PACIFIC NORTHWEST AGRICULTURAL SAFETY AND HEALTH (PNASH) CENTER

RESEARCH FOR *Healthy Workers, Strong Communities & Productive Agriculture*

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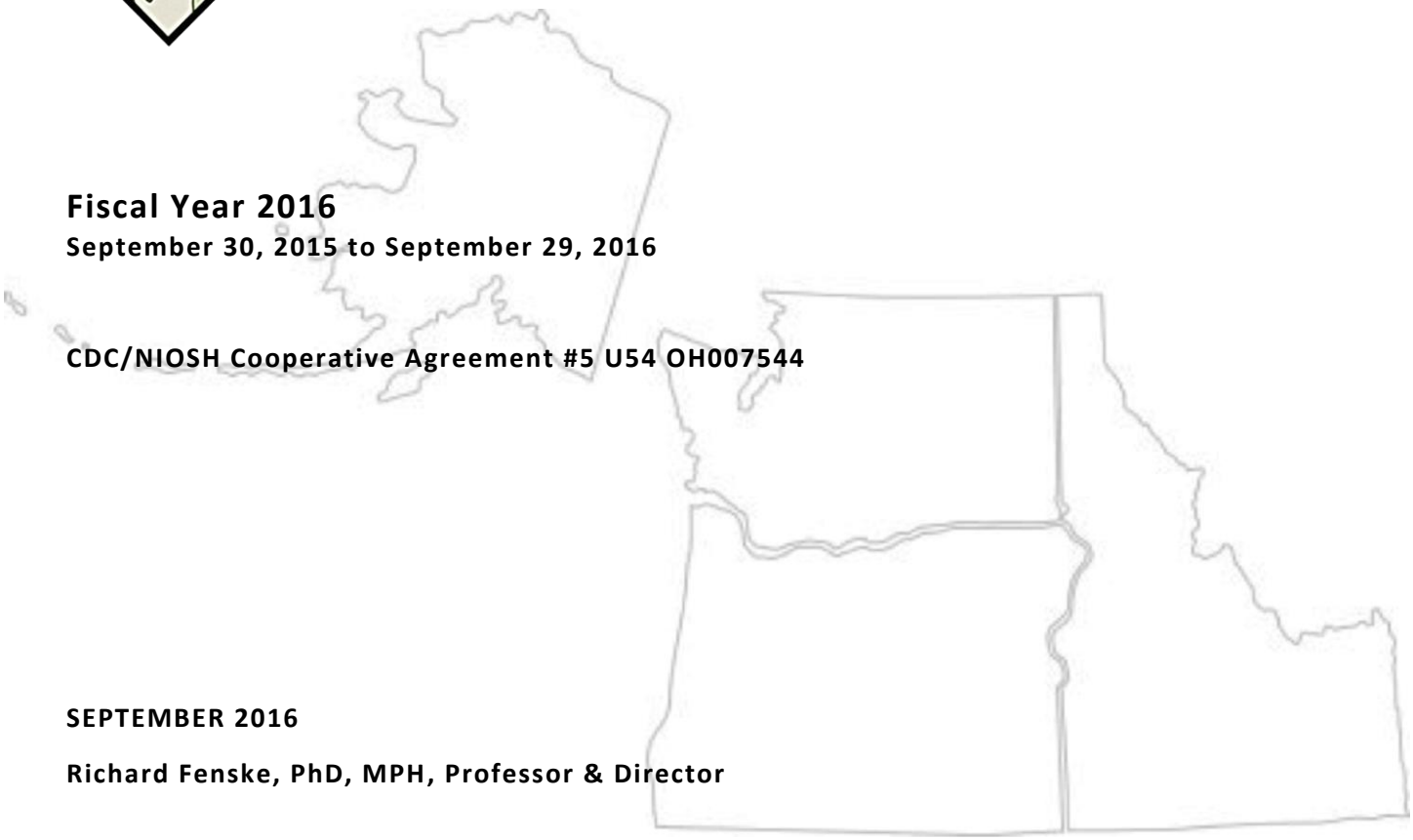
Year End Report



Fiscal Year 2016
September 30, 2015 to September 29, 2016

CDC/NIOSH Cooperative Agreement #5 U54 OH007544

SEPTEMBER 2016

Richard Fenske, PhD, MPH, Professor & Director

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH SCIENCES
UNIVERSITY of WASHINGTON
School of Public Health

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PNASH heat illness study participant completing tablet questionnaire

PNASH featured in video produced by American Public Health Association

OVERVIEW

The Pacific Northwest Agricultural Safety and Health (PNASH) Center is dedicated to the prevention of illness and injury among agricultural producers, workers and their families. One of ten regional centers, PNASH serves Alaska, Idaho, Oregon and Washington, integrating expertise from multiple disciplines, institutions and community partners. The Center is focused on safe and sustainable agricultural workplaces and communities with an emphasis on injury and illness prevention, especially among hired laborers, migrant/seasonal workers, and children. Our approach includes:

- Working in partnership with employers, workers, agencies and other research and service organizations.
- Conducting innovative research and intervention programs that focus on problem solving.
- Taking solutions to the workplace through training, outreach, and participatory research.

We are housed in the UW Department of Environmental and Occupational Health Sciences, School of Public Health and have formal affiliations with multiple UW programs, Washington State University (WSU), and Oregon State University, among others. Our faculty, staff, and students bring expertise to our agricultural industries in the fields of medicine, nursing, industrial hygiene, epidemiology, engineering, and education.

RELEVANCE

The agricultural industries consistently rank among the most dangerous jobs, with fatality rates 6 times that of the all-industry average for farming, and 32 times the fatality rate for the commercial fishing and logging. The Census of Fatal Occupational Injuries showed AFF fatalities were 14 percent higher in 2014 at 568 compared to 500 in 2013, the highest rate of any industry sector at 24.9 fatalities per 100,000 FTE which was a slight rise after three straight years of decline. Fatal work injuries in forestry and logging rose to 92 in 2014 from 81 in 2013, the highest number since 2008. In addition to injuries and fatalities, agricultural workers are also at high risk for illnesses such as lung diseases, hearing loss, heat related illness, skin diseases and certain cancers associated with chemical use and prolonged sun exposure. Farming is a unique workplace in that families frequently live on site. Each year 14,000 children are injured and 100 are killed on US farms. The economic burden in a single year is assessed at a 7.6 billion loss in medical costs and lost productivity.

FY 2016 ACTIVE PROJECTS

RESEARCH

Heat Exposure, Injury Risk, and Productivity in Agricultural Workers (NIOSH 2014-17)

Farmworker OP Exposure through Protein Adducts (NIOSH 2011-16)

Using IPM to Reduce Pyrethroid Pesticide Exposures in Dairy Workers (NIOSH 2011-16)

Transmission of Microorganisms in Dairy Farms (PNASH Small Grant 2013-15)

Non-Fatal Injuries among Commercial Fishing Workers in Alaska, Washington, and Oregon (PNASH Pilot 2014-16)

Injury and Illness Surveillance in the Pacific Northwest for the Dairy Industry (PNASH Pilot 2015-16)

PREVENTION AND INTERVENTION

Safety and Health of Latino Immigrant Forestry Services Workers in the Pacific Northwest (NIOSH 2014-17)

Reducing Agricultural Worker Risks through New and Emerging Technologies (NIOSH 2011-2016, MAAF 2012-13)

Ergonomic Evaluation of Best Practices for the Use of Mobile Platform Technology in Orchards (NIOSH 2011-16)

Impact of Workplace Stress on Health in Farmworker Families (NIOSH 2014-16)

Home Air in Agriculture - Pediatric Intervention (HAPI) Trial (NIEHS 2014-19)

EDUCATION

Pesticide Safety in Tree Fruit: Translating Research, Overcoming Barriers (NIOSH 2011-16)

GRAS^{2}P Food Safety Video (PNASH Small Grant 2013-16)

Agricultural Medicine eLearning Series for Mid-Level Health Care Providers (PNASH Small Grant 2015-16)

Sexual Harassment Prevention Training Video (PNASH Small Grant 2015-16)

PNASH's second home is the Yakima Valley – the 'fruitbowl' of Washington State.
For 18 years PNASH has had Yakima-based offices and dedicated professional staff.

ADMINISTRATIVE AND PLANNING CORE

The Administrative and Planning Core provides an infrastructure for the Center and assists in the implementation of individual project and program objectives. Core programs ensure that activities are well coordinated and integrated within the center, are of high scientific quality, meet their objectives, and work in coordination with community and industry partners to move results into practice.

PNASH PEOPLE

PNASH faculty, staff and students make up an extraordinary team. Each has grown through the enriching experience of our work, especially through our direct engagement with producers and workers. Victoria Breckwich Vásquez is a model example of an extraordinary PNASHer. We are happy to announce that Dr. Breckwich Vásquez is now an assistant professor in the School of Nursing and Health Studies at the UW Bothell campus. She continues as a PNASH investigator on multiple community-based research projects, but as of July 2016 she has stepped down from the position of PNASH's Director of Engagement and Education. This does create a new opportunity for PNASH and our region and we look forward to announcing the next PNASH director. Please read this profile on Victoria Breckwich Vásquez.

In 2016 we welcomed to the PNASH Team, Sarah Fish, as PNASH's Graphic Designer. Ms. Fish brings 10+ years in design and photography, and experience in the field of environmental and occupational health research.

