

## **RESEARCH INTO ACTION:**

A Report of the Center for Child Environmental Health Risks Research

### **Introduction**

The University of Washington Center for Children's Environmental Health Risks Research (CHC) was formed in 1998. Investigators work in the laboratory, in the field, and in the community to increase our understanding of children's susceptibility to pesticides and the ways that pesticides affect normal learning and development. These diverse, multi-disciplinary research projects are integrated in a risk assessment framework with the goal of promoting child protective public health policies and practices. This report describes many of our Center's achievements.

### **Impact in the Field**

*Developing New Approaches for Assessing Children's Pesticide Exposure*

At the CHC innovative approaches to measuring exposures of young children to pesticides are providing an understanding of which children are most highly exposed, and how these exposures might be limited. This has involved collaboration of many scientists using new methods to sort out the various pathways by which young children are exposed. This multi-pronged approach includes:

- Investigation of exposure of subpopulations of young children in agricultural communities based upon the occupation of their parents as pesticide applicators, field workers, or other agricultural type jobs. Exposures to organophosphate pesticides are measured as the total metabolites in the urine of children aged two to six. To understand sources of exposure, measurements were also made of pesticides in dust samples collected from homes and cars, and total metabolites in the urine of the parent involved in agricultural work.
- A new method of using GPS backpacks for detailed characterization of the activities and movements of children through the day is being developed. The portable child-friendly GPS backpacks improve tracking and understanding of children's time/location activities. The units are now being carried by children living in agricultural communities who may be affected by take home and/or drift exposure. Defining children's activity patterns is critical for characterizing children's exposure to environmental hazards, particularly since children have high hand-to-mouth activity and move close to the ground.
- An innovative method has been developed for real-time measurement of drift during pesticide spraying by LIDAR (Light Detection and Ranging System); a laser based system that measures the airborne concentration of a pesticide. LIDAR is more versatile than traditional sampling methods because it provides a more representative sample of pesticide concentrations than do single fixed-point samplers. Data from LIDAR is being used to develop improved models of airborne spray drift.

The findings of these studies have shown that children living in agricultural communities have higher exposures than the general population, and that the take home pathway is the largest pathway for the most highly exposed children. The highest levels of exposure were in the children of the pesticide applicators, the group most likely to bring home pesticides on their skin and clothing. Children in other groups also have elevated exposures when they have parents who work in orchards. Children whose parents do not work in the orchards have elevated exposures in spraying seasons compared to other times of the year. Better prediction of spray drift in agricultural communities, and better understanding of activity patterns of young children are needed to devise strategies to limit exposure of young children in agricultural communities.

The educational intervention of CHC develops methods to inform parents about the take home pathway and how to prevent exposure of their children. By including measurement of the children's urinary metabolites before and after the intervention the effectiveness of the intervention will be evaluated. To accomplish this goal, scientists from different disciplines have come together to design the community intervention study, implement the intervention, collect the field data, measure the urinary metabolites, and correctly analyze the results.

#### *Linking Science and Risk Assessment Needs*

Because the center is built around a risk assessment framework we are able to link findings on pesticide exposure and kinetics to improve our ability to predict outcomes using innovative toxicokinetic and toxicodynamic modeling techniques. Our lab-based projects investigate the mechanisms of susceptibility during three critical stages of brain development, genetic and age-dependent variations in susceptibility, and functional assessments of exposure. As single-projects each of these studies provide important information regarding the kinetics and mechanisms of pesticide toxicity. However, the Center structure allows us to link this data to develop powerful tools for assessing risk and improving protective measures for children's environmental health.

The innovation of these models has been recognized by the Society for Risk Analysis and Society of Toxicology:

- Tom Lewandowski, 2000 Dose Response Award (SRA);
- Julia Hoelt, 2001 Best Student Presentation, Risk Assessment Specialty Section (SOT);
- Julia Hoelt, 2001 Outstanding Presentation, Biological Modeling Specialty Section (SOT);
- Tom Lewandowski, 2001 Best Presentation, Risk Assessment Specialty Section (SOT).

Our Center's risk assessment framework is responsive to the EPA-commissioned National Research Council report titled "Scientific Frontiers in Developmental Toxicology and Risk Assessment." It also serves as the basis for an in-progress, EPA-funded project on the development of a children's risk assessment framework being conducted by the International Life Sciences Institute (ILSI).

#### *Understanding Mechanisms of Susceptibility*

Previous work on paraoxonase (PON-1) and susceptibility to pesticide insult had been supported by Star and RO-1 grants. The collaborative structure of the Center has allowed the scope of this work to increase dramatically in a way not possible with smaller individual grants. Researchers in toxicology and genetics (Costa and Furlong) are evaluating the role that genotypic and phenotypic polymorphisms, such as PON-1 status, play in defining children's responses to environmental agents like chlorpyrifos. This work complements simultaneous behavioral studies using transgenic knock out mice to look at the role of the PON-1 pathway on pesticide mediated neurobehavioral effects. These integrated efforts are helping to elucidate the mechanisms and temporal variation of children's susceptibility to pesticides. In addition, research on PON-1 related to organophosphate toxicity, has facilitated research on other factors affecting PON-1 activity, such as its inhibition by metals.

