Building Self-Reliance in Environmental Science: The ITREOH Experience

As globalization of industry and commerce brings forth the need for international collaboration to ensure public health worldwide, the NIH is responding by supporting programs such as the International Training and Research Program in Environmental and Occupational Health (ITREOH). Under ITREOH, scientists from developing countries are trained to deal effectively with environmental and occupational health problems through epidemiologic research, environmental monitoring, engineering controls, and prevention research. Training formats vary in length of time and in the combination of didactic and practical technical experience that they provide. And although the scientists may receive training in the United States, the research is conducted almost exclusively in the trainee's home country.

This program is funded collaboratively by the John E. Fogarty International Center, the NIEHS, the National Institute for Occupational Safety and Health, the Agency for Toxic Substances and Disease Registry, and the Centers for Disease Control and Prevention. The program, established in 1995, honors the memories of the late Irving Selikoff of the Mount Sinai School of Medicine and Norton Nelson of New York University, who dedicated their lives to training professionals in occupational and environmental careers.

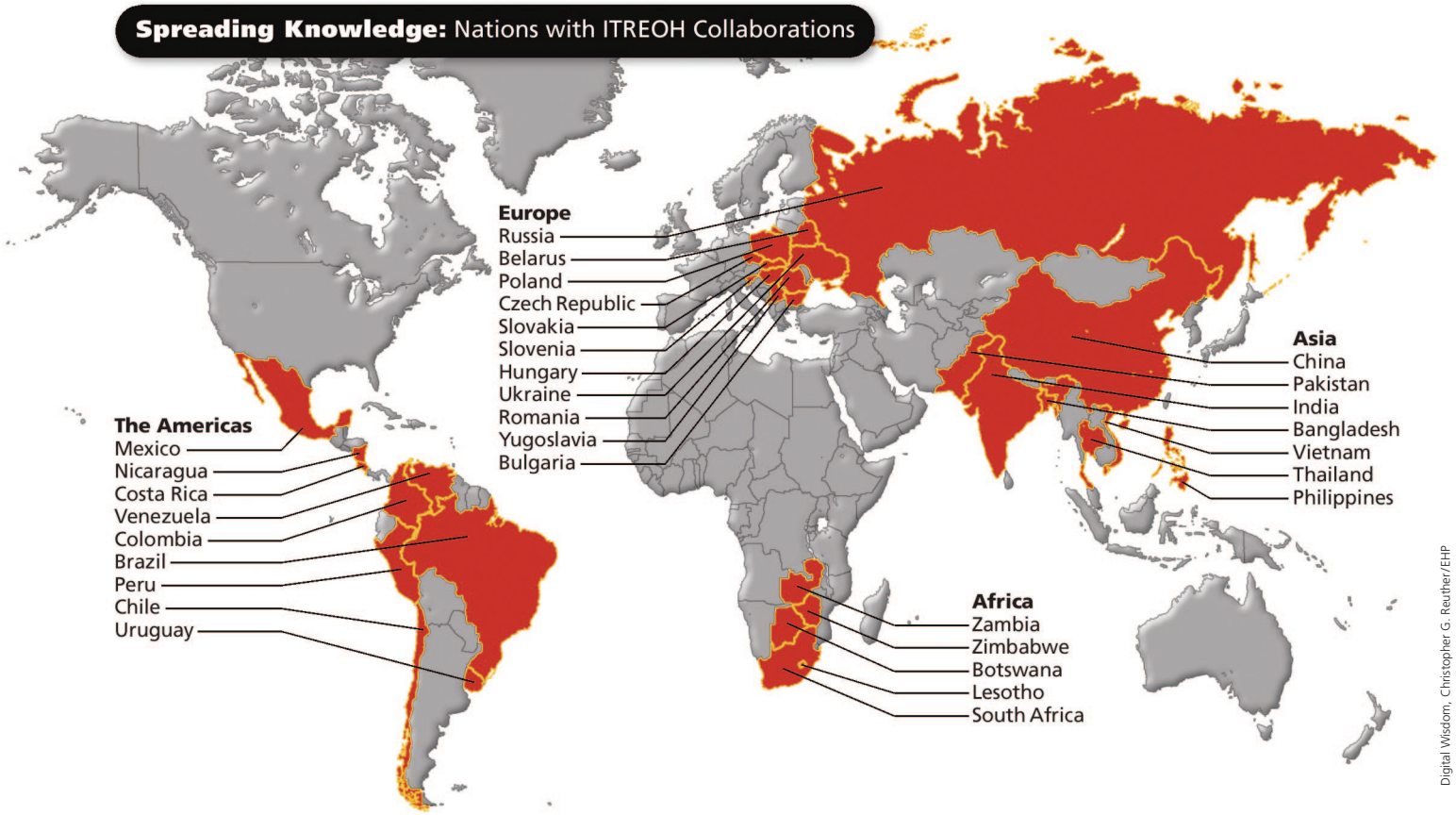
Christopher Schonwalder, director of international programs and public health at the NIEHS, says there are two reasons why it is important to support environmental and occupational health research internationally: "First, it is good science because unfortunately, in many instances there are higher levels of exposure to environmental pollutants in other countries, and we can learn from these situations about what exposures have significance," he says. "Second, it is good foreign policy because with these training programs we are helping people help themselves."