PNASH INTERNAL ADVISORY COMMITTEE

Name	Role	Phone	Email
Richard Fenske, PhD, MPH	Director	206-643-0916	rfenske@uw.edu
Michael Yost, PhD	Associate Director	206-685-3250	airion@uw.edu
Marcy Harrington, MPA	Center Manager	206-685-8962	marcyw@uw.edu
Victoria Breckwich Vásquez DrPH ,MPH	Director of Comm. Engagement & Education	206-478-3024	vbreck@uw.edu
Catherine Karr, MD, PhD	Internal Advisory Committee	206-616-4355	ckarr@uw.edu
Christopher Simpson, PhD	Internal Advisory Committee	206-543-3222	simpson1@uw.edu

PNASH SCIENTIFIC ADVISORY COMMITTEE

Name	Role
Doug Brock	Associate Professor, University of Washington MEDEX Program
Jennifer Lincoln	Associate Director of Science, NIOSH Western States Division
Howard Kipen	Professor and Chair, Environmental & Occupational Medicine, Rutgers University
Linda McCauley	Dean and Professor, Nell Hodgson Woodruff School of Nursing, Emory University

STUDENTS

Our students make significant contributions to projects and Center operations. Our 2016 graduates include:
Jane Pouzou, UW PhD Graduate – Reducing Agricultural Worker Risks through New and Emerging Technologies
Grant Quiller, UW MS Student – Heat Exposure, Injury Risk, and Productivity in Agricultural Workers
Ornwipa Thamsuwan, UW PhD Graduate – Ergonomic Evaluation of Emerging Technologies in the Tree Fruit Industry

Other student contributions over the year included:
Ryan Babodi, UW PhD Student **--** Home Air in Agriculture – Intervention Trial
Miriam Calkins, UW PhD Student -- Heat Exposure, Injury Risk, and Productivity in Agricultural Workers
Viviana Castillo, UW Undergraduate and CAMP Intern -- Administration and Planning Core
Anna Contreras, UW Undergraduate and CAMP Intern -- Administration and Planning Core
Areli Contreras, UC Berkeley Labor and Occupational Health Program Intern -- Safety & Health of Latino Immigrant Forestry Service Workers in the Pacific Northwest
Courtney Chagolla, UW Undergraduate and UW Bothell Intern -- Administration and Planning Core
Christine Delgado, UW Undergraduate -- Reducing Agricultural Worker Risks through New and Emerging Technologies
Kimberly Doughty, UW Masters Student and UW Bothell Intern -- Safety & Health of Latino Immigrant Forestry Service Workers in the Pacific Northwest
Selena Guerrero, Southern Oregon University Undergraduate Intern -- Safety & Health of Latino Immigrant Forestry Service Workers in the Pacific Northwest
Eddie Kasner, UW PhD Student -- Reducing Agricultural Worker Risks through New and Emerging Technologies
Maggie Hughes, UW PhD Student – Ergonomic Evaluation of Emerging Technologies in the Tree Fruit Industry
Carly Miller, UW PhD Student -- Total Worker Health in Salmon Fishermen from Cordova, AK
Samantha Case, Oregon State University PhD Student, -- Non-Fatal Injuries among Commercial Fishing Workers in Alaska, Washington, and Oregon
Laura Syron, Oregon State University MPH Student -- Non-Fatal Injuries among Commercial Fishing Workers in Alaska, Washington, and Oregon
Nicole Davis, UW Undergraduate Intern – Sexual Harassment of Agricultural Farmworker Women
John Yang, Undergraduate Intern, UW – Home Air in Agriculture – Intervention Trial

NEW PROJECT GRANT AWARDS

Each year, thanks to the nucleus of research expertise and support formed by the Center, our faculty and staff researchers successfully procure additional project grants to help advance the goals and priorities of the PNASH Center. In FY2016 the following projects addressing PNASH's mission were awarded, including the 5-year renewal award of our NIOSH Cooperative Agreement for 2016-2021.

PNASH Center NIOSH Cooperative Agreement 2016-2021

This cycle includes 6 projects and an enhanced Outreach Core to support engagement and education as we partner with worker, industry, health care, government, academic, and community groups. The six new projects are categorized as Research, Prevention/Intervention, Surveillance, or Translation.

RESEARCH

Prevention of Occupational Exposure to Pesticide Drift (Fenske, P.I.) This project aims to understand the mechanisms of pesticide drift exposure among agricultural workers and prevent such exposures in the future. We will link data from the WA Department of Health and Washington State University (WSU) AgWeatherNet to determine the probability of drift events due to environmental conditions during spraying, develop a predictive model, and conduct field studies to validate our model. Study findings will be used to provide new user-friendly tools and trainings to predict drift event-prone weather conditions.

The Healthy Dairy Worker Study (Rabinowitz, P.I.) This partnership study with WSU will enroll new workers in the dairy industry and evaluate microbiome changes over time. We will characterize worker exposures to microbes and allergens and evaluate whether these exposures impart immune benefits (the 'hygiene hypothesis'), and/or increase risk of disease, including infection and airway inflammation. This study will help identify priorities for preventive interventions and healthy host adaptation to the dairy environment.

PREVENTION AND INTERVENTION

A Multi-level Approach to Heat Related Illness Prevention in Agricultural Workers (Spector, P.I.) Building on our previous heat-related illness (HRI) studies, we will develop and evaluate a multi-level approach to address HRI for farmworkers in the tree fruit industry. The project will assess a proposed work-based intervention program as well as whether off-hour environmental conditions contribute to risk for HRI during work. To accomplish study aims, an Expert Working Group (EWG), that includes workers, farm managers, and other stakeholders will guide the development, testing, and dissemination of the intervention.

Injury and Illness Prevention in the Pacific Northwest for the Dairy Industry (Yost, P.I.) Dairy workers in Washington State have an injury claim rate 72% higher than the state average. The hazards of animal assaults, slips, trips and falls are exacerbated by a growing hired workforce that has little previous experience in this industry. This project is designed to deliver and evaluate worker safety training, and will include newly hired workers recruited for the Healthy Dairy Worker Study. The project, conducted in partnership with WSU, is guided by the ongoing participation of a Technical Advisory Group of agricultural and safety representatives and an Expert Working Group of on-the-ground dairy managers and workers involved in day-to-day activities of milk production and animal handling.

SURVEILLANCE

Safety Surveillance for Pacific Northwest Fisheries (Kincl, P.I., Oregon State University) While good progress has been made in the surveillance and prevention of fatalities, there is little evidence on the causes of severe, but non-fatal injuries. This OSU research team will assess vessel disaster and casualty data collected by NIOSH and the USCG. The project will include additional sources of vessel and fishermen casualty and safety data from insurance claims, and will also conduct primary data collection. The combination of these data will form the foundation for ongoing, scalable, practical surveillance systems for hazard assessment and for evaluation of programs for interventions in the commercial fishing industry.

TRANSLATION

Practical Solutions for Pesticide Safety (Galvin, P.I.) This project will identify and evaluate solutions that farm managers, forest service managers, and pesticide handlers can implement to minimize pesticide exposures. The new resources will be applicable to the revised EPA Worker Protection Standard and recent food safety requirements. We will engage workers and managers in walk-through evaluations and field testing to identify key safety issues and novel solutions. This project will deliver the solutions through expanded hands-on pesticide training modules and the use of online media to ensure broad access.

EPA Star Grant - Next-Generation Air Pollution Research

PI: Catherine Karr

Dr. Karr received a $750,000 grant from the U.S. Environmental Protection Agency to develop low-cost air pollution sensors to help Native American and Latino communities in the Yakima Valley reduce their exposure to wood smoke. Researchers will use next-generation air particle sensors that are portable and battery powered. Researchers will then work with local students over the next three years to both understand and help reduce the community's exposure to wood smoke. Forest fires and residential fires are likely contributors to wood smoke pollution in rural Washington. "We will work with the community, including Heritage University, the Yakama Nation and area high schools, putting new low cost air pollution sensors to work to understand areas of concern and opportunities to improve local air quality," said lead investigator Catherine Karr, professor of pediatrics and environmental and occupational health sciences. The project builds on longstanding research to action partnerships between the University of Washington Pacific Northwest Center for Agricultural Safety and Health (PNASH) and the Yakima Valley community.

NIH ECHO Cooperative Agreement - Environmental influences on Child Health Outcomes

PI: Catherine Karr

PNASH's Dr. Karr has also been awarded more than $4.7 million by the National Institutes of Health to investigate how the environment influences neurodevelopment and asthma risk in children. This is a seven-year multi-site a study of more than 3,000 ethnically diverse pregnant mothers and their newborns. The cohorts are in communities across the United States, including Seattle, Yakima, San Francisco, Memphis, Minneapolis and Rochester. Karr said. "Our study contributes specialty expertise characterizing air pollution and phthalate exposures as well as social factors such as stress, and examines their influence on child asthma, allergies and neurodevelopment."

WA State SHIP Grant - Measuring Worker Exposure to UV Radiation in the Cannabis Industry, and Efficacy of Protective Clothing

PI: Chris Simpson

The cannabis industry is a rapidly expanding in Washington and there is limited quantitative information about potential health and safety hazards for workers. To characterize the intensity of UV exposure and associated health risks experienced by workers in the cannabis industry, this project measures levels of UV radiation and associated worker exposures in five cannabis growing facilities that will be selected to represent a variety of lighting technologies and process workflows. The project will test new inexpensive wearable UV sensors that employers can use to determine their workers' exposures to UV radiation. In addition, researchers will assess UV protective garments effectiveness for reducing worker exposure to UV radiation.

