

Western Center for Agricultural Health and Safety (WCAHS)

*Protecting farmers, farmworkers,
farm families and their communities*

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SECTION I

CENTER SUMMARY

Agriculture in the Western United States represents one of the most intensive and productive operations in the world. California's agricultural industry alone is the largest and most diverse in the nation, producing nearly half of US-grown fruits, nuts and vegetables. WCAHS' mission is to improve the health and safety of farmers, farmworkers and their families and communities, with particular consideration of those issues unique to western agriculture in the states of Arizona, California, Hawaii, and Nevada. WCAHS has a 25-year history of interdisciplinary research accomplishments, including recognition of inorganic dust as a cause of respiratory disease in agriculture, ergonomic changes to reduce injury in grape harvest, new assays for pesticide monitoring, outreach to farmworkers on pesticide and heat-related illness prevention, and addressing the health impacts of migrant status on farmworkers. WCAHS works with regional growers, industry, labor, governmental and non-governmental organizations (NGOs), and community groups to address agricultural safety and health issues through the translation of research results into effective work-place interventions. WCAHS is located at the University of California, Davis, which has world-renown agriculture and veterinary programs. The multidisciplinary nature of the Center faculty has facilitated a wide variety of field-oriented research projects, along with diverse trainings and multi-lingual educational programs, and interventional prevention programs.

RELEVANCE

Agriculture is one of the most hazardous occupations, and more than 30% of the nation's farm workers live in the four western states covered by WCAHS: California, Nevada, Arizona, and Hawai'i. WCAHS has direct public health importance by increasing the understanding of what causes disease in this population and applying the findings to develop interventions to reduce injury and illness.

WCAHS maximizes the impact of NIOSH Center funding by obtaining extramural funding (e.g., NIH), nurturing existing partnerships (e.g., CalOSHA, CalEPA and Cal Department of Pesticide Regulations (DPR)) and building new NGO/private industry partnerships (e.g., Reiter Affiliated Companies, the largest multi-berry producer in the world). Partnerships and campus graduate student support continue to allow us to broaden our impact, enhance outreach and training activities, and nurture the next generation of researchers. Substantial matching funding from UC Davis further allows us to leverage the core Center funding from NIOSH.

WCAHS' outreach and public communication efforts are comprised of diverse media (e.g., webpage: <http://agcenter.ucdavis.edu>, quarterly newsletters, social media) that include a joint NIOSH 10-Ag Center Health & Safety YouTube channel, Facebook page, and others. The successes and outcomes of all Center activities are evaluated within our comprehensive evaluation program on an on-going basis.

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SECTION II

PROGRAM HIGHLIGHTS

ADMINISTRATIVE CORE

The WCAHS Administrative Core provides the infrastructure, outreach/relationship building, and support for the Center's day-to-day functions (e.g., management of the NIOSH grant and multiple sub-contracts, including convening the Administrative Committee, Steering Committee, External Advisory Board, and Strategic Planning retreat). Administrative Core management provides leadership input for NIOSH and NORA/AFF collaborative efforts and guides WCAHS' three Administrative Core programs: outreach, pilot grants/feasibility, and evaluation. These are described in detail below.

Center-Wide Activities

WCAHS continued convening stakeholders through Steering Committee and Executive Advisory Board meetings to keep stakeholders apprised and solicit input on future WCAHS projects.

Outreach Program

The Outreach Program has been an integral part of WCAHS since its inception over 25 years ago. Outreach is directed by WCAHS investigator Stephen McCurdy, MD, MPH, in cooperation with Outreach and Education Specialist Teresa Andrews, and Junior Specialist Leslie Olivares. The program is essential in the dissemination of evidence-based approaches to improve health and safety conditions in the agricultural community. Our team works in collaboration with WCAHS investigators, outreach personnel at other NIOSH-sponsored Agricultural Health and Safety Centers across the nation, and a diverse array of community members, leaders, and organizations. Below, we describe our efforts to meet the Outreach Program's three main aims.

Aim #1: Promote communication among and between WCAHS investigators. Ms. Teresa Andrews, WCAHS Outreach and Education Specialist, meets periodically with all Center investigators to assist in developing and optimizing each investigator's community outreach efforts. During the past year, Ms. Andrews worked with the heat illness prevention research team to address cultural beliefs and practices regarding drinking water that prevent workers from being properly hydrated. The team conducted two workshops for the Heat Illness Prevention Project (Modesto, 16 participants; Clovis, 22 participants). In addition, we created four short videos in Spanish that can be used to train workers: <http://chips.ucdavis.edu/publications.php>

Aim #2: Promote communication between WCAHS investigators and other Agricultural Health and Safety Centers. Ms. Teresa Andrews, WCAHS Outreach and Education Specialist, and Leslie Olivares, Junior Specialist, attend regular meetings of the Evaluators, Coordinators, and Outreach (ECO) Group comprising 56 outreach personnel from the NIOSH-sponsored Agricultural Health and Safety Centers across the U.S. The ECO group is a forum for sharing experience relevant to the various outreach challenges each Center faces. This year the group met on June 27 during the ISASH conference in Lexington, Kentucky to share best practices and discuss network strategies. Within ECO, the following work groups have been established:

- **Awareness Work Group** – Promotes safety campaigns through two nationally recognized events: National Agriculture Day (3/15/2016; <http://www.agday.org>) and National Farm Safety & Health Week (9/18-24/2016; <http://www.necasag.org>)
- **Evaluation Work Group** - Develops best practices for collecting, analyzing, and reporting Ag Center data
- **National Ag Safety Database Work Group** – Acts as online clearinghouse (<http://nasdonline.org>) of safety education materials for agriculture
- **YouTube Channel Work Group** - Advances health and safety education in the Agriculture, Forestry, and Fishing industry sector with a peer-reviewed YouTube channel: www.youtube.com/user/USagCenters

The WCAHS Outreach and Education Specialist and Junior Specialist contribute to the ECO Work Group activities through leadership and review of submitted Spanish-language videos and design of flyers used to promote health and safety in agriculture. We participated in California Ag Day at the California State Capitol in March 2016, and our Junior Specialist created a promotional flyer for National Farm Safety and Health Week in September 2016 that was customized by all the Centers.

Aim #3: Develop and sustain partnership between WCAHS and key stakeholders in the agricultural community and promote dissemination of research findings and best practices. Examples of community outreach efforts are described below.

- **Worker Occupational Safety & Health Training & Educational Program (WOSHTEP) with partner California Department of Industrial Relations**
This program, in its 7th year, is designed to reduce job-related injuries and illnesses among California workers by promoting health and safety on the job. During the past year, we trained 47 farm labor contractors, growers, and supervisors to strengthen their knowledge and skills to identify and control hazards in their workplace.
- **Heat Illness Prevention Education**
We conducted training for 38 growers, managers, and supervisors to assist them to develop their Heat Illness Prevention Plan and comply with the Cal/OSHA Heat Standard. During the trainings this year, we provided background information on adult education and gave out educational packages with step-by-step discussion guides on topics such as the amount and frequency that one should drink while working in the heat, understanding heat index, and

recognizing early signs of heat illness. The new materials addressed cultural barriers identified during the focus groups conducted in the previous year as part of the heat illness prevention study. In addition, we conducted training for 70 workers, on how to prevent, and recognize heat illness.

