The Link between Disparity and Disease

It's no mystery to scientists and medical professionals that all diseases are not created equal in all population groups—disproportionately high numbers of people in certain ethnic and socioeconomic groups suffer from certain illnesses such as heart disease, obesity, and cancer. Scientists do puzzle, however, over the complex interplay of biological, social, environmental, and even economic factors that appear to influence the rate of disease in a susceptible population. In an effort to understand these health disparities better—and to reduce and, hopefully, eventually eliminate them—the NIH recently established eight Centers for Population and Health Disparities.

"Today, people in this country of various backgrounds, ages, or socioeconomic levels bear an unequal burden of disease. These centers will perform innovative research, collaborating extensively to address the important and complicated issue of health disparities," said NIH director Elias A. Zerhouni upon the formal announcement of the centers' launch.

Over five years, four NIH entities—the NIEHS, the National Cancer Institute, the National Institute on Aging, and the Office of Behavioral and Social Sciences Research—will funnel $60.5 million toward transdisciplinary research efforts to explore how the social and physical environment, behavioral factors, and biological pathways interact to influence human health and cause disease in certain populations. Together, the eight centers will collaborate with community partners who will help plan and carry out research on conditions including obesity, cardiovascular disease, mental health, gene–environment interactions, psychosocial stress, and breast, prostate, and cervical cancer.

The centers will address recommendations made in numerous recent reports from the National Academy of Sciences and the Institute of Medicine calling for research efforts that integrate multiple levels of analysis of biological pathways of disease as well as social and cultural influences. Rather than focus on individual participants, center investigators will study disease causes and health interventions among specific population groups within the environment in which they live, focusing on low-income whites, blacks, Hispanics, and the elderly. "It's a novel paradigm for looking at disease and health outcomes in specific populations," explains Fred Tyson, a program administrator in the NIEHS Susceptibility and Population Health Branch who has coordinated the effort to establish the new research centers.

"We know that multiple factors are at play in determining the risks of groups and individuals for various diseases and [health] conditions," says J. Michael McGinnis, senior vice president and director of the Health Group of the Robert Wood Johnson Foundation in Princeton, New Jersey, who has experience in interdisciplinary research. Many factors conspire to determine the expression of a genetic predisposition to disease in an individual. "Characterizing and understanding the profiles of the biological, the behavioral, the environmental, and the social circumstances—and how they interact—requires the skills of multiple disciplines," McGinnis explains.

Created unequally? New NIH centers will look at issues of population and health disparities.

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Although some research institutions have attempted to foster interdisciplinary work in the past, such collaboration, McGinnis explains, is "not a natural act for scientists and institutions. The multi-institute, multi-year commitment is a strong signal that our progress [toward] really understanding the forces that forge differences among groups and individuals depends on a broader analytic framework."

The centers and their planned projects are as follows:

Researchers from The Ohio State University in Columbus and the University of Michigan in Ann Arbor hope to increase early detection of cervical cancer in Appalachian women by boosting the proportion of these women who receive regular Pap tests and follow-up care.

RAND Corporation investigators based in Santa Monica, California, will team up with several Los Angeles–area community organizations to study whether park improvements positively impact the physical activity and health of local residents, primarily Latinos.

In Boston, researchers from Tufts and Northeastern Universities will study how specific stressors affecting older residents of Puerto Rican descent may lead to poor health outcomes in that population group.

A team of researchers from the University of Chicago and Nigeria's University of Ibadan will employ animal models to determine if social isolation and high stress levels among black women of African descent increase the risk of early, lethal breast cancers.

A team from the University of Chicago and the Healthcare Consortium of Illinois will study the effects of social context on the stage at which breast cancer is diagnosed.

At the University of Pennsylvania in Philadelphia, researchers hope to transform attitudes and beliefs about prostate cancer among black men that may prevent this high-risk population from being diagnosed while the cancer is still treatable.

Investigators at The University of Texas Medical Branch in Galveston will study the relationship between neighborhood environment and measures of health in Hispanic populations.

At Wayne State University in Detroit, Michigan, researchers hope to better understand salt sensitivity in blacks who are at high risk for developing hypertension and cardiovascular disease by studying the effects of stress, obesity, and genetics on oxidative stress and salt sensitivity.

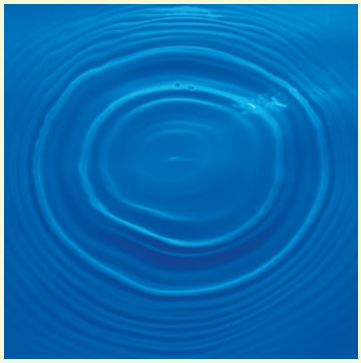
The centers will have strong elements of community involvement and partnership, bringing the results of these scientific endeavors directly to the populations being studied and providing health education and outreach. According to Tyson, the community-based component of these research projects will be critical to their success: "If you translate the results of biomedical research and make it accessible to the public, you make an impact on public health," he says. "You have a better opportunity for a faster payoff in the community." **–Jennifer Medlin**

Environmental Knights of the Roundtable

Water: A Paradigm for Protection

Protecting the nation's water supply is an ever-changing challenge—and one that requires new paradigms, according to participants at the October 2003 workshop From Source Water to Drinking Water: Emerging Challenges for Public Health, sponsored by the Institute of Medicine's Roundtable on Environmental Health Sciences, Research, and Medicine. "The need for creative thinking and innovation in drinking water science, policy, regulation, and legislation has never been greater," said Frederick Pontius, president of Pontius Water Consultants, which advises water utilities, industry, businesses, and regulatory agencies.

