



# **PACIFIC NORTHWEST AGRICULTURAL SAFETY AND HEALTH CENTER**

**FINAL REPORT /'GZGEWIKG'UWO O CT[**  
CDC/NIOSH Cooperative Agreement #5 U50 OH07544

**Program Cycle 2006 - 20011**  
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## I. EXECUTIVE SUMMARY

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The Pacific Northwest Agricultural Safety and Health (PNASH) Center, established in 1996, is part of a vital national infrastructure dedicated to the prevention of illness and injury among agricultural producers, workers, and their families. We work to achieve this goal through partnerships with key stakeholders in the Northwest region (Alaska, Idaho, Oregon, and Washington). We also work collaboratively with other regional centers to formulate national programs and policies in agricultural health and safety. Our Center is housed institutionally within the University of Washington's School of Public Health, the only such school in the four-state region that we serve. Since the Center's inception, we have worked to engage the three major agricultural sectors in the Northwest: farming, forestry, and fishing. Our Center reflects a cross-disciplinary, multi-institutional, and geographically diverse set of initiatives. Our efforts focus primarily on populations not well represented in current research, including hired laborers, migrant/seasonal workers, women, and children.

The primary goals of the PNASH Center are to:

- Conduct high quality research through cohesive, coordinated and synergist activities;
- Translate scientific discoveries into practical applications;
- Exert a sustained and transformative influence on agricultural health and safety in our region;
- Translate and transfer our findings using accessible and appropriate methods to the farming, fishing and forestry agricultural sectors in the Pacific Northwest;
- Provide opportunities for professional learning and development, including undergraduate and graduate student experiential learning, continuing education, investigator mentoring, and academic exchange;
- Engage our stakeholders in Center activities through active partnerships and collaborations.

After 15 years, the PNASH Center is established as a resource, leader, and partner for the Northwest region and across the nation. We continue to address the challenge of a large scope of work in our three industries with numerous commodity groups and worker populations across a four-state region. Consequently, we have worked closely with industry stakeholders and addressed all three agricultural sectors due to the importance of these industries to the Northwest, including for both farming and forestry a NORA-like engagement and the development of the Occupational Research Agenda for Northwest Farming and the Occupational Research Agenda for Northwest Forestlands.

### **Ten Highlights of PNASH Center Accomplishments: 2006-2011**

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- Identification of genetic susceptibility (PON1 status) in farmworkers exposed to organophosphate (OP) pesticides. This is the first time that a study of a working population has demonstrated the validity of the assumptions behind PON1's effect on pesticide overexposure susceptibility (Keifer Research 1 Project)
- Determination of specific risk factors among pesticide handlers for serum cholinesterase inhibition (Keifer Research 1 Project)
- Substantial reduction in WA pesticide handlers exhibiting significant ChE depression from 2006-2010; PNASH Center one among several likely influences on reduction in exposures (Keifer Research 1 Project)

- Isolation and identification of protein adducts for OP pesticides at low levels; an assay more reliable than using the existing cholinesterase activity assays (Simpson Research 3 Project)
- Development of *Practical Solutions for Pesticide Safety*, a bilingual guide for minimizing pesticide handler exposure; developed in partnership with workers and management in 25 orchards and interviews with 95 individuals (Fenske Prevention 1 Project)
- Development and distribution of a Fluorescent Tracer (FT) Kit and DVD to accompany our Fluorescent Tracer Manual; provides everything needed to do real-world FT evaluations. Website: [http://depts.washington.edu/pnash/fluorescent\\_tracer](http://depts.washington.edu/pnash/fluorescent_tracer) (Fenske Prevention 1 Project)
- Engagement with regional Hispanic Radio and national Story Corps project to capture and share life changing agricultural injury stories, “reality tales”; PNASH introduced agricultural health and safety stories to the national Story Corp project (Murphy Education 2 Project)
- Establishment and support of a statewide Community Health Worker (Promotoras) Network; presentations at network’s annual retreats (Murphy Community Outreach Project)
- Survival solutions for commercial fishermen. Findings from a PNASH-funded study on refresher survival drill instruction have been incorporated into US Coast Guard regulations on training frequency, designed to reduce drowning deaths at sea. With AK NIOSH we have conducted field tests of personal floatation devices (PFD) in PNW fisheries. (Dzugan Pilot Projects 1&6, Camp Pilot Project 12)
- Addressing the hazards faced by Hispanic forest service workers in Washington and Oregon. These workers are often immigrant Hispanic males conducting high-risk tasks and struggling with precarious socio-economic positions. (Keifer Pilot Project 5, Wilmsen Pilot Project 11)

## Research and Programs

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PNASH Center investigators have conducted 7 projects and 12 pilot projects over the last project period. Center investigators have published study results in peer-reviewed publications and generated translational materials from research results in the form of articles in trade media, radio novellas, popular education games, best practice manuals, and websites. Presented below are accomplishments from projects funded in the 2006-2011 cycle through both through the NIOSH Agricultural Center Initiative.