SMALL GRANT (PILOT/FEASIBILITY) & EMERGING ISSUES PROGRAM

Every year PNASH sends out a call to Northwest investigators for pilot research or small projects in agricultural safety and health. The 2015-2016 year's awards for small grants were:

Agricultural Medicine eLearning Series for Mid-Level Health Care Providers

PI: Nancy Simcox, Director, UW DEOHS Continuing Education

This one-year project pilots an eLearning series that focuses on unique Occupational and Environmental Medicine (OEM) agricultural issues in the northwest, increasing competency among mid-level providers (MLPs) to recognize, diagnose, treat, prevent and provide patient education pertaining to occupational injuries and illnesses in the region. To meet the wide-ranging needs of agricultural workers, healthcare providers require a broad base of knowledge along with skills in risk assessment and health promotion related to a unique array of activities and potential exposures. The roles of MLPs, (e.g. physician assistants and nurse practitioners) are increasing in rural areas, and training programs are expanding to meet their needs but require better integration of occupational health into their curricula. PNASH is targeting some of these issues through its research and outreach efforts, and this project will enhance the reach of this work to the health care community.

Injury and Illness Surveillance in the Pacific Northwest for the Dairy Industry

PI: Mike Yost, Professor and Chair, UW DEOHS

This project lays the foundations for an ongoing effort to conduct surveillance of injuries and compensation claims in the WA dairy industry. Currently the dairy industry has a high rate of injury claims, leading to adverse impacts on compensation insurance costs. The project will build on existing PNASH collaborations with the WA Department of Labor and Industries SHARP program, to obtain access to worker's compensation claims data as the primary analysis source. Secondary data sources, such as the WA CHARS data and OSHA 300 logs will be examined as additional sources of information that may complement the claims data. Successful completion of this project will provide a rich preliminary data set and create established methods for continued surveillance across agricultural sectors.

Sexual Harassment Prevention Training Video

PI: Victoria Breckwich Vásquez, Assistant Professor, UW Nursing and Health Studies

This video product is one more step towards a more comprehensive effort to address workplace sexual harassment (WSH) in agriculture. PNASH is working with regional and national partners to reduce sexual violence in agriculture and improve knowledge and resources. The problem is timely, urgent, and in need of a sustained response. This project produces a sexual harassment prevention training video specifically for agricultural growers and workers. We will also develop a dissemination plan and evaluation instruments to measure knowledge gain and impacts. By involving multiple stakeholders in this process, we aim to reduce sexual harassment as an agricultural occupational health hazard.

The number of Latina women and girls entering agriculture (as migrant and seasonal workers) is increasing in Washington and the nation. In the U.S., an estimated 24% of the 1-1.4 million farmworkers are women. Women farmworkers are an underserved minority in the agriculture industry. Because they are largely low-income, Spanish-speaking, and work in male dominated environments, they are at higher risk of WSH. Previous work at PNASH employed a community-engaged research-to-action approach. A community advisory group in the Yakima Valley guided the project, conducted interviews with farmworker women, and developed a comprehensive community-level awareness campaign that incorporated our research findings. Two manuscripts are currently underway describing this work. Since this project, the agricultural industry and legal community have shared their concerns about the dearth of culturally-appropriate educational materials to train workers and prevent WSH.

Emerging Issues Fund

An emerging issues fund of 10,000 direct costs allows PNASH to respond to emerged needs across the year. In FY2016 funds were awarded to support the NIOSH SENSOR meeting, supplement the sexual Harassment project, and support additional statistical consultation needs for multiple projects and PIs.

ADDITIONAL ADMINISTRATIVE ACCOMPLISHMENTS

Agricultural Labor Skills and Safety Program Advisory

The Agricultural Labor Skills and Safety Program is a newly funded initiative by the State of Washington. The program launched in 2016 under the leadership of OIC of Washington, The Washington Farm Bureau, and the Association for Farmworker Opportunity Programs. PNASH serves on the advisory committee as a partner and collaborates in the dissemination of information, including the translation of research into the program.

WA DOSH Agriculture Safety and Health Forum

The forum is a new meeting ground and advisory for Washington State agricultural occupational safety and health led by WA Department of Labor and Industries. Multiple stakeholders are being engaged across the state to address issues in rule-making and compliance. PNASH participates in the forum and reports on research findings.

SENSOR Workshop, Seattle, WA

On March 2-3, 2016 PNASH hosted the annual NIOSH SENSOR Workshop. The mission of the **Sentinel Event Notification System for Occupational Risk (SENSOR**) program is to build and maintain occupational illness and injury surveillance capacity within state health departments. Under this program, NIOSH provides cooperative agreement funding and technical support to state health departments to conduct surveillance on one or more occupational illnesses or injuries. This meeting convened these state programs to improve their practice and review results. In addition, the meeting focused on Northwest specific needs and research. PNASH contributed with event coordination and the following presentations:

- SENSOR Case Coding Exercise – Eddie Kasner
- Practical Solutions for Pesticide Safety - Kit Galvin
- Overview of NIOSH Ag Centers - Marcy Harrington
- Pesticide Drift Reduction Strategies - Richard Fenske
- Pyrethrins/Pyrethroids and IPM in Dairies - Mike Yost

Agricultural Center Evaluators, Coordinators and Outreach (ECO) group

PNASH continues to collaborate across all NIOSH AFF Regional Centers through the Agricultural Center Evaluation, Communication, and Outreach (ECO) group. The ECO group's goals are to share resources and knowledge, collaborate on Center-wide communications and evaluation efforts, and enhance intra-extramural dialogue with the NIOSH Ag Centers and NIOSH program offices. Marcy Harrington has facilitated the overall ECO group since summer 2014, a group of 60 members that span all NIOSH Ag Centers. Meetings take place every other month with working groups focused on Legislative Education, YouTube Channel, Awareness Events, and the National Ag Safety Database.

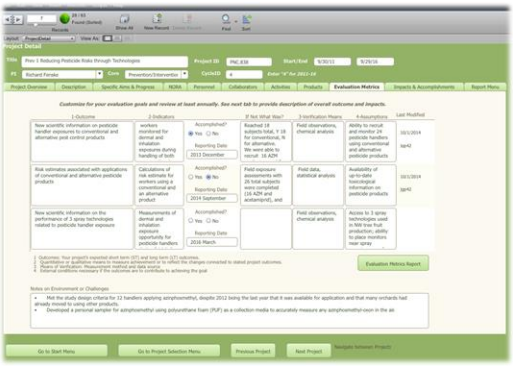
Other Activities

- Monthly meetings of PNASH Internal Advisory Committee and PNASH Staff
- Biannual PNASH Scientific Advisory Committee Meeting, Remote
- Oct 6, 2015. PNASH Staff Strategic Planning Retreat, Seattle, WA
- Feb 2-3, 2016. AUPOHS and Ag Center Directors Meeting, Washington DC
- April 2016. UGS Alternative Safety Compliance Meetings, Newport, OR and Seattle, WA
- June 16. NW Forestry Investigator and Advisory Meeting, Remote
- Sept 29-30 WestON Meeting, Denver, CO

EVALUATION PROGRAM

The PNASH evaluation program moves beyond traditional program monitoring, using a developmental approach to assist project teams in improving efficacy and outcomes. Our goal is to ensure that our efforts are relevant, feasible, sustainable, the best science and practice, and demonstrate efforts consistent with the ultimate goal of reducing injuries and illness. The program focuses at the micro project level and at the macro Center level. On an annual basis, PNASH internally assesses progress and impacts.

Program Monitoring Database, "Harvest," builds on previous NIOSH and Ag Center evaluation tools, allowing our tracking and analysis of PNASH project outcomes and impacts. Unique to this database is the integration of impact stories, stakeholder anecdotes/quotes, PHS Progress Report fields, and a customizable evaluation matrix to track project-specific indictors of success. The system employs a relational database with a web-hosted platform for any-time, any-where data entry and reference. ***Harvest*** was introduced to NIOSH/Ag Centers in November 2014 and has been used regularly for reporting and program review. Currently, two Agricultural Centers, the Nation Children's Center and UC Davis Center are adopting and developing the database for their use.



PNASH's Harvest database is being adopted by other NIOSH Centers

Developmental Evaluation

Dr. Brock and Ms. Harrington continued developmental evaluation consultations with project teams - evaluating successes, unanticipated challenges, plans for navigating challenges, alternative ways success can be defined and evaluated, current and future project impacts, and how stakeholders can become more positively engaged. The Developmental Evaluation approach is described by Michael Patton as "The evaluator is part of a team whose members collaborate to conceptualize, design and test new approaches in a long-term, on-going process of continuous improvement, adaptation and intentional change." In 2016, consultations were held with 14 projects including closing and new projects – key times to inform project design and action plans.

Agricultural Center Evaluators, Coordinators and Outreach (ECO) group

Marcy Harrington has facilitated the overall ECO group since summer 2014, a group of 60 members that span all NIOSH Ag Centers. 2016 evaluation activities included the development of national program materials and templates for centers with an emphasis on outcomes. In addition, the group began a collaboration with NIOSH/CDC on the development of Program Performance One Pagers (PPOPs).

PNASH sponsored Poster Reception at 2016 Western Forum for Migrant and Community Health

OUTREACH & EDUCATION PROGRAM

The Agricultural Community Outreach and Education Program provides the Center's foundation for building relationships and sharing information with our agricultural community. Through our combined education programs, in FY2016 we actively partnered with over 40 organizations representing businesses, community organizations and service providers.