- **Collaboration with UC Statewide Integrated Pest Management (IPM) Program**

Last year, in collaboration with the UC Statewide IPM program, we created a series of materials to assist those in charge of conducting pesticide-safety sessions for farm workers. The materials include step-by-step guides and educational materials for supervisors to assist them in conducting brief 15-to-20-minute tailgate sessions on California's required training topics regarding pesticide safety. This year, we used those materials to train 86 trainers across the state.

- **Collaboration with the Mexican Consulate in Sacramento**

The Mexican Consulate in Sacramento sponsors the *Ventanilla de Salud* program, which provides reliable information to people accessing the services of the Consulate. *Ventanilla de Salud*, or Window of Health, refers to the Consulate's service window where the public engages with consular staff to receive services and information. This summer we went to the *Ventanilla* to provide information about heat illness prevention and talked to 283 workers.

- **Quarterly Newsletter, Blog, and Facebook**

The WCAHS Outreach Program utilizes a mixture of traditional and non-traditional media to engage with the agricultural community. The quarterly *AgHealth News* publication has a subscription base of approximately 225 persons and has been a part of the Center's communication efforts since the beginning of the Center. More recently we have begun to utilize additional media outlets. We maintain a blog, providing topical information on a diverse range of agricultural health and safety topics. Go to <http://westernaghealthandsafety.wordpress.com/> to read the blog. We also have established two Facebook pages. Our English page ([@AgHealthNewsUCDavis](#)) is used to disseminate information such as relevant articles, fact sheets, upcoming conferences, seminars, and webinars as well as occasional job and funding opportunities. Most recently, we established a Spanish Facebook page ([@NoticiasSaludAgUcDavis](#)), which will include articles, tips and any other resources we come across that we feel would be helpful to the farmworker community. Additionally, we have established a Twitter account ([@westernaghealth](#)) where we post relevant articles related to agricultural health and safety. All of our social media platforms continue to grow in their audience and vary in activity depending on what approach we feel is most engaging in that platform and what type of audience we are targeting.

Pilot/Seed (Mini Grant) Program

The NIOSH-funded WCAHS Pilot/Seed Grant Program seeks to encourage the development of creative research and translational, prevention/intervention training and outreach projects particularly by early-stage researchers (graduate students, post-docs, assistant professors)

interested in agricultural health and safety or by established investigators new to the field. The program is open to researchers in the WCAHS four-state region: Arizona, California, Hawaii, and Nevada.

WCAHS Pilot/Seed Grants were awarded for the following projects:

1. Online certificate program for *promotores* on agricultural health and accident prevention
2. Heat exposure, volume depletion, and acute kidney function in California's agricultural workers
3. Investigating the links between chemical exposures and toxicological responses for air pollutants using a novel aerosol mass spectrometry method
4. Biosolarization is a fumigation alternative for controlling soil pests
5. Exploring the role of depression as a moderator of a workplace obesity intervention for Latino immigrant farmworkers
6. Sexual harassment and Latino immigrant farmworkers
7. Impact of California drought on community health –The water quality side
8. Examining primary exposure risks of zoonotic enteric pathogens occurring in large commercial dairies within California
9. Joint funding for agricultural health and safety projects in developing countries

See Appendix A for more information on each pilot/seed grant.

Evaluation Program

WCAHS continues to work with Dr. Julie Rainwater and her evaluation team to assess the impact of WCAHS research, interventions and outreach. The following are examples of specific evaluation efforts:

- **Project Evaluation:** The evaluation team meets annually with WCAHS investigators to review program-specific logic models and document activity, outputs and outcomes of Center projects. At these meetings, the evaluation team reviews a current list of all potential outputs and outcomes with investigators. Publications and grants are extracted from SCOPUS and NIH Reporter. Data on honors and awards, accomplishments, scientific products, media coverage, presentations, success stories, and individuals supported are also collected by the evaluation team from annual progress reports, WCAHS newsletters, personal communication, and online searches. A final description of outputs and outcomes are entered into a database management system for WCAHS utilizing FileMaker Pro software. This year the Evaluation team met with each of the investigators submitting projects for the Center renewal and helped develop an evaluation/outreach component specific to their project.

- **Evaluation of WCAHS Outreach and Translation:** The evaluation team works closely with outreach staff and leadership to document the wide range of activities pursued for Ag Center outreach. A web-based tracking tool utilizing Qualtrics was created by the evaluation team to streamline the tracking process.
- **Presentation Materials:** The WCAHS evaluation team continued to update and refine materials describing the Center's impact on agricultural risk, costs, and impact. New material on the WCAHS summary document features accomplishments of the Center in the areas of heat illness prevention, respiratory disease, ergonomic solutions, pesticide exposures and outreach.
- **Cross-Center Collaborations & Contribution to National Efforts:** The WCAHS evaluation team and outreach specialist are active members of the NIOSH AFF initiative-wide evaluation workgroup, Evaluators, Coordinators, and Outreach personnel (ECO). ECO is a key resource for sharing cross-center program information, best practices, and relevant research for agricultural health and safety. WCAHS has contributed several videos for the Ag Center YouTube site. Additionally, the evaluation team is working on a Program Performance One-Pager (PPOP) with NIOSH to highlight WCAHS accomplishments. The PPOP will be accessible to the public via the NIOSH website.

RESEARCH PROJECTS

Project 1: Effects of California agricultural particulate matter in a murine intranasal sensitization model of allergic airway inflammation

PI Kent Pinkerton, PhD

Challenges

- Assess the relative toxicity of size-segregated particulate matter (PM) in California's Central Valley, with a major impact from agricultural activities and exposures throughout the Valley.
- Test methods for (i) extracting PM from the collection substrates prior to toxicological testing, and (ii) administering the extracted PM doses to animals during exposure/sensitization studies.
- Further development of the mouse (murine) model of asthma and testing using aeroallergens (ovalbumin and house dust mite) and PM samples obtained from agricultural/urban settings.
- Chemical characterization of PM exposures and testing the biological reactivity of PM samples.

Impacts

- Toxicity screening of size-segregated PM common to California's Central Valley will lead to more targeted and effective strategies for regulating air quality to improve human health.
- Better understanding of the relative risk of asthma development in the agricultural setting.

