African Americans. To date, these studies have monitored about 150 people in various areas of the country, representing various air sheds and housing structures, for more than 2,000 person-days.

The National Exposure Research Laboratory also works with the EPA's National Health and Environmental Effects Research Laboratory, also located in Research Triangle Park, to link exposures to health outcomes. Such information is critical for populations who are more sensitive to chemical exposures or more likely to have high exposures, Graham says. The elderly and children, for example, may be harmed by low-level exposures that pose no risk to the general population. Individuals who are genetically more susceptible or immunocompromised may also face a greater risk. The concentration of exposure, however, can also be a factor in the development of disease among the population at large.

A major use of the EPA's data is to develop scientifically sound exposure assessment techniques for application in the risk assessment process. "Exposure monitoring data are also indispensable for the success of epidemiologic research, to determine the status and trends of exposures in populations, and for the development and evaluation of risk management activities," Sheldon says.

Graham acknowledges that progress in deciphering NHEXAS data has been slow. "The data analyses from NHEXAS are very fresh," she says. "They have not been available long enough to be used directly by the EPA." But Graham expects to see increasing use for risk analysis tools as more analyses are completed. So far, more than 20 published articles have resulted from the study.

Application of NHANES data to risk assessment has been improving steadily, and more data are being factored in to analyses that characterize risk. Most experts agree, however, that overall the federal sector needs to improve communication of exposure assessment data to the public. Besides taking a long time—sometimes years—to disseminate study results, many agencies need to work on packaging the data for the public. "Oftentimes, the data that are released are not put out in a way people can interpret well," Kleinman says. For example, in the past, charts that have been released relay information about hazards only and fail to represent actual exposures, needlessly alarming communities. "We need to do a better job of communicating risk for an area," says Kleinman.

Moreover, the information has to be what the public wants. Often, the public wants information that is different from what scientists are interested in. "We need to make sure the community is involved in decisions [regarding research directions]," Masten says. "This is not just about scientists in a vacuum."

Federal and public health researchers alike believe the utility of both the NHANES and NHEXAS data sets would be substantially improved if more emphasis were placed on collecting long-term exposure data and understanding childhood exposures. Ideally, EPA and Department of Health and Human Services administrators would like to initiate a birth cohort and children's longitudinal study analogous to the Framingham Heart Study, which has followed cardiac health in a New England cohort for the past 42 years. This ideal study would use noninvasive monitoring methods (such as urine sampling), which can greatly enhance the success of such studies, because it is easier to recruit and retain children for study without the threat of frequent needle sticks. In addition, noninvasive procedures allow for more frequent collection of data.

Pulling In Other Agencies

In 1996, the NIEHS joined in and began conducting more focused activities in the human exposure arena. In collaboration with the CDC, the institute developed the Human Body Burden Project, collecting human exposure data to study human tissue concentrations of environmental contaminants including hormonally active agents commonly called endocrine disruptors. The project is part of the institute's larger human exposure assessment initiative, which is designed to help prioritize chemicals for further toxicity and carcinogenicity testing and to aid in the interpretation of National Toxicology Program toxicity studies by assessing actual human exposure levels, says Masten.

Each year, the National Toxicology Program can evaluate only 10–20 of the approximately 85,000 chemicals in commerce, so prioritization is essential. The National Center for Environmental Health

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Extracting information. New methods are being devised to monitor the levels of environmental contaminants such as chemicals, metals, and biological agents in people's bodies.

conducts the lab measurements for these studies, which have covered roughly 80 chemicals to date. So far, most of the 200 human tissue samples used for the studies were collected as part of NHANES. Studies are currently under way to better understand exposures to phytoestrogens (estrogen-like chemicals that occur naturally in many plants and fungi) and phthalate esters (commonly used plasticizers). Herbal medicines and drinking water disinfection by-products are potential areas for further study under the National Toxicology Program.

In addition to working with the CDC, the NIEHS conducts numerous epidemiologic and clinical studies exploring the relationship between exposures and disease. The NIEHS shares the EPA's goals of documenting exposures in children, identifying potentially sensitive subpopulations, strengthening the interpretation and use of animal toxicity data, and refining risk assessments. Other objectives include studying relationships between health disparities and fiscal disparities, and establishing links between exposure assessment data and the NIEHS Environmental Genome Project, says Masten.