Of particular importance for children's health risk research is the need to put the geno-phenotypic evaluation into a temporal context as indicated by the Center's research findings of age-related delays in PON 1 activity in children. This work has been lauded by the scientific community and has influenced the way other exposure assessment groups collect and treat samples. Recently, Dr. Furlong has helped the Children's Health Center at UC Berkley to include PON-1 geno-phenotyping as part of their agricultural community exposure and risk assessment.

#### **Translation**

##### *¡Para Niños Saludables! / For Healthy Kids!*

The scientific findings of our Center are translated into an ambitious community intervention program. Information on exposures and mechanisms of susceptibility has been incorporated into culturally appropriate intervention materials. The community intervention project, under the direction of Dr. Beti Thompson of the Fred Hutchinson Cancer Research Center, has gathered together

a diverse community advisory board (CAB) to provide active guidance and oversight of the materials developed and the intervention methodologies employed. The CAB is made up of individuals from the farmworker, grower, public and environmental health professions, and the local media.

The Center structure enables the development of educational materials based on sound science related to mechanisms of susceptibility and exposure. The Intervention staff collaborate with other CHC investigators to develop age appropriate and culturally sensitive educational materials and intervention approaches that incorporate risk communication strategies.

#### *In the Home, School and Community:*

In the intervention communities, activities occur at the household to the community level. The intervention methodologies are meticulously tracked and recorded so that they can be validated. Because of the careful data collection and recording, these methods will be transferable to a wide range of child health issues. The CHC has collaborated with the UC-Berkeley CHAMACOS program to implement many of these strategies in their intervention study.

- **Home Health Parties:** Volunteers complete an extensive training course, conducted by CHC intervention staff, in pesticide safety and alternatives to residential pesticide use. Under the supervision of a professional interventionist, these volunteers then conduct “home health parties” with families and invited friends and neighbors. This program has been very successful and is well received in the primarily Latino farmworker communities. It is an excellent opportunity to bring realistic approaches to pesticide safety to children, parents, and grandparents.
- **Child and Adult Education:** In an effort to improve pesticide safety practices in the intervention communities, pesticide education is taught to preschool and elementary students as well as to adults in classes such as citizenship and English-as-a-second language. The talented intervention staff have developed a wide range of educational materials, including a Head Start curriculum on pesticide safety that will eventually be used in farmworker communities throughout Washington state.
- **Community Health Fairs and Block Parties:** Community wide events such as health fairs and block parties are popular among the mostly Latino intervention community. The intervention project has been visible at these events, providing educational materials and useful items such as laundry detergent and hats to protect workers from sun and pesticide residues.
- **In-Kind Support:** Support for the intervention project has come from local businesses. A Seattle manufacturer of laundry detergent donated thousands of detergent samples which are distributed at the intervention events. Local businesses have donated soap and personal care items, such as a popular “loofa” made of a sturdy Mexican cactus. This support is representative of the community support for our project and the desire to improve health outcomes for at-risk children.

#### **Institutional and Community Capacity**

This spring CHC’s deputy director, Thomas Burbacher, introduced a graduate course titled “Children’s Environmental Health” (EH 590). The course has drawn students from many schools and departments including Public Health Services, Maternal and Child Health Nursing, School of Public Affairs, and pediatricians on fellowship with the UW Medical School. Course instruction will be provided by CHC researchers and will cover the full range of research and knowledge of our investigators.

In its initial offering the demand for this course exceeded the capacity for enrollment. This popularity is strong evidence of the interest in children’s environmental health and the information gap being filled by CHC investigators.

The CHC has coordinated with the UW’s Pediatric Environmental Health Specialty Unit (PEHSU) to conduct continuing education to pediatricians, school nurses, and other child health professionals. This has been an excellent opportunity to directly incorporate research findings into pediatric medical practices.

CHC investigators have also served as course directors and instructors for a wide variety of graduate, undergraduate, and continuing education courses throughout the university. For example, a focus of the School of Public Affairs course “Economics and Public Policy Benefits” is developing child-protective policies. Students in this course have included professionals from the Washington State Department of Health who struggle daily to incorporate science findings into policies such as fish advisories.

Our Center’s outreach activities are coordinated with those of the NIEHS Center for Ecogenetics and Environmental Health’s (CEEH) Community Outreach and Education Program (COEP) and the UW-PEHSU. Dr. Thomas Burbacher serves as the Director of Outreach for each of these programs. Additionally, Ruth Woods, CHC’s Program Administrator, chairs the Department of Environmental and Occupational Health Sciences’ Outreach Committee. These positions within our institution allow us to maximize resources for community outreach and enhance our university’s outreach mission.