EDUCATION & TRAINING

Ag Safety Day, Wenatchee, WA. "Production to Processing"

On February 24th PNASH co-sponsored our state's annual Washington Governor's Industrial Safety and Health Conference for the agricultural industry. The 2016 event had more participation than previously, with close to 500 attendees – the majority Hispanic employees in the Tree Fruit Industry. Led by the Washington Department of Labor and Industries, PNASH served on the planning committee advisory board along with 10 others and organized the pesticide drift management sessions. The conference, with programs in English and Spanish, was designed for employers, supervisors, workers and safety and health professionals. PNASH served as session proctors and exhibited with a demonstration on pesticide exposure using Fluorescent Tracers. In addition, PNASH partner, the Northwest Center for Occupational Safety and Health, hosted a pre-conference course, ***Process Safety Management for Ammonia.***

Western Forum for Migrant and Community Health, Portland, OR

The Western Forum for Migrant and Community Health brings together health professionals from migrant and community health centers and allied organizations for the purposes of education and training, information and resource sharing, coalition building, and program and policy development. The February 24-26, 2016 Forum was held in Portland, Oregon with PNASH serving on the planning committee and sponsoring of the Research Poster Reception. The Poster Reception included 19 posters, with six of these showcasing PNASH research. PNASH also co-led the workshop, ***Pasos Saludables and Sí Sé Bosque – two projects finding solutions to farm and forest worker health and safety through participatory action methods.***

International Society for Agricultural Safety and Health (ISASH) Conference, Lexington, KY

June 26-30 PNASH participated with presentations, posters and an exhibit. PNASH presentations included Richard Fenske on ***Evaluations of New Technologies to Minimize Worker Exposure to Pesticide Drift in Orchards***, and Kit Galvin with ***Translation and Dissemination of Practical Solutions for Pesticide Safety and Health-Related Illness Research, Evaluation and Impact.*** Posters included ***Latino Forest Service Workers: Characterizing Job Tasks and Hazards in the Pacific Northwest*** and ***Injury Types, Frequency and Trends in WA State Dairy Workers***.

NEW PRODUCTS & RESOURCES DEVELOPED

Video: Pesticide Safety for Agricultural Workers: Pesticide Safety (English and Spanish)

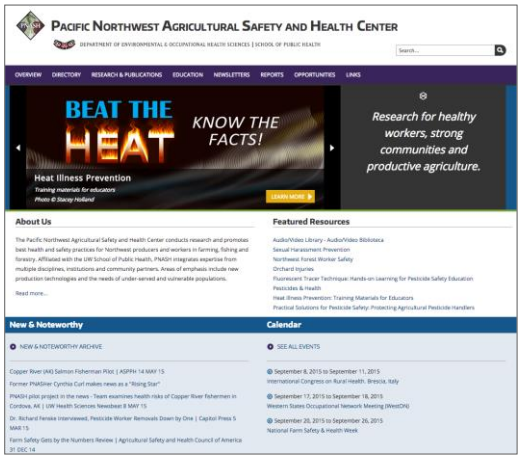
PNASH is pleased to introduce this new training resource for food safety and worker pesticide safety. ***Pesticide Safety for Agricultural Workers*** is a free 21 minute educational video compliant with the criteria set by GlobalGAP, and the EPA's revised Worker Protection Standard, and reviewed by the WA State Departments of Agriculture and Labor and Industries. View at www.youtube.com/channel/UCto11hDpAjpUG5IzWeXPIBg

Glossary of Forestry Services Terms (English and Spanish)

Under an Oregon OSHA contract, Dr. John Garland produced a glossary of terms in English and Spanish for forest services workers and their employers. The glossary covers activities/tasks, tools and hazards. The resource addresses the safety need for clear communication and also introduces this new workforce to the forest management practice goals behind the tasks. Published in September 2016, the glossary will be soon be posted on OR OSHA's website and widely disseminated.

PNASH Website

In FY2016, the website was accessed by 8,000 unique visitors.
See http://deohs.washington.edu/pnash



Sexual Harassment Webpage

PNASH has a new page on sexual harassment prevention summarizing our work and providing resources. It also underwent a review and substantial update. New resources include links to the new Facebook page, promotional video as well as PNASH resources for workers and employers such as the wallet cards. Recently these cards have been shared with an Oregon partner to expand its distribution.
See http://deohs.washington.edu/pnash/sexual_harassment

Heat Illness Prevention Webpage & Materials

Updated educational information has been posted on a page devoted to staying safe while working in the heat. The site presents types of heat illness, identification and treatment, prevention methods, and resources (English and Spanish).
See http://deohs.washington.edu/pnash/heat_illness

REGIONAL ADVISORIES

ADVISORY	TIMELINE/ PNASH ROLE	GOAL	LIASION
Ag Safety Day Committee, Washington Governor's Safety and Health Conference	February event. Planning Committee meets quarterly to monthly.	Advisory committee to WA Dept. of Labor and Industries and Governor; Farm safety education	Pablo Palmández and Jose Carmona
WA DOSH Ag Safety and Health Committee	Quarterly	Stakeholder meeting for transparency/feedback on compliance program	Jose Carmona
Forum for Western and Migrant and Community Health	February-annually/Planning Committee	Integrating occupational health and safety into health care; community health worker edu	Victoria Breckwich Vásquez
NIOSH WestON	Every September 3rd or 4th week	Meeting of state epidemiologists and surveillance researchers in western sates	June Spector
USCG Commercial Fishing Industry Vessel Advisory Committee		Understand stakeholder needs and develop solutions through research, education and regulation.	Laurel Kincl, Marcy Harrington

WA Agricultural Labor Skills and Safety Program	Advisory Committee	Launching new state funded program launching centralized training for agricultural workers in WA	Pablo Palmández
Oregon Occupational Public Health Program	Advisory Board	Provide fatality prevention and surveillance research/expertise to inform Oregon agriculture.	Richard Fenske
Oregon OSHA Forestry Code Committee	Advisory Board – quarterly	Understand stakeholder needs and develop solutions through research, education and regulation.	John Garland
PNW Latino Safety and Health Group	Quarterly/ Planning Meetings	Coordinate across Northwest state agencies to address Latino workforces safety and health needs.	Victoria Breckwich Vásquez
Children's Ag Safety Network	Annual meetings in conjunction with ISASH and remote workgroups	Campaigns in children's/team safety	Catherine Karr, Marcy Harrington
ROPS Program and Tractor Safety Coalition	NW liaison with NY Center – assessing stakeholder interest	ROPs retrofitting and rebate program.	Marcy Harrington
Pesticide Safety Educators and Oregon pesticide group	Annual meetings	Coordination and sharing of information.	Kit Galvin
NORA – Ag Surveillance	10-year cycle ending in 2016. Renewed NORA pending.	NIOSH's National Occupational Research Agenda	Kit Galvin
NORA – Forestry	10-year cycle ending in 2016. Renewed NORA pending.	NIOSH's National Occupational Research Agenda	John Garland and Marcy Harrington

ADDITIONAL OUTREACH & EDUCATION ACCOMPLISHMENTS

- PNASH Mass Communications: monthly E-Newsletter, website, Facebook, YouTube
- Northwest media outlet outreach – radio, trade journals, dailies
- Monthly meetings of Partnership and Community Advisory Board - El Proyecto Bienestar, Yakima County
- Dr. John Garland, safety educator at NW logging conferences and member of Oregon Forest Practices Committee
- Pablo Palmández , PNASH's Agricultural Workplace Specialist, lead outreach and custom training to Latino growers in the tree fruit industry, reaching 15 to 20 people from 5 to 6 farms in central Washington.
- Translational lay articles on sexual harassment in agriculture, heat illness and pesticide exposure
- Oct 2015. Northwest Forest Worker Update – New Safety Research Serving the NW Logging & Forestry Industry
- Dec 2-4, 2015. Washington State Horticultural Association annual meeting, Wenatchee, WA
- March 21. Regional promotion of National Ag Day, "Celebrating Safe and Healthy Ag Workers"
- Sept 18-24. Regional promotion and educational campaign for National Farm Safety & Health Week

Feasibility 7: GRAS2P Food Safety Video

(PNASH Small Grant 2013-2016)

PI: Nicole Brunner, Washington State Tree Fruit Association

PNASH is pleased to introduce this new training resource for food safety and worker pesticide safety. ***Pesticide Safety for Agricultural Workers*** is a free 21 minute educational video compliant with the criteria set by GlobalGAP, and the EPA's revised Worker Protection Standard, and reviewed by the WA State Departments of Agriculture and Labor and Industries. In addition to being made available to all growers in the produce industry, the Washington State Tree Fruit Association (WSTFA) will incorporate this video into their GRAS2P (Growers Response to Agriculture, Safe and Sustainable Practices) educational program.

"This video is a great tool for agricultural producers, which will help them train their employees in various aspects related to worker and food safety"
- Ofelio Borges, WSDA

This educational project integrated the current non-governmental food safety criteria of GlobalGAP and the governmental pesticide safety standards (Worker Protection Standard or WPS) of the EPA into a bilingual (Spanish/English), culturally sensitive, training video for farmworkers in our domestic produce industry. There are few training resources available to creatively assist growers and farmworkers in both food safety and pesticide safety while at the same time assisting them in their compliance with GlobalGAP and WPS. Conceived and created by AJL Productions, this project has been funded primarily through local partners in the agricultural Industry, the WSTFA, PNASH, and the EPA. The pesticide safety component that was sponsored by PNASH, is available at no cost through the EPA and the Pesticide Educational Resources Collaborative.