Meanwhile, the ATSDR conducts limited exposure investigations, mainly carrying out biomonitoring of hazardous waste sites for the EPA. The ATSDR also studies environmental exposures at the request of communities. Currently, the agency's staff of 70 are working on about 55 projects, more than half of which involve exposures stemming from Superfund sites, reports Sharon Campolucci, the ATSDR deputy director of health services. The assessments appraise a few thousand self-selected participants for manifestations of disease, occupational history, and exposure history.

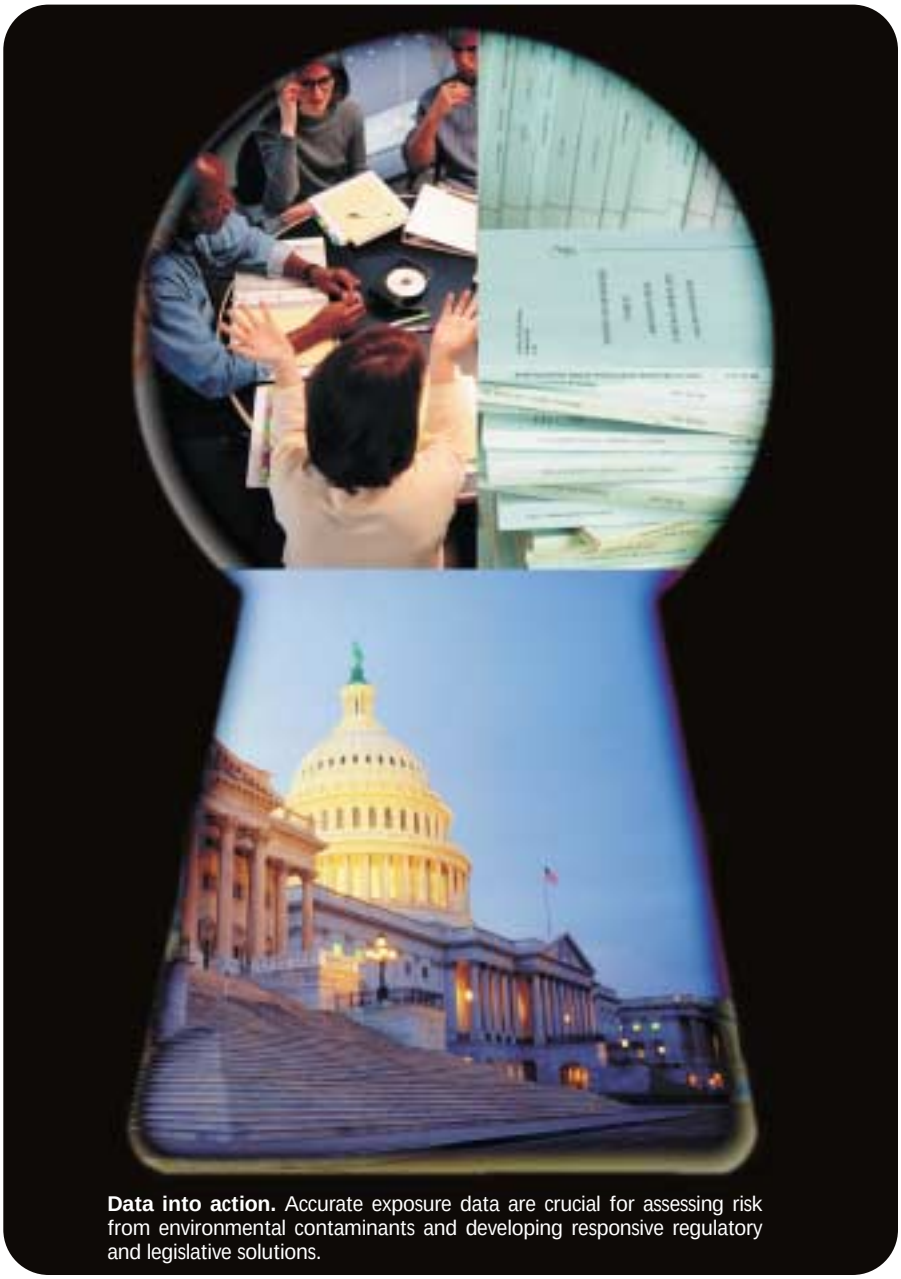
In 1995, the ATSDR created an exposure investigation section within its Division of Health Assessment and Consultation. Its investigations typically entail collecting biologic samples, conducting personal monitoring for site-related contaminants, and analyzing environmental data. Although the studies have proven useful for community outreach and intervention, they generally involve fewer than 100 volunteers and are not intended to be generalized to larger populations. So, although such studies are valuable to the people they study, they will not significantly help fill in the exposure assessment gap on the national level.