### RESEARCH CORE

#### **Risk Factors for Cholinesterase Depression among Pesticide Handlers** (NIOSH/CDC, 2006–2011)

This project works in coordination with the Washington State Cholinesterase (ChE) Monitoring Program to identify the risk factors responsible for ChE depressions, including individual genetic susceptibility. 250 handlers have been recruited over the course of this study in collaboration with occupational medicine clinics in agricultural regions of Washington State. A participant's risk of ChE depression is evaluated with respect to workplace, behavioral, and genetic characteristics (paraoxonase or PON1 status). Findings thus far identify the following risk factors being associated with BuChE inhibition: cleaning spray equipment, mixing/loading pesticides, and not using a locker to store PPE. Protective factors were: wearing a full-face, respirator and wearing chemical-resistant footwear. Identification of genetic susceptibility (PON1 status) in farm workers exposed to organophosphate pesticides. This is the first time that a study of a working population has demonstrated the validity of the assumptions behind PON1’s effect on pesticide overexposure susceptibility.

### **Enhancements to Cholinesterase Monitoring: Oxime Reactivation and OP-ChE Adducts**

(NIOSH/CDC, 2006–2011) Scientists at PNASH and the Centers for Disease Control (CDC) conducted this project to improve the current ChE laboratory test – increasing accuracy to ensure a ChE depression is due to pesticide exposure and identify the specific pesticide involved. Though not useful for clinical diagnosis, the oxime reactivation assay can be used to help diagnose acute poisoning with OP pesticides and guide treatment – for example, when a subject presents at an emergency clinic with symptoms consistent with pesticide poisoning. The second component of this project is the development of a process for tandem mass spectrometry (HPLC/MS/MS) of protein adducts in the blood of exposed workers. The HPLC/MS/MS method can detect exposures to OP pesticides at low levels more reliably than using the existing cholinesterase activity assays. These more sensitive adduct measurements can be combined with information about personal characteristics and workplace practices, either from surveys or intervention studies, to analyze risk factors associated with pesticide exposure. Results could be used to further educate workers and regulators regarding ways to minimize exposures.

### **Neurobehavioral Assessment of Pesticide Exposure in Children** (NIOSH/CDC, 2006–2011)

Oregon Health and Sciences University examined health effects from chronic exposure to organophosphorus pesticides in school-age children and seeks to determine if they are associated with current home pesticide exposure and lifetime exposure measures. To date, over five hundred adults have completed a survey on pesticide knowledge and beliefs in either Spanish or English, and over two three hundred children have participated in the neurobehavioral study, completing neurobehavioral tests, interviews with parents and collection of dust samples. Our previous work provides preliminary evidence of health effects associated with chronic exposure to pesticides in adult farmworkers. However, the absence of exposure and biological data from the non-agricultural group limit the conclusions. These results need to be replicated and extended to children who are a more vulnerable population.

### **Assessment of Job-related Exposures for Diarrheal Illness in Farmworker Families**

(NIOSH/CDC, 2006–2010) This two-year exploratory project investigated a probable cause of high rates of diarrheal illness in specific agricultural counties – bacterial pathogens from livestock, taken home, or in well water. It is hypothesized that occupational and environmental exposure pathways from livestock operations pose a significant risk of exposure to zoonotic bacterial contamination for farmworkers and their families. Our laboratory studies compared several of these methods: swabs, contact plates, and a vacuum assisted for recovery of organisms from hard and soft surfaces. Improved sampling methods have been developed and are submitted for publication.