2016 RESOURCES

Video: Pesticide Safety for Agricultural Workers: Pesticide Safety (Module 6): www.youtube.com/channel/UCto11hDpAjpUG5IzWeXPIBg

Video: Fieldworker Orientation and Food Safety (all 6 modules available for purchase): www.farmworkertraining.com

Feasibility 9: Pilot: Non-Fatal Injuries among Commercial Fishing Workers in Alaska, Washington, and Oregon

(PNASH Small Grant 2014-2016)

PI: Laurel Kincl, Oregon State University

Commercial fishing is the most hazardous occupation in the United States. This pilot study expands on NIOSH's Commercial Fishing Incident Database (CFID) to include data on non-fatal, traumatic injuries. Current information on non-fatal injuries is limited yet constitute the vast majority of workplace injuries and can result in lower productivity, lost wages, lost quality of life, or disability. This study fills the gap with nonfatal injury data, including all traumatic injuries to workers onboard commercial fishing and fish processing vessels operating in Alaska during 2012-2014, and in Washington, Oregon, and California (West Coast) during 2002–2014. This study reviewed US Coast Guard (USCG)

reports, abstracting, coding and entering the information into a study database. A descriptive analysis was completed to identify patterns and characteristics of the nonfatal injuries, work processes, and worker information. In the three-year period, Alaska had more nonfatal injuries (286) than the twelve-year period on the West Coast (208 injuries). In Alaska, the majority of injuries occurred on catcher vessels (57%) and catcher/processors (61%). In the West Coast, the Pacific Whiting fleet (30%) and Dungeness crab fleet (23%) accounted for over half of the injuries. Processors and deckhands accounted for the majority of the injuries. In Alaska, the upper extremities accounted for nearly half of the injuries and included open wounds; traumatic injury to bone, nerves, spinal cord. Over half the Alaskan injuries were due to contact with objects/equipment. In the West Coast, the upper extremities were the most common body part injured with amputations and fractures being more common. Contact with objects/equipment was responsible for over half of the injuries with vessels (29%) and fishing gear (26%) being the most common sources. The research team successfully reviewed reports on injuries in the Alaska and West Coast commercial fishing industry and developed an analytical database. Specific fleets in each region could be engaged to identify prevention strategies targeting specific injuries and work tasks to mitigate risk of injury.

Graduate Student, Samantha Case (NIOSH, Western States Division) with partners Devin Lucas, PhD (NIOSH, Western States Division), and Laura Syron, MPH (Oregon State University)

This study demonstrated the feasibility of the database and analytical methods and has resulted in a 5-year grant award to develop this tool for continued nonfatal injury surveillance and to develop prevention efforts in collaboration with each fishery. Dr. Laurel Kincl at Oregon State University leads this PNASH project, ***Safety Surveillance for Pacific Northwest Fisheries.***

Results relevant to the West Coast Dungeness crab fishery were published (see paper and press release below) and preliminary results on the database presented in Fall 2016 at the Northwest Occupational Health Conference, State of the Coast Conference, National Occupational Injury Research Symposium, and the Epidemiology in Occupational Health Conference.

2016 RESOURCES

Syron LN, Lucas DL, Bovbjerg VE, Bethel J, Kincl LD. Utility of a Work Process Classification System for characterizing non-fatal injuries in the Alaskan commercial fishing industry. Int J Circumpol Heal, 2016. 75. PMCID: 4717151.

Case S, Bovbjerg V, Lucas D, Syron L, Kincl L. Reported traumatic injuries among West Coast Dungeness crab fishermen, 2002-2014. Int Marit Health. 2015;66(4)2017-10. PMC 4704689.

Press Release: http://oregonstate.edu/ua/ncs/archives/2016/jan/injuries-among-dungeness-crab-fishermen-examined-new-osu-study

Feasibility 10: Ag Medicine eLearning Series for Mid-Level Health Care Providers

(PNASH Small Grant 2015-2016)

PI: Nancy Simcox, University of Washington

Professional development training, particularly self-paced online programs, can be used to increase knowledge and skills among health care providers especially in emerging occupational and environmental issues. The Northwest Center for Occupational Safety and Health designed this collaborative e-learning series for primary care providers in rural clinical practices who desire additional training in occupational and environmental medicine. In addition to the broad base of general knowledge required to recognize, treat, and provide preventive health hazard education to their patients, clinicians in agricultural communities of Washington have additional information needs pertinent to our unique regional environmental and occupational exposures. This e-learning course addresses both current and emerging agricultural health hazards, using the latest research on best practices to provide healthcare solutions and resources on regional issues.

"We can use this during the students' didactic year before they go off to their clinical rotations. It is particularly important for our students as we try to place 100% of them in rural or underserved areas where farm workers are a high percent of the population."
-Linda M. Dale, D.H.Ed., PA-C, Program Director, PA Program at Heritage University

This project brings together new regional partners and a program with an expert line-up of instructional and research faculty, covering basics such as workers' compensation resources and administering effective occupational and environmental health histories, and more specific topics such as pesticide exposures, asthma, heat-related illnesses, and lower lumbar spine injuries in agriculture. This program is being offered in a multi-media e-learning format to respond to the needs of busy clinicians. PNASH research results and best practices are highlighted and incorporated throughout the program, and focuses on the regional issues facing agricultural workers today.

The curriculum includes:

Module 1: Overview of Agricultural Medicine

Module 2: Occupational & Agricultural Health History, the Farmworker Physical Examination, and an Intro to Workers' Compensation

Special Topics Lecture Series: Adult Occupational Pesticide Exposure; Pediatric Pesticide Exposure; Heat-related Illness; Lower Lumbar Spine Injury Diagnosis and Treatment, and; Work-related Asthma (with a focus on hops as an agent)

Module 1, the Introduction to Agricultural Medicine: Advancing Occupational and Environmental Health Practice in the Northwest, will be launched in January 2017, with the lecture series following in the next month. It is currently being reviewed as an enduring event by Centers for Disease Control and Prevention (CDC) for continuing medical education accreditation and is compliant with section 508 of the ADA.

Feasibility 11: Injury & Illness Surveillance in the Pacific Northwest for the Dairy Industry

(PNASH Small Grant 2015-2016)

PI: Mike Yost, University of Washington

Washington State claims data indicates that dairy workers in the state have a higher than average rate of injury than the overall worker population. Industry specific risks include acute injuries from animal assaults, slips and falls on wet surfaces and chronic injuries from repetitive stress. A thorough study of injuries to workers in the Washington dairy industry and other similar industries has not been previously conducted. This project lays the foundation for a

surveillance program of dairy injuries in the State of Washington. The data being used in the project was obtained from the Washington department of Labor and Industry (LNI) with cooperation from the Safety and Health Assessment and Research for Prevention program (SHARP). We identified and created data definitions for key field codes present in the LNI SHARP workers' compensation database as well as identified the linkages between this data and the Washington State Employment Security Database and the Comprehensive Hospital Abstract Reporting System (CHARS) database. We additionally created a database framework, here at the University of Washington that will allow for the LNI data to be stored and accessed from department servers. Lastly, we obtained data on injury claims in the dairy industry from 2010-2014 and compared the rates of injuries across different injury types between dairy, agricultural and all Washington State employees covered by the state fund.

This pilot work will be built on in the PNASH Center's next cycle under our Center's ongoing surveillance of agricultural fatalities and injuries and Dr. Yost's 5-year intervention project*, **Injury and Illness Prevention in the Pacific Northwest for the Dairy Industry.***

2016 RESOURCES

Data Dictionary: Washington Workers Compensation: Agricultural Industries

Feasibility 12 (Breckwich Vásquez): Sexual Harassment Prevention Training Video

(PNASH Small Grant 2015-2016)

PI: Victoria Breckwich Vásquez, University of Washington

Workplace sexual harassment (WSH) in agriculture is a growing concern that threatens the livelihoods of farmworkers nationwide. Although there are legal remedies for victims who report WSH to their employers or the police (in cases of sexual assault), few workers know their rights and most are wary of filing an official report or telling anyone. The magnitude of this problem nationwide is 420,000 women farmworkers (and is likely higher due to a persistent undercount of migrant workers). Published literature suggests that 50% of women will experience sexual harassment at some point during their careers and rates may be higher among minority women working in male-dominated environments. Sexually harassed women also experience higher rates of healthcare utilization, chronic pain, depression, and work withdrawal than non-harassed women, even up to ten years after the incident. Thus, prevention of WSH is vital to promoting the health of women workers.

A public health approach focusing on prevention offers great potential for reducing WSH. Prevention efforts could reduce or eliminate the events, conditions, situations, or risk factors that result in sexual harassment and the associated health, social, and economic impacts on the subjected women. Unfortunately, culturally-appropriate and engaging educational materials to train farmworkers on prevention measures at the workplace have not been developed.

Dr. Beckwich Vásquez with UW student exhibiting on sexual harassment prevention in ag

To address this need and demand for solutions in Washington state, PNASH under the leadership of Dr. Breckwich Vásquez, launched this small project, building on our previous community-based studies. This project's specific aims are to 1) develop educational and informational products that address sexual harassment in the agricultural workplace; and 2) effectively disseminate these products through key stakeholders and throughout the Yakima Valley using a variety of methods. The long-term goal is to share this educational and informational strategy with other agricultural communities throughout Washington. This project launched with strong commitments from key players at the WA State Human Rights Commission, Northwest Justice Project, WA Growers League, WA State Department of Labor & Industries, and WA State Department of Agriculture.

Accomplishments in the last year include a final sexual harassment prevention training video script specifically for agricultural growers and workers and video trailer to foster awareness on the issue and recruit partners in this initiative. Methods for developing the video script began with preliminary qualitative analysis of our concurrent study results, storyboarding and iterative development with advisors. The 12-member advisory group met 4 times through the year and has informed these products and the development of the video dissemination and evaluation plan to measure knowledge gain and other impacts. Criteria for selection of advisors was based on their involvement in local issues, contacts, expertise in sexual harassment, service to the migrant farmworker community and knowledge of the agricultural community (including industry). By involving multiple stakeholders in this process, we expect this training video to lead to improvements in the safety of workers in agriculture by reducing sexual harassment as an occupational health hazard.

