# The Southwest Center for Agricultural Health, Injury Prevention and Education

**Cooperative Agreement #: U54 OH007541**

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# List of Terms and Abbreviations

AChE- Acetylcholinesterase
AFF- Agricultural, forestry and fishing
AP Core- Administrative and Planning Core
AR- Arkansas
ASHCA- Agricultural Safety and Health Council of America
ASHCA- Agricultural Safety and Health Council of America
BAL- Bronchoalveolar lavage
CAFO- Concentrated animal feeding operations
COPD- Chronic obstructive pulmonary disease
CP- Center of pressure
EAC- External Advisory Committee
ERC- Education Research Center
FP and EI Core- Feasibility Projects and Emerging Issues Core
FQHCs-Federally qualified health centers
FTE- Full time equivalent
IAC- Internal Advisory Committee
IL 6- Interleukin 6
IL-8- Interleukin-8
IRB- Institutional Review Board
LA- Louisiana-LA
LC- Liquid chromatography
MAPK- Mitogen activated protein kinases
MSFWs- Migrant and seasonal farmworkers
NM- New Mexico
NORA- National Occupational Research Agenda- NORA
OK- Oklahoma
PAR- Protease-activated receptor
NO- Nitric oxide
PFD- Personal floatation device
PIs- Principal Investigators
PKC- Protein kinase C
r2p- Research to practice
ROS- Reactive oxygen species
SA- Sway area
SL- Sway length
STF- Slip, trip, fall
SW Ag Center- The Southwest Center for Agricultural Health Injury Prevention and Education
TAACCCT- Trade Adjustment Assistance Community College and Career Training
TBI- Traumatic brain injuries
TX- Texas
USCG- United States Coast Guard
UTHSCT- The University of Texas Health Science Center at Tyler

# Abstract

The Southwest Center for Agricultural Health, Injury Prevention, and Education (SW Ag Center) is based at the University of Texas Health Science Center at Tyler (UTHSCT). The Center serves Public Health Region 6 comprised of Arkansas, Louisiana, New Mexico, Oklahoma, and Texas with the mission: *to improve the safety and health of agricultural, forestry and fishing (AFF) workers*. This is accomplished through an integrated program of research, intervention, education, and outreach activities that engage and leverage a network of strategic partners who represent the interests of a diverse worker population and a wide range of agricultural production in the region. Each core and project conducted from 2011-2016 was developed to address priority issues that reflect the center's theme "Building Strategic Partnerships to Improve AFF Worker Safety and Health."

The **Administrative and Planning (AP) Core** was led by Jeffrey Levin, MD, MSPH. This core ensured that reporting and financial obligations were met, coordinated meetings with principal investigators (PIs) and advisors, expanded the network, and identified opportunities for collaboration. The AP Core engaged the Internal Advisory Committee (IAC) and External Advisory Committee (EAC) in biannual meetings and throughout the cycle to help overcome challenges and capitalize on opportunities. The **Feasibility Projects and Emerging Issues (FP and EI) Core** was led by Vanessa Casanova, PhD. Thirteen small scale research projects were awarded within the funding cycle. Each feasibility project PI was mentored by an experienced agricultural safety and health researcher. Of the thirteen PIs, four were funded as project PIs for the 2016-2021 cycle, demonstrating the FP and EI Core's success in building research careers. **The Outreach Core** was led by Drs. Levin and Carruth. Outreach core representatives presented at conferences, conducted training programs, developed materials, distributed resources to stakeholders, and built the network of strategic partners. An internship was offered through the outreach program that built the capacity of six young professionals. The Outreach Core also worked with the other NIOSH-funded Ag Centers to develop and maintain a joint YouTube channel and promote agricultural health and safety events.

The Center conducted two research projects, one prevention/intervention project and one education/translation project over the last five year cycle. In the **Research Core**, Vijay Boggaram, PhD applied laboratory techniques to determine the mechanisms mediating inflammatory responses of lung epithelial cells to poultry broiler dust and Eva Shipp, PhD investigated how pesticide exposure among adolescent farm workers may impair neuromotor function and increase the risk of injury. In the **Prevention/Intervention Core,** Ann Carruth, DNS, RN extended the Center's research with Vietnamese fishermen by using social marketing science to motivate, support, and evaluate the adoption of safe work practices. Matt Nonnenmann, PhD, CIH conducted a project within the **Education/Translation Core** to measure worker exposure to concentrations of organic dust during specific tasks in poultry barns. Dr. Nonnenmann also collected important anthropologic information on the challenges to conducting research within the poultry industry.