## **INTERVENTION CORE**

### **Interventions to Minimize Worker and Family Pesticide Exposures** (NIOSH/CDC, 2006–2011)

This field-based study identifies, evaluates and disseminates practical pesticide safety measures developed on farms and brainstormed by a team of industry experts that includes managers, workers, and pesticide safety educators. Direct community involvement is a key element of the project and the participation of experts in the day-to-day aspects of production. To date, over thirty practical pesticide safety solutions have been identified and documented, and participation has included 25 orchards and 95 individuals. In addition, the project team has moved forward with development of previously identified needs and solutions for: a prototype mixer-loader splash shield; PPE fit and cleaning procedures; and validating a field analytic for pesticide residue using fluoro-spectrophotometry. The *Practical Pesticide Safety Solutions* guide is being disseminated regionally and evaluated for use within the industry. *Practical Solutions for Pesticide Safety* website: [http://depts.washington.edu/pnash/practical\\_solutions](http://depts.washington.edu/pnash/practical_solutions)

## EDUCATION CORE

### **Reality Tales: Storytelling to Translate Agricultural Health and Safety Research**

(NIOSH/CDC, 2006–2011) ‘Reality tales,’ has developed the narrative model to translate health and safety research and education for agriculture producers and workers. It used three approaches to develop stories: 1) a radio storytelling contest/call in show, 2) the national oral history Story Corps project to capture and record owner operator stories and 3) Spanish-language novellas (soap operas) to personalize for workers the risks of Ag illnesses and injuries – the message *being “it too can happen to you if one takes safety for granted.”* The radio show featuring farm worker ladder injuries stories has successfully been used in orchard training programs. Story Corps recording sessions yielded nine stories that were rich with detail and lessons for other farmers to include traumatic farm machinery, tractor, ATV, animal, ladder, hay bale, manure pit injuries. Heat-related illness research data was translated into four clever novellas that demonstrate the risk factors, signs and symptoms, and first aid treatments. Story Corps recordings and the novellas have been broadcasted throughout the state and are currently being evaluated and disseminated nationally. Website: Listening Library – Life Changing Ag Injury Stories, [http://depts.washington.edu/pnash/audio\\_library](http://depts.washington.edu/pnash/audio_library)

**Introducing a Cholinesterase (ChE) Test Kit into Clinical Practice** (NIOSH/CDC, 2006–2011) We have shown the Test-mate™ kit to be an effective, cost-efficient test that can provide rapid results for workers – important if they are shown to have a ChE depression. However, test-kit data for red blood cell (RBC) ChE in general did not agree well with the state designated laboratory, so at this time we do not recommend using the test-kit to replace the state designated laboratory for RBC ChE testing.

### **Small Grants/Pilot Projects**

In addition to the NIOSH funded projects above, NIOSH funds a Pilot Project Program, allowing PNASH to grant small 1-year awards to stimulate new directions in Ag injury prevention research, interventions and education. In 2006-2011, 12 projects were conducted.

**Pilot 1 and 6:** Skills Retention in Commercial Fishing Training (2007-2009)

**Pilot 2:** Characterization of Bioaerosols in Washington Dairy Barns (2007-2009)

**Pilot 3:** Inhibition of Cholinesterase by Pharmacological and Dietary Agents (2007-2009)

**Pilot 4:** Point-of-View Video Analysis of the Impact of a Faller Safety Training Program (2007-2008)

**Pilot 5:** Safety and Health of Immigrant Forest Workers on the Olympic Peninsula (2008-2009)

**Pilot 7:** Responding to Uncertain Results: study of pesticide handler responses to PON1 status (2008-10)

**Pilot 8:** Investigation of the Apparent Discrepancy between Observed Cholinesterase Depression among Pesticide Handlers in Washington and Regulatory Estimates of Exposure (2008-2010)

**Pilot 9:** FFA Community Mobilization for Safe Agricultural ATVs and Tractor ROPS Use (2009-2010)

**Pilot 10:** Reducing Workloads for Older Loggers in Physically Demanding Tasks w/ Synthetic Rope (2009-2011)

**Pilot 11:** Oregon Crab Fisherman Safety and Personal Floatation Device Survey (2010-2011)

**Pilot 12:** Occupational Safety and Health of Forest Workers (2010-2011)

Please find in this final report on our 2006-2011 cycle the full project reports and additional accomplishments of PNASH Center. For further information we invite you to visit our website, <http://depts.washington.edu/pnash>, or contact us at 1-800-330-0827 or [pnash@uw.edu](mailto:pnash@uw.edu).

## II. CENTER OVERVIEW

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In order to accomplish these goals we need to continually identify critical regional needs; develop and apply novel and effective methods to address these needs; and integrate evidence-based prevention strategies and practical interventions through innovative outreach, education and evaluation activities. An Agricultural Center needs be forward-looking and function holistically so that its overall value to the region is greater than the outcomes of individual projects.