The continuing development of this educational resource for the agricultural workforce is vital for preventing worker exposure to sexual harassment. The outcomes (finalized script, promotional trailer, evaluation plan) we have produced as a result of this project together contribute to a comprehensive plan that better protects farmworkers. Through additional funding donation we expect to begin filming in Spring 2017 and finalizing the video (Spanish) by Fall 2017. In addition, two funding application were submitted in Summer 2016 and if funded, we will move forward with finalizing evaluation instruments, audience testing the educational curriculum (including the video), and assessing the outcomes of the video on over 800 agricultural workers, managers and owners in Washington.

2016 RESOURCES

Video script: **Sexual Harassment in Agriculture: A Workplace Prevention Training. August 28, 2016**

Video trailer: **Sexual Harassment in Agriculture**, https://vimeo.com/north40productions/review/151036367/f6e25b0ed8

Website: http://deohs.washington.edu/pnash/sexual_harassment

Facebook page: www.facebook.com/harassmentinagriculture

News: Bandanas Connect Students with Farmworkers, UW Bothell News (5/12/16), http://www.uwb.edu/news/may-2016/bandana

NIOSH SPONSORED PROJECTS – CONTINUING

PNASH current cycle of research projects has received a six-month extension to complete final analysis and preparation of results. The final report on PNASH's 2011-2016 cycle will be released in Spring 2017.

Res 1: Farmworker OP Exposure through Protein Adducts

(NIOSH 2011-2016, UW Royalty Research Fund 2012)
PI: Christopher Simpson, University of Washington

The overall goal of this project is to improve methods for detecting overexposure to organophosphorus pesticides (OPs). This is being achieved through the development of new analytical approaches to detect OP-protein adducts, and using these tools to measure pesticide exposures in agricultural workers who handle OP pesticides.

Orchard pesticide application

In Washington State, cholinesterase (ChE) activity is measured in farmworkers who are expected to have high exposures to OPs. When depression in cholinesterase activity is observed, remedial actions are undertaken to reduce exposures and protect worker health. High exposures can have fatal consequences and longterm effects. The current ChE test for exposure lacks sensitivity and specificity, resulting in a substantial number of false positives and false negatives. To improve assessment of worker exposures to OP pesticides we developed an assay based on the measurement of OP-adducts to butyryl cholinesterase (BChE) using immunomagnetic beads and HPLC-mass spectrometry. The assay provides accurate determination of the percentage modification of the active site of BChE and can detect down to 2% of BChE modified with pesticide, thereby eliminating the need for collection of a baseline pre-exposure blood sample from each worker. The assay has since been expanded to measure pesticide adducts to two other enzymes, acylpeptide hydrolase (APH) and red blood cell cholinesterase. These additional enzymes are more sensitive than BChE to certain pesticides, so their addition increases the breadth of pesticide exposures that we can monitor. Another improvement was to decrease the amount of blood required such that a dried blood spot can be analyzed. This could allow monitoring using a simple finger-stick rather than a blood draw. The assay has been, and will continue being used to measure OP exposure in samples collected from agricultural workers in Washington and Pakistan, and pesticide manufacturers in Pakistan. The three populations represent a range in levels of pesticide exposure with which to evaluate the assay as it is improved and expanded. By expanding this assay we will improve the understanding of worker exposures to a wide range of OP pesticides and develop it for use in field and clinic settings, providing rapid feedback to workers, clinicians, and physicians. Results from the new assays will be compared to measurements of ChE depression in the same samples.

We will continue to collect and archive blood and plasma samples from pesticide exposed workers and then apply the BChE and APH assays to the new and archived blood and plasma samples. Demonstrating the application of BChE, APH, and AChE assays in exposed populations, and the association between OP adduct levels and risk factors for OP overexposure. Manuscripts are currently in preparation.

Res 2: Using IPM to Reduce Pyrethroid Pesticide Exposures in Dairy Workers

(NIOSH 2011-2016)

PI: Michael Yost, University of Washington

This project partners with Washington State University to reduce pyrethroid pesticide use in dairy operations by introducing Integrated Pest Management (IPM) practices in these workplaces. Since 2001, pyrethroid-related illnesses documented by the WS-DOH have quadrupled, suggesting that exposures to pyrethroid insecticides have been increasing both at home and in the workplace. Not only are pyrethroids harmful to workers, but they are also expensive to purchase and store. This project aims to evaluate new IPM strategies that reduce worker exposure as well as costs.

Treating for pests

The results of the 2015 study provide dairy operators important information about IPM options for their fly management programs. In addition to their usual IPM fly management practices, we introduced a larvicide in feed-through products for cows and calves. At one dairy, the operator observed that the use of the larvicide administered in the calves' milk showed a mark reduction in fly populations in a large calf-hutch area compared to previous years, and he plans to continue using it. At the same dairy it extended the time between use of permethrin applications on adult dairy cows (once every 30 to every 40 days). In another calf barn with minimal natural ventilation, fly populations were higher than others in the area. In a small calf barn at another dairy, clean bedding, which includes removal of manure, and instituting consistent use of the larvicide in milk, dramatically reduced very high fly populations. This operator in previous years used pyrethroid pour-on products for adult cows once every three weeks. With the feed through in the dairy cows feed, he used it once at the very end of the fly season. He also observed fewer flies around the adult cows compared to previous years.

In addition to the study of the feed through larvicide, two other studies assessed the potential for dairy worker dermal exposure to the pesticides' residues on non-permeable surfaces. One study looked at the residue levels on surfaces adjacent to pesticide application areas where workers were likely to touch, such as metal railings and gates. The pesticides are applied to the backs of adult cows. Residue levels increased after application. This increase was most pronounced in the area closest to where the wear application took place. The other study looked at pesticide decay rates. Using a randomized design using one-inch aluminum disks, decay rates of both cis- and trans-permethrin were similar to those found in studies of cattle hair. The half-life was seven days and residues were still present 21 days after application when the study ended. Dairy workers need to be aware that pyrethroid residues will persist on non-reactive (metal surfaces) after applications and they need to take precautions to avoid dermal exposure to these residues.

We continue our outreach to dairy farm stakeholders throughout the state and are currently translating results into best practice guidance.

2016 RESOURCES

Video: Lessening the Risks To Dairy Farm Workers – feature on student, Sara Mar.
www.youtube.com/watch?v=bibReMn5aYo&feature=youtu.be

Prev 1: Reducing Agricultural Worker Risks through New and Emerging Technologies

(NIOSH 2011-2016, MAAF 2012-2013)

PI: Richard Fenske, University of Washington

Agricultural worker pesticide exposure and pesticide drift continue to be serious public health concerns in Northwest tree fruit production. Tree fruit production currently involves the use of high volumes of toxic pesticides. Personal protective equipment is the most commonly used form of protection among agricultural workers. However, previous PNASH research has found that the use of personal protective equipment is often insufficient for protecting workers. The purpose of this project is to analyze the effectiveness of new pest control practices and application technologies in reducing worker exposure and drift.

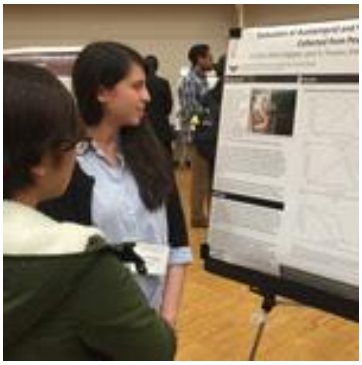
Field test measuring pesticide drift with three application technologies

A primary aim of the project is the evaluation of a product substitution intervention. PhD student, Jane Pouzou, conducted a comparative risk analysis of nine different alternatives to the organophosphorus insecticide, azinphos-methyl, which was recently phased out for tree fruit pest control. Exposure data used by EPA and other regulatory agencies were obtained from two industry task groups, and toxicity studies were obtained from EPA. These data were combined with PNASH-generated exposure data to estimate total exposure and risk of acute neurotoxicity for each pesticide. Results of this analysis supported the cancellation of azinphos-methyl from the perspective of acute occupational health impacts, but also indicated that acetamiprid exposures may be higher than anticipated in handlers who wear protective clothing according to label instructions. Dr. Pouzou was recognized for her work through a competitive training grant award from the NIEHS Environmental Pathology/Toxicology Program. She also received the Russell L. Castner Endowed Student Research Fund Award, and was named Outstanding PhD Student in the Department of Environmental and Occupational Health Sciences.

"I'm hoping we'll find a win-win scenario, where the pesticides that are the most effective and preferred by the growers are also safer."
- Jane Pouzou, PhD Graduate

In tandem with these quantitative risk assessments, our research team conducted the Comparative Risk and Pesticide Decision Making Survey, a mixed-media survey and phone interview with 68 licensed crop consultants in Washington State to understand the drivers of pesticide selection and how to better characterize new pest control compounds and principles. Participants responded positively to the study and have received the final results for their own review. Results of the survey are being integrated into a Multi-Criteria Decision Analysis model to better understand priorities among pesticide users.

The second aim of this project is focused on evaluation of new pesticide application technologies for drift reduction. We have continued our collaboration with Washington State University in field-testing that began in the Fall of 2014. Under the direction of PhD Candidate, Eddie Kasner, novel methods for measuring tracers of pesticide spray drift were developed and used in two orchard-based field studies (fall 2015 and spring 2016). More than 300 field samples are being analyzed to compare worker exposure to drift from two sprayer technologies: one traditional air blast sprayer and one tower sprayer. Preliminary results were presented at the annual meeting of International Society of Exposure Sciences in October 2015. Field studies for comparison to a third sprayer technology were completed in September 2016.



Christine Delgado, student research assistant poster

Close collaboration with Washington State University (WSU) and Washington Tree Fruit Research Commission (WTFRC) ensures the integration of WSU orchard sprayer calibration techniques into our field studies and aids in dissemination and communication to Washington growers.