The workshop, the fourth in a series on a variety of environmental health topics, focused on identifying issues critical for protecting the water supply at all stages, from the water in our aquifers to the cool drink coming from the kitchen tap. Speakers and participants identified environmental areas—including the natural, built, and social environments—that impact the nation's ability to ensure safe water. Urban sprawl, rapid population growth, non–point source pollution, and unregulated contaminants were noted as key emerging challenges. Other difficult issues include protecting sensitive subpopulations, achieving sustainable water systems, providing affordable drinking water for systems that supply a single house or development (as opposed to a whole community), and controlling emerging waterborne pathogens.



Critical Gaps

The Safe Drinking Water Act and Clean Water Act have made significant progress toward safeguarding the nation's source and drinking water, but as these pieces of legislation have evolved through reauthorizations and amendments since their enactment in the 1970s, gaps have arisen in the infrastructure. The lack of coordination between the acts' targets, approaches, and regulatory framework have resulted in public health being neglected, said Joan Rose, Homer Nowlin Chair in Water Research at Michigan State University.

For example, planning of integrated watershed protection efforts is supported under the Safe Drinking Water Act, which is aimed at controlling key pathogenic waterborne microorganisms using a risk assessment approach including concerns for sensitive populations. However, enacting the tools for implementing such controls—such as permitted discharge limits and total maximum daily loads (how much of a particular pollutant a water body can assimilate without violating state water quality standards)—fall sunder the Clean Water Act.

Gaping holes exist in monitoring of contaminants, especially pathogens. "Fundamentally, we're in crisis," asserted Jeffrey Griffiths, an associate professor of family medicine/community health and of medicine at Tufts University. The United States has no ongoing, national-scale epidemiologic surveillance, he says, only scattered individual projects. "In terms of drinking water, the monitoring that is going on is extremely limited," he said. "We're just looking at basic quality indicators. We essentially . . . don't know what is going on."

There is a real need to seek out integrating themes to revamp disjointed policies and management practices. "We need to develop an integrated view of water management issues and water quality resources," said Paul Schwartz, national policy coordinator for the citizen advocacy group Clean Water Action.

Outdated Paradigms

Participants agreed that the research and regulatory communities are operating with old ways of thinking about water supply, management, and policy. Societal changes such as the migration of people out of urban centers are driving development patterns that create new public health risks in areas where planning or authority may be insufficient, said Douglas Hall, manager of watershed initiatives at Ohio's Miami Conservancy District, a political subdivision formed to address water concerns. For example, the proliferation of individual septic systems in expanding outer suburbs presents unchecked new risks, such as overflowing into wells or contaminating groundwater. Comprehensive land use planning must address sustainability of water resources, Hall said, and public health risks associated with the development patterns of the last three decades must be better understood.

New scientific methods for studying health risks in the population, advanced monitoring, and analysis are also needed to protect the water supply. Currently, 80% of U.S. waterborne disease outbreaks go uncharacterized, Griffiths said. "We don't know the sources of them."

Water treatment approaches also need updating to keep in step with emerging microbial threats such as hepatitis E virus. "Conventional treatment did the trick in 1910, but it doesn't do the trick right now," Griffiths said. Not only does conventional water treatment not remove all risk of pathogen transmission, but 99% removal or inactivation is not good enough for some threats, for which the remaining 1% can still cause health problems. Although there are technologies that can remove or inactivate 100% of contaminants in water, such technologies are costly or impractical for now, Griffiths said. He believes developing inclusive technologies—for example, methods to kill everything in the water that contains nucleic acids—are the way to go.

Moreover, existing models are not good at water quality forecasting, said Ken Reckhow, director of the Water Resources Research Institute of the University of North Carolina. Scientists currently don't have the data or tools necessary to test with any reasonable level of reliability how land use control or restrictions or watershed activities affect concentrations of water contaminants.

Policy and the People

Setting clear research priorities is another thorny problem. Many critical research questions remain to be answered, such as at what level concentrations of different compounds present an unreasonable health risk. "I'm not sure we actually know which stressors are more important. And trying to decide where to put our research dollars is one of the more difficult issues that we have," said Cynthia Dougherty, director the Environmental Protection Agency Office of Ground Water and Drinking Water.

But in the end, successfully communicating research results may be the most important factor in changing water use behaviors and conservation practices. "The science has to be understood and put into action by average people as well as the experts. We need to see the public as a vital resource and force for positive change," said Susan Seacrest, president of The Groundwater Foundation, an education and advocacy group. Even if the public is reluctant to accept such radical notions as drinking recycled wastewater, they need to start appreciating that, over time, water really is not an unlimited resource. Said James Crook, a Boston water reuse consultant, "Water is greatly undervalued and subsequently underpriced as to what it's worth overall." **–Julie Wakefield**

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beyond the BENCH

Cyber Schoolhouse Rocks!