Each core and project responded to both the NORA II strategic plan for the AFF sector and the SW Ag Center's strategic plan**.**

# Administrative and Planning Core
# PI: Jeffrey L. Levin, MD, MSPH

## Project Description


### Abstract
The Southwest Center for Agricultural Health, Injury Prevention, and Education (SW Ag Center) is based at the University of Texas Health Science Center at Tyler. The Center serves Public Health Region 6 comprised of Arkansas, Louisiana, New Mexico, Oklahoma, and Texas with the mission: *to improve the safety and health of agricultural, forestry and fishing (AFF) workers*. This is accomplished through an integrated program of research, intervention, education, and outreach activities that engage and leverage a network of strategic partners who represent the interests of a diverse worker population and a wide range of agricultural production in the region. The Center produces high quality research and translates research findings into formats that influence protective work practices for members of the AFF workforce. The SW Ag Center organized the scope of work for the 2011-2016 funding cycle around the theme, *Building Strategic Partnerships to Improve AFF Worker Safety and Health*. The Center is guided by an experienced management team and advisors who represent twenty-one disciplines and each state in the region. The SW Ag Center continually builds on its regional strengths and purposefully expands the network of partners to address its mission. Finally, the evaluation framework measures impact at the project level, as well as, Center level to assure that activities support the Center's mission and demonstrate regional impact.


### Background
The five state region encompassed by the SW Ag Center represents significant and diverse agricultural production from citrus and row crops to concentrated livestock operations including poultry, beef, and dairy. Four of the five states contribute to the substantial timber production in the south and the coastline of Texas and Louisiana provides landings for the country's second largest commercial fishing region. The workforce is equally diverse and dynamic; hired labor and H2A (guest) workers include Chinese and Vietnamese immigrants in addition to the more traditional Mexican immigrant workers. The ability of an agricultural center, dedicated to worker safety and health, to stay current with changing trends and emerging issues depends in large part on the network of well-positioned, respected, and informed partners.

Established in 1995 at the University of Texas Health Science Center at Tyler (UTHSCT), the SW Ag Center has become a mature organization under the direction of Jeffrey Levin, M.D., M.S.P.H. It has an established track record of success. The management team for the SW Ag Center, both staff and members of the Internal Advisory Committee (IAC), bring a depth of experience that provides continuity to Center operations with a demonstrated ability to effectively direct a multi-site program. The Center staff possesses the leadership and management skills to operate a complex, integrated program of research, intervention, translation and outreach activities to make a positive impact on the safety and health of the regional AFF workforce. The success of the SW Ag Center is largely attributable to identifying and engaging partners throughout the region who share a mutual concern about injuries and illness among the workers in the AFF sector and who are willing to collaborate in order to make a difference. The infrastructure is in place to support efficient administrative functions that facilitate meaningful interactions between advisors, investigators, and staff to assure that the work of the Center is relevant, responsive, and integrated.

**Aims**

1. Provide the infrastructure to promote cross-discipline interactions among all cores, programs, and projects, and to support translation of research findings.
2. Provide the infrastructure for internal and external advisors and investigators to address the Center's theme.
3. Implement a program of effective fiscal and resource management and growth.
4. Contribute to and utilize Center-wide evaluation results to identify and respond to opportunities, gaps, and emerging issues and take action based on Center advisor's recommendations.
5. Assure compliance with all Human Subjects approvals, fiscal and progress reports, and other funding agency requirements.

**Methods**

The organizational structure for the SW Ag Center was designed to provide the infrastructure to facilitate the integration of cross-disciplinary expertise, keep the center forward-looking, and exercise good stewardship. The SW Ag Center assembled a multidisciplinary team that represents a broad cross section of research and management experience and expertise in regional occupational safety and health issues for the AFF sector. Senior staff and members of the IAC have worked together for at least five years and more than ten years in some instances.

SW Ag Center staff met bi-weekly to discuss the status of ongoing items, address arising opportunities, and review calendars and assignments to stay on track with timelines. The IAC convened quarterly to review recent Center progress, guide priorities and advise the Center on any challenges. Center staff, IAC members and the External Advisory Committee (EAC) met twice a year to share project and core updates, learn about emerging issues and brainstorm strategies for overcoming barriers to research and outreach. A field experience was incorporated into the spring meeting in order for the Center partners to stay connected to various facets of AFF occupational safety and health in the region.

The Administrative and Planning (AP) Core for the Center was responsible for ensuring that all reports were completed and submitted to the funding agency in a timely manner. AP Core staff members provided instructions and report templates to principal investigators (PIs) and core leaders for the annual report and progress reports. In addition, the AP Core kept a calendar for Institutional Review Board approvals and renewals. The Program Manager collected and filed IRB renewals and sent them to NIOSH. Like each component of the SW Ag Center, the AP Core participated in a comprehensive evaluation framework using logic models.

The SW Ag Center was a complex, multi-site program that held subcontracts with multiple universities from across the region. Center leaders and staff reviewed invoices and reconciled accounts. The account balances for the Center and its components were accurately determined at the end of each fiscal year. The AP Core maintained a close relationship with the Grants Management Office at its institution and the subcontracting institutions.