We welcomed additional student researcher assistants in 2016. Magali Blanco, Masters student, received funding from the Graduate Opportunities and Minority Achievement Program to investigate the effect of using different spray technologies on pesticide drift in neighboring orchards. The study aims to better characterize pesticide drift patterns as well as potential worker exposure. This research is the first to use real-time particle monitoring and time series data to better characterize drift variability during a spray event. And Christine Delgado, undergraduate student, has joined the team supporting multiple aspects of this study.

Related to this project is addressing drift to reduce exposure to neighboring workers, lands and bystanders. Farmworker exposure to agricultural pesticide drift is a high priority concern for public health. In May 2014, the Washington Department of Health (WA DOH) alerted state agencies and growers of a spike in pesticide spray drift illness cases among orchard workers. Over a two-month period, approximately 60 individuals were exposed to pesticides in 15 drift events, which is equal to the number of cases that the agency normally sees over the course of an entire year. A recent CDC/NIOSH report documented one of these drift events. In response, there have been calls for improved communication among farms, applicators, and workers. We conducted a systematic review of pesticide spray notification systems throughout the world, with the goal of addressing the needs of Washington State orchards. Assuming that costs, work burdens, and legal liabilities are minimized, a remote farm-to-farm spray notification system appears to be a promising means by which to prevent farmworker exposure to pesticide drift. Future work is needed by a coalition of partners (farm owners and managers, farmworker groups, research and education communities, and state agencies) to engage stakeholders and determine how to best develop agricultural workplace spray notification systems. (See paper below.)

2016 RESOURCES

Kasner EJ, Fenske RA, Galvin K, Yost MG, Palmández P. Review of Agricultural Spray Notification Systems. Technical Report 2016-1. Pacific Northwest Agricultural Safety and Health Center, Department of Environmental and Occupational Health Sciences, University of Washington, July 2016.

Pouzou JG. The Use of Multi-Criteria Decision Analysis in Performing Alternatives Assessment and Comparative Risk Analysis: The Case Study of Codling Moth Pesticides. 2016 Doctoral Thesis, University of Washington.

Video: Reducing Agricultural Worker Risks through New and Emerging Technology – feature on student, Jane Pouzou. www.youtube.com/watch?v=eKls2ghP_dI

Prev 2: Ergonomic Evaluation of Emerging Technologies in the Tree Fruit Industry

(MAAF 2009-2011, NIOSH 2012-2016)
PI: Peter Johnson, University of Washington

Tree fruit production activities, such as pruning and structural cutting, green fruit thinning, and fruit harvesting require high-intensity physical labor. Traditionally, these activities are performed from the ground or from ladders. Now, new interventions are being introduced: innovations in hand-held tools (pruners), apple collection systems (vacuums and conveyors), and ladder replacements (mobile platforms). This project aims to perform ergonomic evaluations of ladder replacement interventions, integrating productivity and safety evaluations into the process of developing new agricultural technologies. In collaboration with an

innovative manufacturer and growers, our field study compared the two methods for ergonomic stressors, including kinematic (arm movements) and physiological (muscle fatigue and muscle activity).

Overall, the use of the harvest-assist platform along with ground picking reduced ergonomic stressors compared to the use of ladders during apple harvesting. The workers using the harvest assist platform had lower ergonomic stressors, than those picking from the ground. Stressors measured while picking from the ground were lower than picking from ladders. Two exceptions for the ground-picking group were, greater back bending and time with the right arm above the shoulder. A suggested intervention could be to rotate workers between ground and harvest assist platform groups.

These results were provided to the project advisory group, participating employers and manufacturers and at the 2015 annual meeting of the Washington Tree Fruit Association.

Other recommendations include:

- Continue and expand the use of harvest assist platforms as they can reduce ergonomic stressors for apple pickers.
- Move the lunch break to a later time in the morning to reduce afternoon fatigue.
- To obtain maximum benefit in productivity, adjust the number of workers on the platform to match the upper canopy fruit load.

A best practices report is currently under review. This will be presented to our advisory group and industry partners in Winter of 2017.

2016 PUBLICATIONS

Thamsuwan, O. Objective Methods for Characterizing Physical Exposures which may contribute to Work-related Musculoskeletal Disorders in Agricultural Workers. 2016 Doctoral Thesis, University of Washington.

Prev 3: Impact of a Total Worker Health® Intervention on Workplace Stress in Farmworkers (NIOSH 2014-2016)

PI: Diane Rohlman and Kent Anger, Oregon Health Sciences University

This 2-year project was recently awarded to the OHSU Total Worker Health Center to build a program to address workplace stress– a need seen in our previous surveys of farmworker families. Based on community and industry input, this project has adapted current training and wellness programs to pilot a new Total Worker Health® (TWH) intervention to reduce stress for Latino agricultural workers. The aims of the pilot project are:

Aim 1: Identify workplace stressors and lifestyle factors associated with stress in farmworkers. (STRESS FACTORS SCREENING) A cohort of Latino agricultural workers currently employed in agriculture participated in a broad-based total worker health assessment with measures that reflect stress and factors that affect stress and the response to stress.

Aim 2: Develop a Total Worker Health® intervention to reduce workplace stress in the farmworker community via the workplace. (INTERVENTION) Training on effective supervision and work-life balance developed in the Oregon Healthy Workforce Center (OHWC) was adapted for farm managers and supervisors. In 2016 our TWH intervention for agricultural workers was piloted with a large grower with the goal to reduce workplace and individual stress, through lifestyle education using small-group procedures. The program includes:

Computer-based training and HABITRACK app

1) computer-based training program for supervisors/managers to improve work-life balance in the workforce,
2) a practice app, ***HABITRAK***, for supervisors to track and practice what they learn, and
3) a team-based education program addressing lifestyle behaviors and safety that also includes take-home activities to practice the lifestyle behaviors. The TWH intervention is designed to reduce stress due to work and improve lifestyle-related behaviors, including the topics (28 in total): Get Healthier, Stress and Stress Reduction, Sleep, Sun Protection, Calories, Nutrition, Exercise, Strength, Flexibility, Moving Forward, Stress, Relaxation techniques, Public Assistance Programs, Health Care and Insurance, Pesticides, Heat Stress, Ergonomics.
4) Evaluation through pre- and post-intervention surveys and health measures.


Dr. Kent Anger introducing the project at a participating vineyard

We are now expanding the pilot to additional growers. The program will be sustained into the future through the OHSU Total Worker Health Center and close partnerships with Salud, Tuality Health Care and LIVE, Inc. LIVE is a new partnership to the project - a wine grape grower certification program with the motto ***Science-based standards for sustainable winegrowers***. Their membership includes 317 winegrowers in the Northwest.

2016 RESOURCES

Computer-based Training: cTRAIN Total Worker Health® for Farmworkers
App: HABITRAK Total Worker Health® for Farmworkers

28 Get Healthier and Wellbeing Cards

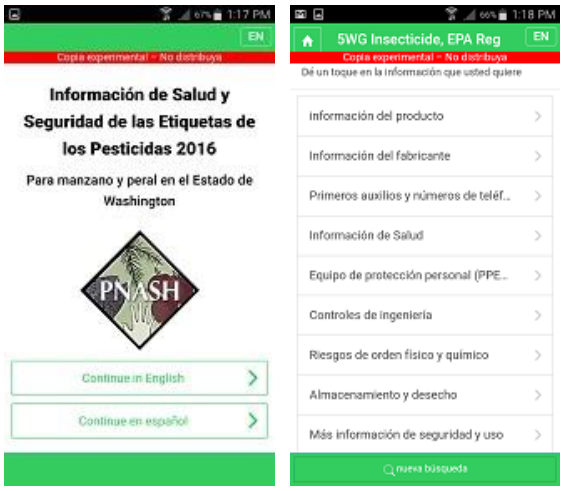
Edu 1: Pesticide Safety in Tree Fruit: Translating Research, Overcoming Barriers
(NIOSH 2011-2016)
PI: Nadine Lehrer, Chatham University, and Kit Galvin, University of Washington

The overall goal of this project is to minimize agricultural worker and family pesticide exposure in the tree fruit industry by translating and disseminating research results and overcoming barriers to pesticide safety practices, particularly those that affect the large Hispanic workforce in the Pacific Northwest. By translating research into an accessible and relatable form, orchard owners, managers, and handlers will be better equipped to protect workers and their families from potential pesticide exposure and illness. This project capitalizes on the expertise of two institutions, the University of Washington PNASH Center and the Washington State University Tree Fruit Research and Extension Center.

For the aim to identify and address barriers in pesticide safety education, Dr. Lehrer and the project **Stakeholder Working Group (SWG)** concluded that to improve worker pesticide safety, the underlying issue of management and supervisor training, needed to be addressed. Thus, in years 4 and 5, we conducted 21 interviews with human resources managers at tree fruit companies, 90 surveys with tree fruit supervisors, and included questions in a broader survey of tree fruit owners/managers about supervisory training needs in the industry. The stakeholder group has developed a plan for meeting during 2016-17, was awarded a seed grant from UW-PNASH for this work, and plans to analyze existing trainings, develop a certificate program curriculum, and apply for further funding to continue these efforts beyond 2017.

> *"I don't have that [training resources] at this time. It's just me… So I was super excited to hear about what you're doing, because I'm like, 'Ahh, maybe there's another access point for getting information.'*
>
> *- Human Resource Manager*

Survey: Emerging Issues in the Washington State Tree Fruit Industry. An objective of the PNASH and WSU - TFREC collaboration was to "take the pulse" of growers on a several emerging issues in the industry through a state-wide survey. The survey included topics on emerging pests, IPM programs, drift of lime sulfur, supervisory training for the industry, the revised worker protection standard, and HRI as it pertains to PPE use. After developing and validating the survey questions, we followed recommendations to make the survey bilingual. PNASH contracted with the WSU Social and Economic Research Survey Center to manage the survey distribution and data collection. A mixed mode method (paper and online) was used to increase the response rate. The pool of potential participants (1179) received 5 mailings, which either contained a letter with instructions how to fill out the survey online or a similar letter with the paper versions in Spanish and English and a pre-paid return envelope. Data analysis is currently under way. The summary results will be shared with the Tree Fruit Industry this fall.