Other pockets of exposure assessment, though smaller in scale, are scattered across several agencies. For example, the Food and Drug Administration's National Center for Toxicological Research in Jefferson, Arkansas, is developing animal testing methods to improve exposure assessment. And the Consumer Product Safety Commission also runs its own lab and does periodic exposure assessments on adults related to specific product testing.

Spreading such investigations across agencies plays to the expertise of different programs, but it also means exposure assessment research is quite disjointed. For example, data on exposure to a given chemical in soil may reside with one agency, while data on exposure to the same chemical in water reside with another, and air exposures with yet another. In large part this is because assessments are often made in response to mandates and regulations. Still, Lioy says, "We need better coordination across agencies for how exposures match up for air, soil, water, and food."

In fact, the nation's need for a coordinated federal strategy for monitoring human exposures to potentially toxic chemicals is the chief finding of the GAO report. Such a strategy should link data collection efforts with agency goals, needs, and expertise, as well as identify at-risk populations and factor in states' informational needs, the report says.

The findings came as no surprise to environmental health practitioners and officials, who have been working to coordinate interagency efforts for years. In the mid-1990s, the National Science and Technology Council's Committee on Environment and Natural Resources made integrating and coordinating environmental monitoring and research networks and programs across federal government a priority. The committee recognized that many such programs had single-agency or single-resource focuses, and that chief among such programs were exposure assessment initiatives. Last fall, the Committee on Environment and Natural Resources advocated creating an



(Clockwise from upper left) PhotoDisc, Arnold Greenwell, Corbis

Data into action. Accurate exposure data are crucial for assessing risk from environmental contaminants and developing responsive regulatory and legislative solutions.

interagency coordinating body for exposure assessment, and an informal committee is already being assembled.

Despite the realization that interagency cooperation is crucial to accurate exposure monitoring, progress has been slow until this fall. In response to the concerns outlined in the GAO report, the Department of Health and Human Services and the EPA have created an informal group to coordinate agency activities, and a formal coordinating committee is to be named soon, Graham says.

Industry Lends a Hand

Industry, too, is evolving in terms of human monitoring, changing both its role and its image. The Rosslyn, Virginia–based Chemical Manufacturers Association recently took a new name: the American Chemistry Council (ACC). With the new moniker come new and strengthened initiatives, including several targeting human exposure assessment and improving communication of study data. For example, this fall the ACC began funding for a comprehensive chemical exposure framework designed to characterize people's exposures to chemicals and reduce the guesswork involved in quantitative estimates of exposure.

"Exposure is the wasteland of risk assessment because we tend to rely on default assumptions when we don't have methodologies or information," says Carol Henry, vice president of science and research at the ACC. "When it comes to the Toxics Release Inventory [the EPA's accounting of the chemicals released into the environment by industry]," she says, "there is a tremendous amount of uncertainty revolving around what the actual health impacts are, and it will take a huge amount of work to fix that."

This year, the chemical industry launched its Long-Range Research Initiative (LRI) as part of a $1.2 billion ACC research campaign to boost public confidence in chemical manufacturing. The program will be cofunded by the European Chemical Industry Council and the Japan Chemical Industry Association. The International Council of Chemical Associations will help oversee the project.

The LRI strives to study how chemicals act in the human body and the environment, and to develop new testing and screening tools to support risk assessment in order to produce better scientific data and influence policy making in 10 key areas, including exposure assessment. Risk assessment, respiratory toxicology, endocrine modulation, chemical carcinogenesis, endocrine modulation, immunotoxicology, ecotoxicology, neurotoxicology, and the health effects of HPV chemicals are also among the research priorities, according to Henry.