During its first funding cycle, from 1995 to 2001, ITREOH emphasized epidemiology, risk assessment, and surveillance. In June 2000, Fogarty convened an independent panel of academicians, consultants, and government representatives to review ITREOH. The panel was unanimous in its praise for the program, recommending that the level of funding be increased and the range of countries expanded. With the second round of funding, from 2001 to 2006, the scientific focus of the program has shifted to reflect the need for prevention and intervention research to reduce risks in collaborating countries.

A World of Knowledge

ITREOH currently supports 17 U.S. institutions conducting training and research with partners in 32 other countries. The program has an impressive track record. Between September 2001 and September 2002, ITREOH programs trained 266 foreign scientists, with more than 300 publications resulting from this training. The programs have also offered more than 40 short courses in the collaborating countries, reaching more than 2,000 participants. Each program has its own application process, but in general candidates are chosen based on an evaluation of their capacity and potential to conduct environmental or occupational health research that will have a positive impact on their home country.

The Americas. Nine Latin American countries are participating in ITREOH programs. One of these is led by George



Digital Wisdom, Christopher G. Reuther/EHP

A font of information. Thomas Voice, director of an ITREOH program at Michigan State University, watches as Bulgarian colleagues Nellie Niagolova and Niky Stavrev take a water sample from a village spring in the Vratza region of Bulgaria. The samples are being analyzed to better understand the occurrence of Balkan endemic nephropathy.

Delclos and Sarah Felknor, the director and deputy director, respectively, of the Southwest Center for Occupational and Environmental Health (SWCOEH) at The University of Texas School of Public Health at Houston. Its activities are conducted primarily in collaboration with academic and governmental institutions in Colombia, Costa Rica, Mexico, and Venezuela.

The SWCOEH experience in Colombia serves as a model of how the research training of one foreign scientist can have a synergistic effect on education and public health in a collaborating country. In 1999, Leonardo Quintana-Jiménez, the first SWCOEH doctoral trainee supported by the school's ITREOH program, graduated with a doctorate in safety engineering and ergonomics. Quintana-Jiménez then returned to Colombia, where he leveraged Fogarty funds to create Latin America's first center for studies in ergonomics, housed at the Pontifical Javeriana University in Bogotá. The purpose of the center is to promote the study and teaching of ergonomics and to develop ergonomic design standards appropriate to Latin American populations. According to Quintana-Jiménez, this work can have a tremendous impact in improving worker safety because previous policies allowed for permissible weight-bearing levels that were based on the physical characteristics of U.S. populations, making them dangerously high for Colombian workers.

Often, studies of populations in collaborating countries can shed light on important research questions that are generally applicable to populations in other parts of the world. For example, a collaboration between Jia Chen, an assistant professor in the Department of Community and Preventive Medicine at the Mount Sinai School of Medicine, and Lizbeth López-Carrillo, a researcher at the National Institute of Public Health in Cuernavaca, Mexico, uses a molecular epidemiologic approach—genotyping the population to look at frequency of different genes that are involved in folic acid metabolism—to investigate whether low maternal folate intake before conception has long-lasting effects on neurodevelopment in children. For this, they are tapping into an ongoing population-based cohort study in Mexico, where there is a high rate of reproductive abnormalities and high prevalence of polymorphisms in the genes that metabolize folic acid.

Chen explains that Mexican women are an ideal population for studying the biological mechanisms of folate, because even though they have high intake of folic acid in foods (higher than in the U.S. population), they experience more reproductive abnormalities. Chen and López-Carrillo hypothesize that modes of food preparation and genetic polymorphisms may lower the beneficial effects of folate. Despite the culture-specific nature of this hypothesis, this information could have an impact on recommendations for folate intake for women in any country, says López-Carrillo.