Pesticide label App in (SPAN/ENG)

Mobile app: Pesticide label Health and Safety Information
Year 5's educational tool focus was to improve accessibility for pesticide label health and safety information in Spanish for the Tree Fruit industry. A mobile app was developed and piloted that provided in both English and Spanish labels including the sections on: 1) the pesticide product, and 2) health and safety. As this was a pilot, the app was limited in scope. It focused on seven major pests of apples and pears, drawing on WSU's 2016 Tree Fruit Crop Protection guide and labels database. Spanish is the first language for most the orchard managers and pesticide handlers. Frequently, in our project engagement we heard, "We need labels in Spanish" or "The English is hard to understand." To meet this unaddressed need, we developed the bi-lingual mobile app, ***Pesticide label Health and Safety Information***. The pilot test was a resounding success, demonstrating the urgent need for label information in Spanish, and that the app is

the appropriate delivery media. Managers and pesticide handlers have not been getting the critical information from the labels they need through the current law to use the labels on the pesticide container. Ten orchard managers participated in the test (primary language, English = 2 and Spanish = 8). Nine of ten already used smart phones and reported that the Spanish helped them understand the label, and that they found the app easy or very easy to use. When asked if they preferred the app or the paper label, 9 of 10 choose the App. Most participants were willing to pay for the app 7 said they would spend between five and ten dollars for the bilingual label app with just the product and health and safety information (the version they tested) or a full label.

"We've never had something similar in Spanish. Spanish is the handler's language. Our boss never explained to us the labels and we have to consult the labels by ourselves. (Now) It takes me two to three minutes to consult information I need using the app."

- Pesticide Handler piloting the app

The future of the app will take a significant investment in the maintenance and expansion of the database as well as the cost of accurate and culturally appropriate translation. Our current challenge is to meet the demand, so we are now introducing these results to the US EPA, NIOSH and industry and exploring how to bring the app to market.

2016 RESOURCES

Galvin K, Krenz J, Harrington M, Palmández P, Fenske RA. Practical Solutions for Pesticide Safety: A Farm and Research Team Participatory Model. J Agromedicine. 2016;21(1):113-22. doi: 10.1080/1059924X.2015.1107519. PubMed PMID: 26488540.

Survey: Emerging Issues in the Washington State Tree Fruit Industry (SPA/ENG)

App - beta version: Pesticide Label Safety and Health Information (SPA/ENG)

ADDITIONAL FY 2016 ACCOMPLISHMENTS

Heat Exposure, Injury Risk, and Productivity in Agricultural Workers

(NIOSH K01 2014 - 2017)

PI: June Spector, University of Washington

This new investigator award, to Dr. June Spector, examines the association between heat exposure and traumatic injury risk in agricultural workers, with the ultimate goal of developing injury prevention solutions. The study will first draw on established climate models and WA workers' compensation data. Then, harvest workers will be evaluated, in the field, for associations between heat stress, psychomotor performance and productivity. In addition, the field studies will test the feasibility of using urinary 8-hydroxy-2'-deoxyguanosine (8-OHdG) as a biomarker of heat acclimation.

Researchers reviewed 12,200 workers' compensation injury claims between 2000 and 2012 in relation to maximum daily humidex exposures. The paper released (see citation below) shows an increased risk for traumatic injuries in ag workers during hot conditions, particularly with certain work-intensive harvesting activities in July. The connection between heat and injury was not surprising. With heat exposure, dehydration, and fatigue, a person

"Our findings underscore the importance of working together with workers and growers to identify and evaluate practical strategies that address the increased risk of injury that outdoor agricultural workers face in the heat."

- June Spector, Principle Investigator

can become less stable on their feet and have more difficulty concentrating.

The study team will now take these lessons into the field to determine the specific mechanisms and risk factors for injury, and engage with employers to estimate future productivity losses and health effects and develop heat related illness prevention interventions.

2016 RESOURCES

Spector JH, Bonauto DK, Sheppard L, Busch-Isaksen T, Calkins M, Adams D, Lieblich M, Fenske R. A Case-Crossover Study of Heat Exposure and Injury Risk in Outdoor Agricultural Workers. PLOS ONE 2016 Oct 7. http://dx.doi.org/10.1371/journal.pone.0164498

Trade article: Avoiding heat-related illness - Study finds workers paid piece rate tend to work harder and take fewer breaks, increasing the risk of heat-related illness symptoms. Good Fruit Grower Dec 28, 2015. http://www.goodfruit.com/avoiding-heat-related-illness

Press release: Hot Weather can Increase Risk of Agricultural Worker Injuries, http://deohs.washington.edu/news/more-washington-agricultural-workers-injured-hot-weather

Safety and Health of Latino Immigrant Forestry Services Workers

(NIOSH U01 2014 – 2017)
PI: Arnold de Castro, University of Washington

Occupational injury and illness rates among workers in the forestry services industry (tree planting, forest thinning, brush piling, etc.) are 2 to 3 times the rates of the average US worker, and fatality rates are 9 times as high. The largely immigrant, Latino workforce in this industry is essential to US forest management, yet marginalized because of documentation status, lack of English proficiency, low literacy, occupational immobility, working in remote locations under contracted employment, and deficiencies in skills training. Applying principles of participatory action research with workers and a community-based promotora program, we examine how hazardous working conditions, workplace practices/systems and worker fears of retaliation affect occupational injuries and illnesses, post-injury health outcomes, and worker attempts to improve workplace safety and health. We are developing case studies based on in-depth, interviews with forest workers in southern Oregon about serious on-the-job injuries/illnesses experienced in the previous year and their proactive attempts to improve working conditions. These case studies will be transformed into print and digital educational resources for workers and employers utilizing personal narrative storytelling.

Our second year accomplishments included the completion of our target interviews, with 99 worker pre-selection interviews and 25 case study interviews. Our Technical Advisory Group and Expert Working Group (EWG) each informed the development of the interview tools, community engagement and interpretation of results. In addition, we began the development of educational materials, including: 1) 6 videos with worker narrated stories to create training that is culturally, linguistically, and educationally appropriate for Latino forest workers and their supervisors, and 2) employer tailgate training materials which were piloted with workers and reviewed by our participating employers. Currently a comprehensive qualitative analysis is underway of both the pre-selection and case study interviews.

2016 RESOURCES

Videos: Six worker video narratives of forest work injury experience

Home Air in Agriculture Pediatric Intervention Trial

(NIEHS R01 2014-2019)

PI: Catherine Karr, University of Washington

The primary goal of the HAPI project, made possible through El Proyecto Bienestar, is to reduce exposure to inflammatory agents and allergens in the homes of asthmatic Latino children residing in an area of intense dairy and crop based industrial agricultural production. Community based participatory activities in the Yakima Valley, Washington State have identified pediatric asthma as a priority health concern for the community. This study addresses three highly underdeveloped components of asthma and environment research: the health of children with asthma living in communities with industrial scale agricultural operations, asthma in a particularly vulnerable subpopulation (Latino farm worker children), and evidence-based intervention strategies in these populations.

Children with poorly controlled asthma aged six through twelve years, recruited through the Yakima Valley Farmworker Clinic, are randomized to the clinic's usual asthma educational program or an enhanced program which includes two portable high efficiencies particulate air (HEPA/NH3) cleaners located in the child's sleeping area and living room. Children in the usual program group will receive HEPA/NH3 units after their study year. This study seeks to characterize key indoor pollutant exposures for 75 children with asthma who reside within 400 meters of crop production or dairy operations. The program opened for recruitment in the summer of 2015 and has approximately 40 families who are either currently enrolled or have completed their study year.

ADDITIONAL 2016 RESEARCH PUBLICATIONS

Additional publications based on PNASH-related projects funded in previous cycles.

Butler-Dawson J, Galvin K, Thorne PS, Rohlman DS. Organophosphorus pesticide exposure and neurobehavioral performance in Latino children living in an orchard community. Neurotoxicology. 2016 Mar;53:165-72. PMID: 26820522.

Gibbs JL, Yost MG, Negrete M, Fenske RA. Passive Sampling for Indoor and Outdoor Exposures to Chlorpyrifos, Azinphos-Methyl, and Oxygen Analogs in a Rural Agricultural Community. Environ Health Perspect. 2016 Aug 12. [Epub ahead of print]

Loftus C, Yost M, Sampson P, Torres E, Arias G, Breckwich Vásquez V, Hartin K, Armstrong J, Tchong-French M, Vedal S, Bhatti P, Karr C. Ambient Ammonia Exposures in an Agricultural Community and Pediatric Asthma Morbidity. Epidemiology. 2015 Nov;26(6):794-801. PMCID: 4587379.

Spector JT, Krenz J, Blank KN. Risk Factors for Heat-Related Illness in Washington Crop Workers. J Agromedicine. 2015;20(3):349-359. PMID: 26237726.

Fowler H, Adams D, Bonauto D, Rabinowitz P. Work-related injuries to animal care workers, Washington 2007-2011. Am J Ind Med. 2016 Mar;59(3):236-44. PMC4872621.

Kim NJ, Vásquez VB, Torres E, Nicola RM, Karr C. Breaking the Silence: Sexual Harassment of Mexican Women Farmworkers. J Agromedicine. 2016;21(2):154-62. PMID:26797165.