Milestones

- The results of our study to evaluate PM samples from the ambient atmosphere in Fresno, CA, a large Central Valley city surrounded by agriculture and having high air pollution, have been published in two articles during this past year in the journal *Atmospheric Environment* (Bein et al., 2015; Plummer et al., 2015) In brief, vehicular emissions, the regional background PM mixture – which is dominated by agricultural emissions – and residential and commercial cooking emissions were found to significantly cause inflammatory responses depending on PM size and the season.
- From experiments during the past year, we have determined that the most reliable way to measure the toxicity of fine (PM_{2.5}) and coarse (PM_{10-2.5}) particles, the dominant atmospheric particle sizes present in agricultural settings. Particles have been collected from an agricultural setting at the Kearney Agricultural Research and Extension (KARE) Center in Parlier, CA, and the rural agricultural community of Taft, CA, near Bakersfield in the southern portion of the San Joaquin Valley. PM sizes were collected at different times of day corresponding to (i) the nocturnal inversion (00:00-06:00), (ii) breaking of the nocturnal inversion (06:00-12:00), (iii) development of the mixed layer and peak actinic flux (12:00-18:00) and (iv) formation of the nocturnal inversion and residual layer (18:00-24:00). The collected PM samples are being extracted and analyzed for toxicological testing.
- Animal experiments with mice to induce allergen sensitization and challenge have been completed with PM samples collected in the Central Valley. We have found PM enhances the allergic inflammatory response via enhancement of Th2-mediated inflammation. The methodology developed has been published in *Current Protocols in Toxicology* (Castañeda and Pinkerton, 2016). We are pursuing evidence that suggests AhR activation by PAHs in PM promotes Th17-immune responses, which drive the allergic immune response.
- In conjunction with investigators in the Department of Animal Sciences at the University of California, Davis, we have examined hutch housing of calves on immune development of the respiratory system (Calvo-Lorenzo et al., 2016).
- With investigators in the Department of Otolaryngology, we have initiated and published a study to examine the impact of allergen and combustion-generated PM to elicit eosinophilic laryngitis in an animal model (Belafsky et al., 2016).

- We prepared a comprehensive review of the literature on atmospheric pollutants including ozone, nitrogen oxides and particulate matter, all common atmospheric pollutants of urban and rural (agricultural) environments (Kurt et al., 2016).

Project 2: Using large national datasets (NAWS) and econometrics in agricultural injury research

PI J. Paul Leigh, PhD

Challenges

- Attempts to estimate the national economic burden of agricultural injuries and illnesses present challenges because cost data are from different sources than injury data that, in turn, are from different sources than illness data.

Impacts

- Analysis of data from the US Department of Labor and compilation of estimates from the literature to forecast annual costs of autism in 2025. Coverage included *The Economist* magazine from April 16, 2016. <http://www.economist.com/news/briefing/21696928-children-rich-world-are-far-more-likely-be-diagnosed-autism-past-why>
- Analysis of data from the California Department of Developmental Disabilities pertaining to the per-person annual costs of providing services for children and adults with autism. We found that Hispanics received fewer state dollars than any other ethnic group. Coverage in numerous press sources, including one from Australia, April 20, 2016.
- Literature review of the effects of low wages on worker health. Press coverage included *Science Daily* (May 3 2016). <https://www.sciencedaily.com/releases/2016/05/160503153029.htm>

Milestones

-
- Final estimates of participation in the federal Supplemental Nutrition Assistance Program (SNAP), or food stamps program were produced. We found that undocumented households participate at roughly one-third rate as citizens documented households. We also found that undocumented households were far more likely than documented households to increase their participation rate as more children were added to the family.
- Work continues to assess predictors of which groups of farm workers (e.g., authorized vs. unauthorized) are covered by insurance, access medical care, report barriers to care, work for contractors and work excessive hours. Data will be drawn from the National Agricultural Workers Survey (NAWS).

- Final estimates for participation in Medicaid by authorized and unauthorized households were produced. We found that unauthorized households participate at about half the rate of authorized households and that, again, the unauthorized were more likely to increase their participation with greater numbers of children in the household.

Project 3: Impacts on new caging laws in California on worker health & safety in layer hen facilities

PI Jerold Last, PhD

Challenges

- To determine the effect on exposure of workers to toxic air pollutants upon housing layer hens in unconventional facilities required to achieve compliance with the new caging laws in California (and elsewhere).
- To evaluate effects on workers of worker exposure in unconventional facilities required to achieve compliance with the new caging laws in California (and elsewhere).
- To evaluate the toxicity of PM contained in ambient air being inhaled by workers in the San Joaquin Valley in the course of their normal workdays.

Impacts

- Our toxicological studies in mice demonstrate equivalent toxicity on an equal mass basis for particulate matter (PM) collected in layer hen barns with conventional (battery) or enriched caging, or with free-range confinement (indoors). Thus, conventional PM monitoring of indoor air to ensure compliance with OSHA standards should be protective of worker health in any of these types of facilities.
- However, PM concentrations in free-range barns were much higher than in conventional or enriched facilities, so additional precautions will be required to ensure adherence with OSHA standards in these types of facilities.

Milestones

- A manuscript summarizing our studies of mice exposed to PM collected from three different types of layer hen facilities, traditional battery caging and two Proposition-2 compliant modalities, was published in *Toxicology and Industrial Health*.

PREVENTION/INTERVENTION PROJECTS

Project 4: Rapid assays for human and environmental exposure assessment

PI Bruce D. Hammock, PhD

Challenges

- The overall goal is to develop improved tools to detect pesticides in farm- and landscape-workers and to apply these tools to examine exposure levels.

Impacts

- Assays developed add to the number and variety of immunoassays that can be utilized by researchers for both human and environmental exposure assessment. Specifically for the fipronil immunoassays, our methods correlated well with conventional chromatographic methods.
- Advances from this project provide the foundation for commercial improvement of immunoassays that could increase the shelf life of products, reduce production costs and allow the immunoassays to be made available in developing countries where refrigeration is not optimal.
- The exposure studies contribute to the body of knowledge that provide guidance to educators to inform the participant population about pesticide use and how to avoid or minimize exposures. This information informs regulators to develop or modify pesticide use in occupational settings.

Milestones

- Three biomonitoring studies were completed in this reporting period (see below) and indicate that educating workers about minimizing their exposure is important.
- In the first study, collaborators from northern Thailand used our pyrethroid insecticide (3-PBA) immunoassay and found that female university students had high concentrations of 3-PBA in their plasma. This suggests that the students may be exposed to pyrethroid insecticide by consuming contaminated food or use of household pesticide and that it is excreted at low levels or may be stored in their body.
- In a second study, urine was collected from 33 individuals who worked in farm, landscape, and greenhouse settings in California. A significant difference in urinary detection of glyphosate herbicide was found between those who reported applying the pesticide versus those who did not.
- In a third study, golf course workers applying the synthetic plant growth regulator trinexapac-ethyl in Hawaii were found to have detectable levels of the chemical on their head, chest, back, upper arms, thighs, shins and hands following application.

Project 5: Reducing the risk of heat-related illness (HRI) in western agricultural workers

PI Marc Schenker, MD, MPH

Challenge

Advance the understanding of the physiological responses to increased environmental heat and physical exertion among farm workers through the analysis of personal characteristics, monitors and sensors. Determine the barriers preventing wider success of HRI training and possible solutions.