The way to clean water. Trainee Xavier Savarimuthu, a doctoral student in environmental health sciences, takes a water sample to test for pathogens as part of a pilot shallow well project to provide aresenic-free water to West Bengal, India.

Asia. The developing world, in particular, is prone to problems associated with poverty, overcrowding, indoor and outdoor air pollution, and industrial development. Perhaps nowhere is this more apparent than in India, one of seven Asian nations participating in ITREOH. For instance, says Allan Smith, principal investigator of the University of California, Berkeley, ITREOH program, West Bengal (along with neighboring Bangladesh) has been confronted with widespread arsenic contamination of drinking water to an extent that is without parallel in world history. More than

Monitoring young minds. Trainee Shalini Poddar, a doctoral student in child psychology, studies the effects of arsenic in drinking water on child development in West Bengal, India.

6 million people rely on wells in areas of West Bengal where groundwater sources are contaminated with naturally occurring arsenic. And the use of biofuels for indoor cooking and heating is a major contributor to indoor air pollution in India, although it is unknown exactly how many people are affected. The Berkeley program focuses on two areas of research and training: arsenic exposure via drinking water in West Bengal, and indoor air pollution including its impact on tuberculosis, blindness (cataracts), and acute respiratory infections in young children throughout India.

As well as investigating various health outcomes from drinking arsenic-contaminated water, trainees in this program have established monthly monitoring of wells and field surveys for diarrheal disease in a

Top photo: Michigan State University ITREOH; bottom photos: UC Berkeley ITREOH

Seen but not heard? A hearing protection notice is part of an ITREOH mining health and safety project in Zambia.

pilot mitigation program that installs arsenic-free shallow wells. Berkeley trainees are also investigating a urine biomarker for exposure to wood smoke. Such a biomarker would tell researchers who among the population is exposed and whether this exposure may explain diseases seen in India, especially among children. Even though people may need to continue to burn wood indoors, there may be ventilation strategies they can use to reduce exposure.

Europe. Eleven Eastern European countries are partners with four ITREOH centers in the United States. "There are many needs and also many opportunities for collaboration in these countries," says David Carpenter, a professor of environmental health and toxicology at the University at Albany and head of the ITREOH program there. The program at the University at Albany draws greatly on a sister-city relationship between Albany and Tula, Russia. Tula, about 150 miles south of Moscow, is a former closed military city where the major industry was gun and ammunition production. It has a legacy of heavy metal contamination and air pollution, and a faltering economy in the post–Cold War era. The sister-city program has supported exchanges of physicians, educators, and businesspeople, and Albany's ITREOH program sponsors foreign trainees to develop projects in epidemiology and environmental health in Tula.

"I want to assure you that the Fogarty training has been most beneficial to my professional career," says Beata Peplonska, a professor of occupational and environmental epidemiology from Lodz, Poland, one of the trainees working in Tula with Carpenter. "I use this knowledge in my everyday work, and being a teacher, I share it with students at different training courses which are conducted at my institute." Peplonska points out that the learning comes at many levels. "With regard to things we have learned, there have been many," she says. "Some are just appreciation of things you take for granted in the United States. For example there is no routine lead testing in children in Tula, in spite of the fact that they have very high levels."

Africa. Programs in Africa have concentrated on five countries directed by two U.S. institutions. The program directed by Jeffrey Burgess, an assistant professor of public health at the University of Arizona in Tucson, aims to improve environmental and occupational health associated with mining operations and mineral processing in sub-Saharan Africa through training, research, prevention, and intervention.

Learning to deal with dust. One aspect of an ITREOH mining health and safety project in Zambia involves training workers to protect themselves against the effects of exposure to dust generated in manufacturing cement for infrastructure construction.

University of Arizona ITREOH

Mining and mineral processing are major sources of revenue in many African countries. They account for 80% of foreign exports in Zambia and 45% in Zimbabwe. Mining is also one of the most dangerous professions. Potential environmental effects of mining and mineral processing include exposure to metals such as arsenic, lead, and mercury, and other pollutants such as sulfur dioxide.

Although the University of Arizona program was started only two years ago, it has already had a significant impact on mining practices in the collaborating countries. This program represents the first time people from industry, government ministries, and academia have teamed up, according to Emmanuel Mulenga, a Zambian trainee obtaining his master's of public health at the University of Arizona College of Mines. Says Burgess, "Our program empowers the [University of Zambia] to serve a critical role of bringing the important parties together [to discuss mining safety issues]. This is more important than any information we can give them." Mulenga has returned to Zambia to pursue research studies there that will be part of his master's thesis.