The Chemical Industry Institute of Toxicology in Research Triangle Park will conduct much of the research for the ACC, although university research will also be included. Funding, the bulk of which comes from the ACC, will run about $20 million a year through 2003, and then increase to about $25 million annually, Henry says. Before any LRI projects begin, the Chemical Industry Institute of Toxicology will seek external review of each project by researchers at academic and federal institutions, including the EPA and the National Institutes of Health.

In another project, as part of improvements to its 12-year-old Responsible Care initiative, the chemical industry also plans to conduct voluntary screening tests to determine potential health and environmental effects of 2,000 of the roughly 2,800 total HPV chemicals, according to Larry W. Rampy, leader of the ACC product stewardship team. The voluntary program is largely the result of a 1997 challenge by Environmental Defense (formerly the Environmental Defense Fund) to make adequate risk data publically available. The goal is to complete testing of the 2,000 chemicals by 2004 at an estimated cost of $300–500 million. Testing on some 1,000 chemicals should be completed this year, provided ongoing conflicts with animal rights activists who object to using animals as test subjects are ironed out, Rampy says.

The Organisation for Economic Cooperation and Development established a cooperative international program for screening HPV chemicals a decade ago, but little progress was made until recent years. To date approximately 500 HPV chemicals have been tested under this program. In 1998, Vice President Al Gore unveiled the Chemical Right-to-Know Initiative, which included a challenge to voluntarily complete screening information data sets on the 2,800 HPV chemicals or face mandatory testing under the Toxic Substances Control Act. A voluntary testing arrangement, the EPA's HPV Challenge Program, was developed by the ACC, Environmental Defense, and the EPA. Although the EPA plans to mandate tests for HPV chemicals if industry doesn't volunteer, the regulations haven't been promulgated yet.

The ACC is also working to improve communication of available environmental, health, and safety data, largely to comply with federal rules. In March 2000, 14 chemical firms and associations, including the ACC, formed the Alliance for Chemical Awareness to disseminate chemical data to the public. Initially, the alliance will focus on chemicals being tested as part of the HPV Challenge Program. The alliance is seeking more involvement from government and academic stakeholders. However, disputes continue between the EPA and the ACC over exactly how information should be disseminated—the EPA intends to make all HPV testing data public, while many chemical companies fear that risks could be mischaracterized by environmental groups. The ACC is also in the process of developing an electronic tracking system that will allow the public and test sponsors to follow progress in the HPV testing program via the Internet.

Federal Tracking Improvements

Will the next exposure-related crisis be caught earlier than the Libby situation was? It's hard to predict.

Current disease tracking efforts are sketchy at best. Most states don't track autoimmune diseases such as lupus, endocrine and metabolic disorders such as diabetes, neurologic conditions such as migraines and multiple sclerosis, or developmental disabilities such as autism, cerebral palsy, and mental retardation, despite the fact that all are on the rise. Less than half of states track asthma cases.

One of the leading ideas for plugging gaps in the environmental health body of knowledge is the creation of a national health tracking network. Proponents, which include Pew Commission researchers and more than a dozen national public health organizations such as the American Cancer Society and the American Public Health Association, contend that such a system would help link diseases with exposure, and exposure assessment with disease etiology, disease prevention, and genetic vulnerability to environmental agents. This would, in turn, protect Americans from often fatal or debilitating chronic diseases. Estimates for creating such a network run to about $275 million.

The idea of building a network has already attracted some attention from Congress and the White House. In July 2000, Gore told the Children's Environmental Health Network that he supported the establishment by 2004 of a national tracking system for asthma, cancer, and other diseases afflicting children that are potentially linked to environmental causes. The system would use the Internet to facilitate information collection by local public health agencies and health care providers, which would help focus efforts to address environmental health risks.

Such a network might have mitigated the tragedy in Libby. "Active tracking of environmental disease might have picked [the disease cases] up much sooner, and started preventive activities decades earlier," says Campolucci. "We need an environmental surveillance system that evaluates human health." Adds O'Hara, "All too often we haven't had all the exposure information we need to make good policy." But better coordination and expansion of human exposure assessment programs at the federal level and by industry should help fill the gaps, leading to better policies—and healthier people.

Julie Wakefield