Impacts

- Physiological data collected by the study will improve HRI estimates specifically for farmworkers and replace the current data derived from intense, short-term work (e.g., firemen, military and athletes).
- 12% of the workers suffered Acute Kidney Injury (AKI) over the work day in 2014 (defined by changes in serum creatinine) putting them at risk of chronic kidney damage. Risk of AKI was independently associated with heat strain (changes in core temperature and heart rate) and if the worker was paid by piece rate (sex, diabetes or hypertension status, obesity and volume depletion did not contribute to the association).
- Focus groups conducted by the California Institute for Rural Studies (CIRS) indicated that convincing workers to actively prevent HRI requires more than training. A complex interaction of pay structures, employer relations and the perception of workers' control over their work environment affect their willingness to adhere to training messages. Workers did prefer HRI prevention education to be participatory and delivered orally.
- A new HRI train-the-trainer program was developed using information from the focus groups and interviews with employers. Key components include a PowerPoint® presentation, a work book, videos and materials / exercises to encourage active participation of farm workers. The materials were piloted at 3 training sessions with 38 supervisors, and the contents will be published in Spanish and English on our Center Web Site.
- Presentations and manuscripts have been published from the study results. They are listed on the project web site: <http://chips.ucdavis.edu/index.php>
- Outreach delivered 11 trainings in 2014-2016 (including at pesticide training workshops) throughout California reaching over 170 supervisors and workers. The study was also publicized on National Public Radio – KVPR Central Valley on October 13, 2015.

Milestones. All major milestones were achieved.

- The physiological field study monitored 100 farm workers in the 2012 pilot and 587 farm workers in the summers of 2014-2015, throughout California, in conjunction with a supplemental grant that continues for one more year (also NIOSH funded).
- The social behavioral component of the study conducted 12 focus groups and 50 key interviews in the Central Valley of California, 2013-2016.

Project 6: Effects of ladder rung spacing on agricultural workers

PI Fadi Fathallah, PhD

Challenges

- The ladder rung spacing project is a multi-year effort to model and develop an optimized ladder design to reduce falls in agricultural orchard work. The overall work includes theoretical modeling, laboratory testing and validation, and subsequently testing and validation work in the production agriculture environment. Developing relationships with the ladder and orchard industries is an important element.

Impacts

- Potential to decrease ladder related injuries related to agricultural work and increase worker comfort and efficiency.

Milestones

- Completed lab study collecting motion analysis, electromyographic, heart rate, video, relative perceived exertion, preference rating, and anthropometric data.
- Began inverse kinematics model validation using lab study data.
- Major orchard ladder manufacturer continues to be willing to manufacture custom rung-spacing orchard ladders as official products.
- Work will continue this coming year under the no-cost extension arrangement.
- In coordination with the North American Guidelines for Children's Agricultural Tasks, assisted with developing job hazard analysis for portable step ladders, straight and extension ladders, fixed ladders, and orchard ladders.

APPENDIX A – Pilot/Seed Projects Detailed Descriptions

Project 1 – Online Certificate Program for *Promotores* on Agricultural Health and Accident Prevention

Health Initiative of the Americas (HIA), UC Berkeley

The goal of this project is to build a healthier and better-informed agricultural worker community in the U.S. by reducing occupational health and safety issues and promoting healthy lifestyles among Latino agricultural workers and their families. The strategy to achieve this goal is to create, pilot, and launch an online certificate program on Agricultural Health and Accident Prevention for *promotores*. The certificate program will be the first in the nation focused on the occupational health and safety of agricultural workers and will be accredited based upon the Agricultural Health and Accident Prevention *promotores* manual that was produced by HIA in Phase I of this multi-phase project. The long-term goal is to institutionalize the certificate nationwide among *promotoras* agencies, groups, and associations so *promotoras* can be professionally trained to assist Latinos who work in agriculture. Certified *promotoras* will be better able to serve their constituents, ultimately leading to a healthier group of agricultural workers across the country. The scope of this phase of the project was to continue working in conjunction with the Autonomous University of Zacatecas (UAZ) to finalize the online certificate program, pilot the results among a selected group of *promotoras* representative of the target population for the certificate, and conduct a focus group to inform revisions and refinements of the program.

Results:

All six modules for the online certificate program were completed. In June 2016, HIA held a pilot study at UC Berkeley where seven *promotoras* tested parts of each module and then participated in a focus group immediately following the pilot. They completed a 12-question evaluation survey and offered suggestions regarding reading and comprehension level of the modules and the presentation of the information. The consultant who has been creating the modules is currently analyzing the observations and modifying the program to address the common themes. Once the certificate program has been revised, the final version will be provided to the UAZ partners for translation into the online platform, the design of which was completed during this cycle. The first module is already uploaded, and Mexican and U.S. researchers and the consultant are currently evaluating the quality. Pilot testing of the platform is scheduled for November/December 2016, and the results will inform the other 5 modules.

Other results from this phase include the 2016 Binational *Promotoras* Conference, which took place on May 23rd in Oakland, California. Over 250 attendees from Mexico and the US participated in the event.

Project 2 – Heat exposure, volume depletion, and acute kidney function in California's agricultural workers

Sally Moyce, PhD Candidate, Betty Irene Moore School of Nursing, UC Davis

Funds were used to help support Dr. Moyce's travel to the Second International Research Workshop on Mesoamerican Nephropathy, where she presented her work on acute kidney disease in California agricultural workers. The cumulative incidence of acute kidney injury (AKI) over one work shift and the estimated associations of heat exposure and volume depletion on incident AKI were investigated in a study with 295 agricultural worker participants. AKI was detected in approximately 12% of the participants. Preliminary analyses showed weight loss to be associated with twice the odds of incident AKI. Dr. Moyce and the research team concluded that the cumulative incidence of AKI after a single day of agricultural work is alarming due to the increased risk of long-term kidney damage and mortality. The association with volume depletion suggests that AKI may be prevented with proper rehydration during a work shift.

Project 3 – Investigating the links between chemical exposures and toxicological responses for air pollutants using a novel aerosol mass spectrometry method

Qi Zhang, PhD, Professor, Department of Environmental Toxicology, UC Davis

The connections between the chemical properties of particulate matter (PM) and adverse health effects, such as cardiopulmonary disease, remain poorly understood due to the enormous chemical complexity of PM. The goal of this project was to identify both sources and key chemical components of PM that are potentially responsible for toxicological responses through detailed analysis of ambient PM samples. A secondary goal was to develop analytical techniques to identify markers for inflammation in a non-selective, top-down approach using a High-Resolution Time-of-Flight Aerosol Mass Spectrometer (AMS).

In this study, PM_{2.5} (particles with diameters less than 2.5 micrometer) samples collected during winter from the City of Sacramento located in the Central Valley of California (CA) and the City of Taiyuan in northern China were analyzed for chemical composition and toxicological responses. Both locations experience high levels of air pollution and have diverse sources of PM enabling highly complex and chemically different aerosol compositions to be compared.