True Impact

ITREOH programs support the flow of trainees who go back to their countries with increased knowledge of research, risk assessment, and intervention strategies that can benefit exposed populations in their countries. But the true impact of ITREOH lies in whether environmental policies are informed through the research supported by the program.

This may be difficult to measure. Nevertheless, as Aron Primack, a program director with the Fogarty Center, says, "We know that many individuals who are now in powerful policy-making positions in different countries throughout the world have participated in ITREOH at some point in their careers." Translation of environmental and occupational medicine knowledge gained through these experiences and the collaborations being forged between foreign and U.S. institutions very well may serve to inform policies in those countries. **–Luz Claudio**

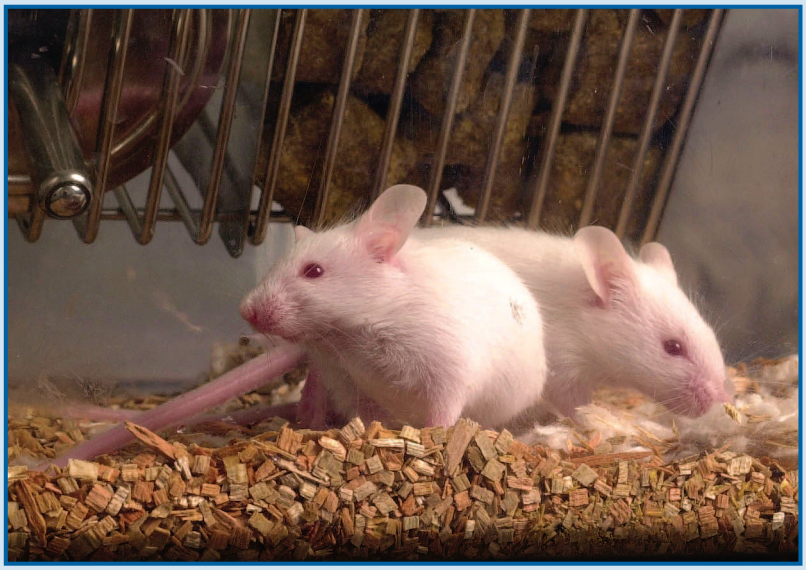
For More Information

For more information on ITREOH, visit the program website at **http://www.fic.nih.gov/programs/environ.html**

Steve McCaw/Image Associates

Headliners | Endocrine Disruptors

NIEHS-Supported Research



Bisphenol A Linked to Chromosome Damage in Mice

Hunt PA, Koehler KE, Susiarjo M, Hodges CA, Ilagan A, Voigt RC, et al. 2003. Bisphenol A exposure causes meiotic aneuploidy in the female mouse. Curr Biol 13:546–553.

Bisphenol A (BPA) is a common component in polycarbonate plastics used in food and beverage packaging and in dental sealants. BPA has hormone-like properties that mimic the effects of endogenous estrogens. Although a variety of reproductive complications have been ascribed to compounds with androgenic or estrogenic properties, little attention has been directed to the potential consequences of such exposures to the genetic quality of the gamete.

During a 1998 study on meiosis in mouse oocytes, NIEHS grantee Patricia A. Hunt of the Department of Genetics at Case Western Reserve University and colleagues observed a spike in meiotic disturbances including aneuploidy (an abnormal number of chromosomes). The spike coincided with the test mice having been accidentally exposed to BPA following the use of a harsh detergent to clean their plastic cages. This observation prompted Hunt and colleagues to replicate the finding in a controlled experiment. The results implicate BPA as a potent disruptor of meiosis and provide the first conclusive link between mammalian aneuploidy and an accidental environmental exposure to BPA.

The researchers dosed mice with environmentally relevant doses of BPA. Eggs from the dosed animals showed dose-dependent increases in problems of meiosis including aneuploidy and disorganized or unaligned chromosomes. Hunt and colleagues found that only brief exposure to relatively modest concentrations of BPA was necessary to induce significant meiotic effects. The study suggests that the mouse oocyte may provide a sensitive system for the study of reproductive toxicants.

The kinds of chromosomal abnormalities resulting from both the accidental exposure and the controlled experiment are leading causes of miscarriage, congenital birth defects, and mental retardation in humans. Further study is necessary before direct conclusions can be drawn on potential human health effects from BPA. However, the current results raise concerns, especially when considered alongside those of a study by Schonfelder et al., published in the March–April 2002 issue of *Neoplasia*, indicating that pregnant women are exposed to comparable amounts of BPA. **–Jerry Phelps**