Getting high school kids to read about science can be a challenge at best. Many consider the topic boring, hard to understand, or irrelevant to their daily lives. But now teachers, physicians, researchers, and web designers have worked with the Community Outreach and Education Program (COEP) of the NIEHS Environmental Health Sciences Center at Detroit's Wayne State University to develop a way to reach teenagers through one of their favorite media—the Internet—and package environmental science information in creative ways that students can get excited about.

The Environmental Cyber Schoolhouse, located online at **http://www.cyberschoolhouse.org/**, is a set of interactive, web-based curricular units geared toward students in grades 9–12. On the site, students can choose one of two "quest" scenarios through which they can help characters confront an environmental problem and return to good health, much like an engaging video game. The Health Quest addresses the issue of lead poisoning through a character named Maria who visits a health fair with her mother and takes a variety of medical tests to tell if she has been exposed to dangerous levels of lead. The Sports Quest delves into asthma through a teenage basketball player named Charlie who begins to have breathing problems while exercising. Students must follow the story lessons in a linear fashion and successfully complete each chapter quiz before moving on to the next chapter.

To incorporate the Cyber Schoolhouse into their curricula, teachers must attend an online class offered as a regular course in environmental health through Wayne State or an in-person workshop given by the COEP staff. After learning about the curricula, teachers may register their student group online and are given login codes for their students. They then also have access to teacher's notes and a discussion forum where they can exchange information with other educators. A Teacher Administration area allows them to check on their students' progress, download various

Environmental Cyber Schoolhouse

files, post questions on the discussion forum, and visit any chapter. To date, 112 teachers have been trained to use the Cyber Schoolhouse, and about 1,300 students have used the website in their classrooms.

Guest visitors to the site who are not teachers or students can access a selection of topics and downloadable articles from each quest lesson as well as a list of additional online and other resources on lead poisoning and asthma.

Reaction from teachers to the interactive site has been positive. Says one, "The students play an interactive role in the entire process, from the start of the problem to solving the problem in the end. Incorporating real labs along with the virtual labs and streaming videos not only refines the students' skills, but allows them to see the entire process instead of just being told the results. The graphics, pictures, animations, and explanations made it easy to understand and grasp concepts that would be very difficult to explain in a book or a lecture." **–Kimberly G. Thigpen**

Headliners | Respiratory Disease

NIEHS-Supported Research

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Mold Exposure in First Year of Life May Lead to Asthma

Belanger K, Beckett W, Triche E, Bracken MB, Holford T, Ren P, McSharry J, Gold DR, Platts-Mills TAE, Leaderer BP. 2003. Symptoms of wheeze and persistent cough in the first year of life: associations with indoor allergens, air contaminants, and maternal history of asthma. Am J Epidemiol 158:195–202.

Asthma clinicians and researchers have reported a substantial rise in the prevalence and severity of asthma in children over the past decade. Genetic predisposition and exposure to various environmental agents, such as environmental tobacco smoke, endotoxins, and indoor allergens, especially during early childhood, have been reported as risk factors for the development of sensitivities to inhaled allergens and the development and exacerbation of asthma. NIEHS grantee Brian P. Leaderer of the Yale University School of Medicine and colleagues at the University of Rochester, Brigham and Women's Hospital, Harvard Medical School, and the University of Virginia Medical Center recently investigated exposures to indoor allergens as well as other air contaminants as they affected asthma development in a birth cohort study.

The team enrolled mothers delivering babies in four Connecticut hospitals and one Massachusetts hospital who already had a child under the age of 11 with a diagnosis of asthma. This high-risk cohort ensured that a sufficient number of index infants would develop asthma for subsequent analyses. In 849 infants born to these mothers, the team measured a number of indoor exposures related to dust mites, cockroaches, cats, dogs, gas stoves, wood-burning stoves, and mold. They also measured indoor levels of nitrogen dioxide, which has been linked with asthma exacerbation in children.

The team used questionnaires and measured airborne cultural spores to study the association between these exposures and the development of wheeze and cough by 12 months of age. A strong association was found for mold, and a modest association was found for cockroaches in children whose mothers had asthma. Among children of mothers without asthma, none of the allergens were associated with persistent cough or wheeze, although exposure to mold and use of a gas stove were significantly related to persistent cough.

This is the first study to simultaneously measure early childhood exposure to both indoor allergens and other air contaminants. A few additional studies have shown a link between the risk of a child developing asthma and maternal asthma history. The current findings suggest potential differences in susceptibility to these exposures for children, regardless of whether the mother has asthma. They also suggest that these differences in susceptibility are genetically based, making some children more sensitive to specific environmental agents. The overall results of the study suggest that early mold exposure may increase the risk of asthma.

These findings should be interpreted carefully because of the poor predictability of early wheeze and cough in asthma development. Continued research into specific gene–environment interactions may help to elucidate the cause of these differences. **–Jerry Phelps**