Results:

Notable compositional differences were observed between the CA and China samples, including organic contribution to total PM mass, average degree of oxidation of the organic compounds, metal content, and distinct tracer ions, indicating different sources of the PM. The CA PM had a greater organic contribution, higher levels of oxidized organics, and high concentrations of copper whereas the China PM had a greater contribution of inorganics, especially from sulfate, more reduced organics, and higher concentrations of alkaline metals. Analysis indicated that the CA PM was influenced by biomass burning emissions whereas coal combustion compounds were more abundant in the China PM. Toxicological analysis demonstrated significantly different biological responses between the two samples, with higher inflammatory responses resulting

from exposure to the CA PM on an equal mass basis. CA PM appears to be more toxic than China PM due to a greater degree of oxygenation of the organics and a higher concentration of copper. This study highlights the importance of considering chemical composition when assessing PM toxicity and provides evidence for targeted emission abatement and source-specific regulations in order to improve human health and air quality.

A manuscript on these findings was submitted in August 2016 to *Toxicology Letters*.

Project 4 – Biosolarization is a fumigation alternative for controlling soil pests

Christopher Simmons, PhD, Assistant Professor, Department of Food Science and Technology, UC Davis

Biosolarization involves using passive solar heating and induced soil microbial activity synergistically to create pesticidal conditions in the soil. To better characterize the potential for biosolarization to displace fumigation, we are studying the efficacy of biosolarization in managing two major pests, puncture vine and root knot nematode. We are also quantifying volatile emissions from soil during biosolarization, which can impact both process efficacy and worker exposure. We are adapting conventional methodologies for measuring weed seed and nematode mortality to enable detection of pest inactivation during biosolarization. Furthermore, we are preparing to conduct atmospheric sampling near biosolarized and fumigated fields to measure emission of volatile compounds during both biosolarization and conventional fumigation with chloropicrin and 1,3-dichloropropene. These data will be used to assess the composition of biosolarization emissions and compare their toxicity to the emissions stemming from conventional fumigation.

Results:

The pilot funding provided by the WCAHS has allowed us to accelerate our pest mortality measurement and atmospheric sampling efforts ahead of our larger NIOSH-sponsored project.

We have investigated methods to study biosolarization efficacy against puncture vine weed and root knot nematodes. We intend to use tetrazolium staining to determine the viability of weed seeds and brightfield microscopy to measure the viability of nematodes after soil treatment. To this end, we have acquired dissecting and compound microscopes to observe and photograph weed seeds and nematodes, respectively, during viability assays. We have obtained stocks of puncture vine seeds and are currently measuring their baseline viability using both germination and tetrazolium staining assays. We are also establishing the nematode viability assay in our laboratory, which involves saturating samples of infested soils with water within a funnel, collecting the viable nematodes that migrate out the bottom of the funnel, and counting viable nematodes via light microscopy in a compound microscope. For both pests, positive (i.e., known viable pests) and negative controls (heat-sterilized pests) are being used to confirm that the assays are working correctly. Furthermore, we have compiled methods for sampling volatile organic compounds from air, including the volatile fatty acids and fumigants we expect to

encounter in biosolarized and fumigated fields, respectively. We have acquired a gas sampling device that is appropriate for capturing our target volatile compounds and are working to validate our sampling and detection protocols.

Project 5 – Exploring the role of depression as a moderator of a workplace obesity intervention for Latino immigrant farmworkers

Jessie Pintor, PhD, Post-doc, Center for Health Policy and Research, UC Davis

Latino immigrant farmworkers experience high rates of both obesity and depressive symptoms; over 70% of are overweight or obese, and 20% to 50% report symptoms that could indicate depression. We explored if and how depressive symptoms moderate the effect of a workplace obesity intervention for Latino immigrant farmworkers. We used secondary data from a randomized, controlled pilot intervention, *Pasos Saludables*, whose objective was to reduce obesity within an immigrant farmworker population. The primary outcome was change in BMI; BMI was assessed pre-randomization and at 12-14 weeks follow-up. Risk of depression at baseline was assessed with the CES-D 10; scores of 10 or higher may indicate clinical depression.

Results:

We compared the treatment effect within groups stratified by depression risk, adjusting for age, gender, education, and baseline BMI. Over one quarter (27.3%) of participants scored 10 or higher on the baseline CESD-10. Overall, compared to the control, intervention participants saw a 0.57 reduction in BMI ($p < .01$); among females, BMI was reduced by 0.63 ($p < .01$). For those with no indication of depression at baseline, the intervention group reduced their BMI by 0.62 on average, compared to controls ($p < .01$). The reduction observed within the group at risk for depression was not statistically significant from controls (0.45 reduction compared to controls, $p = .141$). Among women, a larger treatment effect was observed for those with no risk of depression at baseline, while again no significant effect was detected for those with baseline risk of depression: 0.72 BMI reduction for no depression ($p < .01$) vs. 0.42 reduction for baseline depression ($p = .233$).

Our study provides preliminary evidence that the experience of depression may keep Latino immigrant farmworkers from benefiting fully from a successful workplace obesity prevention intervention. The findings suggest that obesity and mental health need to be jointly addressed. Efforts to mitigate the structural factors that contribute to depression among farmworkers, as well as efforts to increase access to mental health services and/or coping education, could improve both mental and physical health. We are submitting our manuscript to the *Journal of Immigrant & Minority Health*.

Project 6 – Sexual harassment and Latino immigrant farmworkers

Kim Prado, Graduate Student, Center for Health and the Environment, UC Davis

Workplace sexual harassment is an unwelcome fact of life for women working in the fields and food processing plants across the US. The farm work environment offers isolated venues, e.g., distant orchards, outbuildings, and other settings, where perpetrators can bring their victims under pretense of work responsibilities and remain unobserved. Fear of potential repercussions – social stigma, adverse employment consequences, and deportation - often ensures silence. Previous research efforts have focused on experience of women farm workers without exploring attitudes and beliefs among men, who are in almost all cases the perpetrators. As a result, we lack important epidemiologic information regarding sexual harassment in the agricultural workplace, limiting our ability to develop and target effective prevention programs. The purpose of this project is to characterize attitudes, beliefs, and experience relevant to workplace sexual harassment among men and women farm workers in California and Mexico to inform subsequent development of effective educational materials and policy recommendations for agricultural employees, employers, and governmental agencies.