The CHC contributed to the planning of an NIEHS sponsored Town Meeting hosted by the CEEH. Because of our role, a major focus of the meeting was agricultural pesticide use. The planning process enabled us to develop important relationships with community groups such as El Centro de la Raza, Community Coalition for Environmental Justice, and the Seattle Public Utility’s environmental justice division. Relationships built during the meeting have resulted in funded projects with community partners and enhanced university-community relationships.

Each year the Washington State Environmental Health Association conducts a joint conference with the Washington State Education Association. Due in part to our outreach activities at the CHC, the theme of last year’s conference was on Children’s Environmental Health. Center participants played a major role in a panel on these issues. Ruth Woods lead a workshop on internet resources for children’s environmental health and, in collaboration with the CEEH-COEP, we will exhibit our research findings and intervention materials.

The CHC has been recognized by the UW for its research and intervention efforts in the Yakima Valley. Articles have appeared in the University weekly newspaper, the School of Public Health’s newsletter “Spotlight on Research” and the Department of Environmental Health and Occupational Health Sciences’ monthly newsletter. Our research has been presented to members of the statewide legislative community as an example of research with strong relevance to our state.

### **Leveraging**

Partners from rural areas of Washington state identified the lack of Spanish language health and safety education materials as a barrier to protecting farmworkers and their children from exposure to agricultural pesticides. Last spring, Julia Grossman, a graduate student working with Beti Thompson, completed a pesticide control curriculum oriented toward Latino preschoolers. Subsequently, the CHC, in partnership with the Washington State Migrant Council and ¡Para Niños Saludables! / For Healthy Kids!, was awarded a grant from the US EPA to provide training to Head Start teachers and Heritage College faculty, and to disseminate the curriculum to K-12 partners in Western Washington.

Possible contamination in shellfish from pesticides, fecal coliform, and biotoxins, has prompted members of Shoalwater Bay Indian Tribe to voice concern regarding the safety of consuming shellfish from the bays. They are also alarmed by a high rate of pregnancy loss. The CHC, in collaboration with the CEEH has developed a partnership with the Tribe to provide technical expertise on the development of a management plan. The Tribal-University partnership was recently awarded funds from NIEHS to create a shellfish quality management plan. The plan will be created by the Tribe's environmental analysis staff with technical input from University risk analysis experts and will allow the community to systematically assess shellfish quality in their Bay. The important community-university partnership relies on the academic strength of the CHC to give voice to an underserved community. It is a strong example of leveraging funds to broaden the scope of public health research and service.

Recognizing similarities in research study populations, Dr. Clement Furlong of the CHC and Drs. Brenda Eskenazi and Nina Holland of the UC-Berkeley Child Environmental Health Center, successfully proposed a study to look at PON 1 status of subjects enrolled in the California study. Their study will

correlate PON 1 status with exposure (based on urinary metabolites) and consequence as determined by cholinesterase inhibition and behavioral testing of the children. The first samples were recently analyzed for PON 1 status at Dr. Furlong's UW laboratory.

This new research project combines UW CHC research on arsenic with field research being conducted in Mexico on arsenic exposure by University of Arizona investigators (J. Burgess). The objective of this research is to measure and compare alterations in gene expression in epithelial cells associated with chronic ingestion of inorganic arsenic.

An EPA contract is pending to apply the risk assessment methodology developed by the CHC. The objective of this work is to develop four case studies that illustrate the application of quantitative considerations (kinetic and dynamic factors) for developmental neurotoxicity.

### **Sustainability**

The Community Intervention Project was designed to provide an infrastructure for sustainability. By actively engaging community members as trained interventionists, bringing together a diverse body to oversee the project, and developing lasting materials and curriculum, the intervention project will continue to be an active force for integrating health promoting practices into classrooms, homes, and communities.

Faculty and staff involved in the CHC are members of numerous committees and advisory panels. Their knowledge of children's environmental health issues will influence their roles on these committees and integrate child health research with other professional activities.

From the local to the national and international levels, there is increasing concern regarding threats to children's health from environmental sources. Our CHC website receives an average of 330 visits per month. We have had site visitors from 45 different countries, including Uruguay, the Czech Republic, Ghana, and Vietnam. Requests for reprints of CHC publications have come from a number of sources, such as a rural library in Arizona, a tropical disease researcher in Thailand, and a public health official in Switzerland. We receive phone calls from many different people, such as concerned parents regarding possible contamination in rental properties and through contaminated water (we refer questions of this sort to the UW Pediatric Environmental Health Specialty Unit). This interest in our Center is indicative of a growing demand for an understanding about low-level, chronic exposures to environmental contaminants.