### **Center Theme**

The theme of the PNASH Center is "*Promoting safe and sustainable agricultural workplaces and communities.*" This theme grew out of our regional conference, "Cultivating a Sustainable Agricultural Workplace." The conference attracted participants from across the nation because it brought occupational health and safety researchers and educators face-to-face with sustainable agriculture practitioners. Our goal was to highlight the need to recognize explicitly the health and safety of farmworkers within the concept of sustainable agriculture, and to develop metrics for a sustainable agricultural workplace. We have noted that neither federal legislation (e.g., the 1990 Farm Bill and amendments), nor major federal reports (e.g., the President's 1997 Sustainable Agriculture Task Force Report) have acknowledged the need to include occupational health and safety as a part of sustainable agricultural production processes. In our view, the need for sustainable agricultural workplaces extends beyond the boundaries of the farm, and into the rural communities that are themselves the sustenance of the agricultural economy. Thus, our theme encompasses a broad, public health view of sustainability, and includes the next generation within these communities.

### **Technological Innovation and *Prevention through Design (PtD)*: an Emerging Theme**

Technological innovation has long been a critical factor in U.S. agriculture, with changes occurring at an increasingly rapid pace. New equipment, novel plant types including genetically modified organisms, and more environmentally friendly pest control products were just a few of the innovations that transformed the agricultural landscape in the 20th century. Technological innovations represent both a challenge and an opportunity for those engaged in creating a safer agricultural workplace. How do we, as safety and health professionals, fit into this system? We first need to recognize that technological innovation is a dynamic process that presents a moving target for research and education. The process does not slow down in order to allow us to refine our study designs or choose optimal time windows for data collection. Our research needs to keep pace with innovation. We will constantly need new tools and methods in order to evaluate emerging hazards. Ideally, we can apply the NIOSH concept of *Prevention through Design (PtD)* to agricultural production. That is, we can work with agricultural engineers and equipment manufacturers to ensure that worker safety considerations are part of the design process for technological innovations.

### **Focus on Agriculture, Forestry and Fishing in the Northwest Region**

The PNASH Center strives to have active programs in farming, forestry and fishing. Much of our effort has been focused on the farming industry because of the labor-intensive nature of activities in orchards and vineyards and other crops. However, we engaged the forestry industry early on through surveys and workshops with key stakeholders, developing a regional NORA document: *Occupational Research Agenda for Northwest Forestlands*. Over the past five years we have sponsored five small-grant projects in forestry, and have edited and published the Northwest Forest Worker Safety Newsletter. For this proposal we are fortunate to have Dr. John Garland as an investigator who will lead a project aimed at improving safety in the logging industry. Dr. Garland is an Emeritus Professor at Oregon State University and has been a leading voice on forestry issues as a member of the NORA AFF Council.

We also convened an external Fishing Advisory Committee early in the Center's development to help identify the critical research and education needs in that industry. Over the past five years we have sponsored three small-grant projects in fishing (see Past Performance section). In this proposal our Director of Outreach, Helen-Murphy Robinson, is taking her very successful "Reality Tales" project into the forestry and fishing industries (Education Project 3). Additionally, Dr. Jennifer Lincoln, Deputy Director for the NIOSH Alaska Pacific Regional Office, has agreed to serve on our Scientific Advisory Committee. We recently collaborated with Dr. Lincoln on an important safety survey among Dungeness crab fisherman. Her active participation in the PNASH Center will greatly improve our ability to work with the fishing industry. In summary, our work in these two industries has now advanced from pilot projects to full 5-year projects, with active collaborations and partnerships.

### **Moving Science to Practice: r2p**

The Research-to-Practice concept (*r2p*) pioneered by NIOSH has become an integral part of our Center's strategic planning. Even our strongest scientific projects have well-defined practical endpoints that are likely to improve the health and safety of agricultural workers. For example, Dr. Chris Simpson's research on organophosphorus (OP) pesticide adducts (Research 1) is able to benefit from a close collaboration with Dr. Clem Furlong in the Department of Genome Sciences, a world leader in understanding the mechanisms of OP pesticide toxicity. Yet a primary aim of this project is the development of a field deployable assay that can be used in clinics that serve agricultural workers. The inclusion of such *r2p* activities in even basic research projects is a change in the way that medical and public health science is conducted here at UW. The notion that scientific investigations need to demonstrate impact and value is spreading rapidly, and is likely to produce much more useful research products. We are privileged to be at the forefront of this effort, particularly as our work is likely to affect some of the most vulnerable worker populations in the nation.