Progress made includes:

- Graduate student Kim Prado reviewing the scientific literature and compiling articles and other information relevant to the study. She is leading the effort to develop study materials and securing IRB approval, as described below.
- Regular meetings for our UC Davis team (Dr. McCurdy, Teresa Andrews, Kim Prado) and approximately twice-monthly plenary meetings including our Mexican collaborators (Dr. Maria Elena Rivera, Lizlupita Martinez at the University Michoacana de San Nicolás de Hidalgo).
- The establishment of Community Advisory Boards (CAB) by the UC Davis and Mexican teams, with first meetings set in mid October 2016. The CABs will provide input in the development of the study instruments and help identify populations and organizations helpful in conducting the study.
- The UCD team drafting study materials and initiating the IRB process, including:
 - Materials for focus groups of men and women, respectively, addressing sexual harassment. Female staff have been identified to facilitate the focus group for women and a male staff member to facilitate the focus group for men. Information from the focus groups will inform the development of survey questionnaires.
 - Questionnaires addressing sexual harassment to be completed by approximately 50 men and 50 women in California and in Mexico (total 200 persons)

Project 7 – Impact of California drought on community health: The water quality side

Swee Teh, Adjunct Professor, Anatomy, Physiology, and Cell Biology, UC Davis

Drought is affecting groundwater/surface water exchange, and pollutants may inadvertently be concentrated in well water resulting in decreased drinking water quality. Rural agricultural areas have been found to suffer from unsafe tap water. Therefore, it is important to assess and monitor water quality regularly, especially in areas that have agricultural runoff and are dependent on well water. This project samples water quality from the California Central Valley, where some rural towns suffer from unsafe water. Specific sampling sites were selected in conjunction with a Community Stakeholders' Advisory Committee meeting at UC Merced on May 27, 2016. Following the meeting, we met at the Community Water Center, which advocates that all communities should have access to safe, clean, and affordable water, in Sacramento on July 11, 2016, to confirm and schedule water sample collection.

Water sampling was conducted at a private well located in Porterville, CA on August 11 and 22. A well-established fish model (Japanese Medaka) was used to determine water quality; larval fish (7 days old) were exposed for 4 days and juvenile fish (30 days old) were exposed for 7 days to the collected water on August 25 and the exposures were terminated on August 29 and Sept 1 2016, respectively. Larval fish were preserved for microarray analysis. Ten juvenile fish per replicate (for 3 replicates) were sampled at the end of exposure for RNA-sequencing, and the remainder of the fish was raised in tanks with clean water for 1 month. These fish will be sampled for histopathological analysis on Sept 30, 2016.

Results

The Aug 11, 2016, water sample was used to measure general parameters of water quality. Since all the evaluated parameters were within the range of the recommended levels for fish, no water dilution was performed. The Aug 22, 2016, water samples were collected in brown glass jars and shipped refrigerated at ~4 °C to UC Davis. No obvious signs of acute toxicity (changes in swimming pattern and behavior, and mortality) were observed during both the 4 day larvae and the 7 day juvenile exposures. Fish samples collected from those experiments will be analyzed for endocrine disruption and carcinogenesis by microarray, RNA-sequencing and histopathology in October 2016. The next sampling event is scheduled for October 25, 2016, and the respective experiments will be conducted on October 27, 2016.

Project 8 – Examining primary exposure risks of zoonotic enteric pathogens occurring in large commercial dairies within California

Robert Atwill, Professor, Western Center for Food Safety, UC Davis

Using seed funds provided by WCAHS, we are establishing and optimizing laboratory protocols designed to simultaneously quantify *Escherichia coli* O157, *Salmonella* spp., and *Listeria monocytogenes* in dairy cattle feces using a real-time molecular method (qPCR). Additionally, we are establishing a novel protocol to quantify *Campylobacter jejuni* in dairy cattle feces. This study targets four major zoonotic enteric bacterial pathogens that are endemic in dairy cattle

populations and are distributed throughout the dairy environment (Mohammed et al., 2009), posing a constant threat to human and animal health (Suresh et al., 2012). While previous studies have investigated the prevalence of one or more pathogens in dairy cattle populations, few have been designed to simultaneously quantify these specific pathogens while investigating exposure risks in the dairy worker population.

Results:

We enrolled two working dairies from the California Central Valley. Fecal samples were collected during routine health screen visits directly from the rectum of up to 20 individual adult animals on August 29, 2016, and September 12, 2016, in accordance with standard veterinary practices. The samples were screened for the presence of *E. coli* O157, *Salmonella* spp., *L. monocytogenes*, and *C. jejuni*. To evaluate the specificity and sensitivity our proposed methods, we inoculated different fecal sources (cow feces from different dairies) with the four types of bacteria. This allows evaluation of how well the assay works when cows are being raised under different management practices (i.e., dietary supplements). These trials also allow us to make any necessary adjustments to proposed methods if deemed inefficient or performs with low sensitivity/specificity. PCR confirmation from the first inoculation trial will be completed before September 29, 2016.

Provided the initial trial proves successful, and further dairies can be enrolled, we anticipate conducting a minimum of two more inoculation trials. We have made contact with additional dairies and have discussed participation in our study. All analyses will be finalized before November 2016. We also anticipate the completion the IRB review process of our application to enroll human participants in a larger dairy worker study.

**Mohammed, H.O., K. Stipetic, P.L. McDonough, R.N. Gonzalez, D.V. Nydam, E.R. Atwill. 2009. Identification of potential on-farm sources of Listeria monocytogenes in herds of dairy cattle. American Journal of Veterinary Research 70(3):383-388.*

**Suresh, K.G., G.A. Toranzos, R. Fayer, V. Nissaparton, R. Olveda, N. Ashbolt, V.P.J. Gannon. 2012. Assessing the importance of zoonotic waterborne pathogens. In: Animal Waste, Water Quality and Human Health. World Health Organization Emerging Issues in Water & Infectious Disease Series. Edited by Al Dufour, Jamie Bartram, Robert Bos and Vic Gannon. ISBN: 9781780401232. IWA Publishing, London, UK. pp 17-72.*

Project 9 – Joint funding for agricultural health and safety Pprojects in developing countries

Blum Center for Developing Economies, UC Davis

The Western Center for Agricultural Health and Safety (WCAHS) partnered with the UC Davis Blum Center for Developing Economies to help impoverished communities around the world improve their agricultural health and safety. WCAHS and the Blum Center jointly funded three UC Davis students to conduct agricultural health and safety related projects both in the U.S. and abroad in conjunction with a local non-profit or agency.

Hands-on opportunities allowed the students to gain fieldwork experience in establishing change to problems that they are passionate about solving. The students, faculty and outside organizations affiliated with these projects aim to further the WCAHS' and the Blum Center's mission of assistance and aid domestically and abroad. This represents an excellent opportunity to train the next generation of leaders through experiential learning in agricultural health and safety.

APPENDIX B - WCAHS OUTPUTS

Publications authored by WCAHS investigators

Bein KJ, Zhao Y, Wexler AS. Retrospective source attribution for source-oriented sampling. *Atmospheric Environment* 2015 Oct;119:228-239.

Zhou J, Ning X, **Fathallah F**. Differences in lumbopelvic rhythm between trunk flexion and extension. *Clinical Biomechanics* 2016 Feb;32:274-279. PMID: 26577865

Fathallah FA, Tang SC, Waters T. Development and evaluation of ergonomic interventions for bucket handling on farms. *Hum Factors*. 2016 Aug;58(5):758-76. PMID: 26994024

Zhou J, Ning X, **Fathallah F**. Investigating the effects of movement speed on the lumbopelvic coordination during trunk flexion *Human Movement Science* 2016 Aug;48:153-160. PMID: 27209236

Shu M, Xu Y, Liu X, Li Y, He Q, Tu Z, Fu J, Gee SJ, **Hammock BD**. Anti-idiotypic nanobody–alkaline phosphatase fusion proteins: Development of a one-step competitive enzyme immunoassay for fumonisin B1 detection in cereal. *Anal Chim Acta*. 2015;92453-59. PMID: 27181644

Rossotti M, Pirez M, Gonzalez-Techera A, Cui Y, Bever C, Lee KSS, Morisseau C, Leizagoyen C, Gee SJ, **Hammock BD**, Gonzalez-Sapienza G. A method for sorting and pairwise selection of nanobodies for the development of highly sensitive sandwich immunoassays. *Anal Chem*. 2015 December;87(23):11907-14. PMID: 26544909. PMCID: PMC4666776.

Zhang W, He L, Zhang R, Guo S, Yue H, Ning X, Tan G, Li QX, Wang B. Development of a monoclonal antibody-based enzyme-linked immunosorbent assay for the analysis of the plant growth regulator 6-benzylaminopurine and its ribose adduct in bean sprouts. *Food Chemistry* 2016;207: 233-238. doi: 10.1016/j.foodchem.2016.03.103. PMID 27080901

Ahn KC, Ranganathan A, Hwang SH, Fritsch E, Morisseau K, Pessah I, **Hammock BD**, Gee SJ. Detection of the antimicrobial triclosan in environmental samples by immunoassay. *Environ Sci Technol*. 2016 April;50(7):3754-61. PMID: 26937944. PMCID: PMC4821808.

Bever CS, Dong JX, Vasylieva N, Barnych B, Cui Y, Xu ZL, **Hammock BD**, Gee SJ. VHH antibodies: Emerging reagents for the analysis of environmental chemicals. *Anal Bioanal Chem*. Epub ahead of print. May 2016. PMID: 27209591.

Franzi LM, Linderholm AL, Rabowsky M, **Last JA**. Lung toxicity in mice of airborne particulate matter from a modern layer hen facility containing Proposition 2-compliant animal caging. *Toxicol Ind Health*. 2016 Mar 3. pii: 0748233716630490. [Epub ahead of print] PMID: 26939833

Leigh JP, Du J. Brief Report: Forecasting the economic burden of autism for 2015 and 2025. *Journal of Autism and Developmental Disabilities*. 2015 December;45(12):4135-4139.

Leigh JP, Medel-Herrero A. Participation in the Women, Infants, and Children (WIC) program by documented and undocumented farm worker households. *Journal of Agromedicine*. 2015, 20 (4):409-418.

Leigh JP, Grosse SD, Cassady D, Hertz-Picciotto I. Spending by California's Department of Developmental Services for Persons with Autism across Demographic and Expenditure Categories *PLOS ONE* 2016 March;11(3):e0151970.

Leigh JP, De Vogli R. Low wages as occupational health hazards. *Journal of Occupational and Environmental Medicine*. 2016 May;58(5):444-447.

Leigh JP. Could raising the minimum wage improve the public's health ? *American Journal of Public Health*. 2016 August;106(8):1355-1356.

Quandt SA, Brooke C, Fagan K, Howe A, Thornburg TK, **McCurdy SA**. Farmworker housing in the United States and its impact on health. *New Solut*. 2015 Nov;25(3):263-86. PMID: 26320122

Plummer LE, Carosino CM, Bein KJ, Zhao Y, Willits N, Smiley-Jewell S, Wexler AS, **Pinkerton KE**. Pulmonary inflammatory effects of source-oriented particulate matter from California's San Joaquin Valley. *Atmos Environ*. 2015 Oct 1;119:174-181. PMID: 26568698

Belafsky PC, Peake J, Smiley-Jewell SM, Verma SP, Dworkin-Valenti J, **Pinkerton KE**. Soot and house dust mite allergen cause eosinophilic laryngitis in an animal model. *Laryngoscope*. 2016 Jan;126(1):108-12. PMID: 26197967

Kurt OK, Zhang J, **Pinkerton KE**. Pulmonary health effects of air pollution. *Curr Opin Pulm Med*. 2016 Mar;22(2):138-43. PMID: 26761628

Castañeda AR, **Pinkerton KE**. Investigating the effects of particulate matter on house dust mite and ovalbumin allergic airway inflammation in mice. *Curr Protoc Toxicol*. 2016 May 4;68:18.18.1-18.18.18.

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Mitchell DC, Andrews T, **Schenker MB**. Pasos Saludables: A pilot randomized intervention study to reduce obesity in an immigrant farmworker population. *J Occup Environ Med*. 2015 Oct;57(10):1039-46. PMID: 26461858

Courville MD, Wadsworth G and **Schenker MB**. “We just have to continue working”: Farmworker self-care and heat related illness. *J of Agriculture, Food Systems, and Community Development* 2016 Mar;143-64.

Moyce S, Joseph J, Tancredi D, Mitchell D, **Schenker MB**. Cumulative incidence of acute kidney injury in California’s agricultural workers. *J Occup Environ Med* 2016 Apr;58(4):391-7.

Reid A, **Schenker MB**. Cohort study of physical activity and injury among Latino farm workers. *American Journal of Industrial Medicine* 2016 Aug;59(8):644-55.

Presentations by WCAHS investigators

Fadi Fathallah. Research-to-practice-to research: an academic’s perspective on occupation ergonomics. *Human Factors & Ergonomics Society, Washington, DC, September 19-23.*

Fadi Fathallah. Agricultural Safety and Health Council of America booth. *Agricultural Personnel Management Association, Monterey, California, January 27-29.*

Fadi Fathallah. As part of a California Ag Leadership Foundation Fellows Program educational tour of the Heidrick Western Center for Agricultural Equipment (home of the UC Agricultural Ergonomics Research Center), presented various agricultural ergonomics interventions including past and current work on orchard ladders. *Woodland, California.*

Tippawan Prapamontol, Surat Hongsibsong, Sarunya Thiphom, Shirley Gee, **Bruce Hammock**. Immunoassay, an alternative or complimentary technique to study pesticide contamination: A perspective from an environmental toxicology lab in Chiang Mai, Thailand. *Pacificchem, Honolulu, Hawaii, December 2015.*

Natalia Vasylieva, Ki Chang Ahn, Bogdan Barnych, Shirley Gee, **Bruce Hammock**. Development of an immunoassay and biosensor for the detection of the phenylpyrazole insecticide fipronil and its metabolite. *Pacificchem, Honolulu, Hawaii, December 2015.*

Bruce Hammock, Shirley Gee. Single domain heavy chain antibodies (nanobodies or VHH): Monoclonal antibody replacement? Pacifichem, Honolulu, Hawaii, December 2015.

Jiexian Dong, Andres González-Techera, Shirley Gee, Gualberto González-Sapienza, **Bruce Hammock**. One step noncompetitive detection of 3-PBA based on anti-immunocomplex peptide-alkaline phosphatase fusion protein. Pacifichem, Honolulu, Hawaii, December 2015.

Dongyang Li, Yongliang Cui, Shirley Gee, Yibin Ying, **Bruce Hammock**. Nanobody based ELISA for protein and small molecule detection using a polymeric enzyme as the label. Pacifichem, Honolulu, Hawaii, December 2015.

Candace Bever, Jiexian Dong, Yongliang Cui, Jia Wang, Zuzana Majkova, Gualberto Gonzalez-Sapienza, Shirley Gee, **Bruce Hammock**. Isolating alpaca-derived VHH antibodies to small molecule targets: Anecdotes from 7 experiments. Pacifichem, Honolulu, Hawaii, December 2015.

T Xu, J Wang, C Bever, SJ Gee, QX Li, **Bruce Hammock**. Environmental and human exposure monitoring for tetrabromobisphenol A by immunoassays based on a variable domain of heavy chain antibody. Pacifichem, Honolulu, Hawaii, December 2015.

CS Bever, S Gee, **Bruce Hammock**. Application of nanobodies, sensors and other immunochemical techniques for the analysis of mycotoxins and other small molecules. ACS Meeting San Diego, California, April 2016.

Sally Moyce. Heat exposure, volume depletion, and acute kidney function in California's agricultural workers. Second International Research Workshop on Mesoamerican Nephropathy, San José, Costa Rica, Nov 18-20, 2015.

DE Young, X Sun, H Wei, **Kent Pinkerton, Keith Bein, Qi Zhang**. Investigating the Links Between Chemical Composition of Atmospheric Particulates and Adverse Health Effects. Postdoctoral Research Symposium, University of California, Davis, May 18, 2016.

X Sun, H Wei, DE Young, **Keith Bein, Qi Zhang**, AR Castaneda, AK Pham, W Li, **Kent Pinkerton**. Comparison of the Biological Effects of Wintertime California and China PM in Healthy Young Mice. American Thoracic Society International Conference, San Francisco, CA, May 13-18, 2016.

DE Young, X Sun, H Wei, **Kent Pinkerton, Keith Bein, Qi Zhang**. Investigating the Links between Chemical Composition of Atmospheric Particulates and Adverse Health Effects. Berkeley Atmospheric Science Symposium, University of California, Berkeley, February 19, 2016.

Marc Schenker. An Overview of Global Migration and Health. Plenary Lecturer, Inaugural Event of XV Binational Health Week, Binational Policy Forum on Migration and Global Health, Oakland, CA, October 5, 2015.

Marc Schenker. Immigration and Health. Guest Lecturer, SPH 290 Seminar, University of California Davis, Davis, CA, October 14, 2015.

Marc Schenker. The Global Burden of Occupational Injury and Illness among Immigrant Workers. Guest Lecturer, Temporary Migration Cluster Seminar, University of California Davis, Davis, CA, October 22, 2015.

Marc Schenker. Improving Health of the Most Vulnerable Workers. Guest Speaker (Webex), N273A Occupational Health and Diverse Worker Populations, School of Nursing, University of California San Francisco, San Francisco, CA, October 28, 2015.

Marc Schenker. Health and Health Disparities of the Migrant Farm Workers and Their Families. Concurrent Breakout Session Speaker, Latino Health Conference 2015, Oakland, CA, October 31, 2015.

Marc Schenker. Immigrant Health: A Global and Local Challenge. Public Lecture, University of California Merced, Merced, CA, November 3, 2015.

Marc Schenker. Migrant and Farmworker Health. Presenter, Public Health Sciences Dean's Symposium, University of California Davis, Davis, CA, November 16, 2015.

Marc Schenker. MICASA: Worker Family Cohort. Poster Presentation, Environmental Health Sciences Core Center Retreat, University of California Davis, Davis, CA, January 21, 2016.

Marc Schenker. The Global Challenge of Silicosis. Guest Lecturer, EXT 110, Toxic Tragedies and Their Impact on Society, University of California Davis, Davis, CA, January 25, 2016.

Marc Schenker. The Occupational Respiratory Hazards in Agriculture. Keynote Speaker, Symposium on the Occupational Respiratory Hazards in Agriculture, University of Comoros, Moroni, Union of Comoros, February 25, 2016.

Marc Schenker. Occupational Disease. Guest Lecturer, PHS 262, Principles of Environmental Health Science, University of California Davis, Davis, CA, March 1, 2016.

Marc Schenker. Immigrant & Refugee Health: A Global & Local Challenge. Guest Lecturer, SPH101, Perspectives in Community Health, University of California Davis, Davis CA, March 10, 2016.

Marc Schenker. Heat Stress in the Workplace – A Growing Occupational Hazard. Occupational & Environmental Medicine (OEM) Symposium 2016, Davis, CA, May 14, 2016.

Marc Schenker. Migrant Health. Keynote Speaker, Symposium, Environmental, Occupational and Population Health, Assembly of the American Thoracic Society (ATS), Moscone Center, San Francisco, CA, May 15, 2016.

Marc Schenker. Not All Occupations Are Equal: Migrant Workers as a Case Study. Keynote Speaker, Symposium, Environmental, Occupational and Population Health, Assembly of the American Thoracic Society (ATS), San Francisco, CA, May 17, 2016.

Marc Schenker. Migration and Health: Global and U.S. Historic and Current Trends. Presenter, Summer Institute on Migration and Health, Oakland, CA, June 14, 2016.

Marc Schenker. Infectious Diseases Among Migrant Populations. Presenter, Summer Institute on Migration and Health, Oakland, CA, June 15, 2016.

Marc Schenker. Demographics of Undocumented Status in a Study of Farmworker Health. Presenter, 6th European Public Health Association (EUPHA) Migrant and Ethnic Minority Health (MEMH) Conference, Oslo, Norway, June 24, 2016.

Marc Schenker. Immigrant, Contingent and Trafficked Workers: A Berkeley Story? Berkeley Rotary, July 13, 2016.

Marc Schenker. Heat Stress Illness. COEH Summer Institute Symposium, UC Berkeley, July 27, 2016.

Marc Schenker. Occupational Illness and Disease. Occupational Lecture, UC Davis August 18, 2016.

Marc Schenker. Health Disparities of Immigrant Workers in Agriculture. AgriSafe Webinar, August 24, 2016.

Marc Schenker. Risk of dehydration: California Latino farmworkers' knowledge of and actions taken to prevent dehydration. 25th EPICOH Conference, Barcelona, Spain, Sept. 5. 2016.

Marc Schenker. Occupational Health of the Precarious: Immigrants, Contingent and Trafficked Workers. University of Arizona, Tucson, AZ Sept. 14, 2016.

Marc Schenker. Immigrant Worker Health Issues. OEH Interdisciplinary Grand Rounds, UC San Francisco, Sept. 22, 2016.