**Findings (by aim)**

1. Provide the infrastructure to promote cross-discipline interactions among all cores, programs, and projects, and to support translation of research findings.
    a. Annual (spring) in-person board meetings served as an effective venue to communicate core and project progress, provide/receive feedback related to challenges, share emerging issues across the AFF industries, engage in an AFF workplace site visits to better understand diverse working risks and meet with current or past project partners. For example, the Center visited an organic farm, large scale dairy and small dairy, aquaculture farm, and apple orchard. Projects, feasibility

studies, and outreach programs have been inspired by site visits and new connections with local organizations were made during board meetings. In this cycle, board meetings took place in Ardmore, OK; Baton Rouge, LA; Albuquerque, NM; Dallas, TX; and Tyler, TX.

b. Annual (fall) virtual board meetings allowed the group to convene in a cost effective and time conscious manner. Although, the meetings were limited to brief industry updates and project/core updates, it allowed PIs to receive guidance mid-year in order to expedite the mediation of any obstacles.
c. A work group comprised of members of the IAC, EAC and staff received input from Center partners and other stakeholders to develop a strategic plan in 2012. The format was aligned with the AFF sector strategic plan that evolved from the NORA II agenda. The strategic plan was revised in 2016.
d. Dr. Levin served on adviosry committees for the Colorado Ag Center, the Southeast Ag Center in Kentucky, Ann Carruth's project, Southwest Education and Research Center (ERC), and the Heartland ERC. Dr. Levin also participated in the National Tractor Safety Coalition established by the Northeast Ag Center.
e. Dr. Levin, Dr. Casanova, and Ms. Wickman served on the fishing, forestry and outreach NORA working groups respectively.
f. Dr. Casanova participated in the Farmworker Housing and Health Conferences.
g. Dr. Levin attended annual Center Directors' meetings in Washington, DC.
h. Dr. Levin served as the leader of the Center Directors' group from 2014-2016. In this role, he led monthly conference calls with all the Center Directors and selected Center staff members, he acted as a liason between the Centers and NIOSH and convened special meetings as needed.

2. Provide the infrastructure for internal and external advisors and investigators to address the Center's theme.
    a. Quarterly IAC conference calls kept the Center leadership well-connected to long term partners who help make decisions regarding opportunties and priorities.
    b. Advisors were invited to submit applications for feasibility studies and they were informed of outreach opportunities in their respestive fields of interest.
    c. Travel support was offered to investigators to present their research findings at national conferences. Matt Nonnenmann and Eva Shipp attended the 2012 Agricultural Safety and Health Council of America (ASHCA) Conference.
    d. Dr. Casanova worked with feasibility study PIs to submit abstracts to regional and national conferences. For example, she helped two PIs submit a joint abstract to the International Society for Agricultural Safety and Health in 2014. It was accepted.
3. Implement a program of effective fiscal and resource management and growth.
    a. Subcontracts were established and managed between the host inistitution and the consortium members and the consultants that govern the responsibilites of each party includig a scope of work with deliverables and a performance timeframe.
    b. Internal procedures were in place to assure that purchases, travel, and sponsored activities are within the approved scope of work for the Center.
    c. Grants outside of the NIOSH cooperative agreement were sought to augment the Center's resources and broaden the reach of services to AFF workers and stakeholders. Proposals were submitted to ASHCA, the Houston Livestock Show and Rodeo, Sea Grant, and the Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant.
    d. Applied Research Manager, Vanessa Casanova, PhD, was awarded a U01 award for her project, Development of Safety Management and Leadership Training for Logging Contractors. She shared the PI role with Dave Douphrate, PhD, MBA from

The University of Texas School of Public Health San Antonio Regional Campus. It was a 3 year award in the amount $274,000/year.

e. The Center was awarded a $10,000 grant from ASHCA to update, translate, and disseminate Spanish language copies of Bites, Stings and Venomous Things. The dissemination targeted Hispanic farmworkers and migrant health clinic patients.

4. Contribute to and utilize Center-wide evaluation results to identify and respond to opportunities, gaps, and emerging issues and take action based on Center advisors' recommendations.
    a. Based on results from the Social Network Analysis performed in 2013, the Ag Center strengthened its relationship with the Education Research Center in the region by co-authoring a poster for the Association of Occupational Health Clinics conference. The Ag Center and Southwest ERC based in Houston also worked together to foster growth among junior investigators through the feasibiltiy studies program. In addtion, the two Centers collaborated to educate and inform a wide audience of stakeholders.
    b. Amanda Wickman worked with the Information Technology department at UTHSCT to build a mobile friendly website database for capturing process evaluation information. Project and core activities are linked to aims and logic model activities.
    c. PIs and Center staff completed bi-annual evaluation charts to record progress toward activities listed in their respective logic models.
    d. Daily, automated online searches produced news articles related to 'accidents' in AFF. Articles were reviewed by partners at Texas A&M School of Public Health, saved in pdf and incident details were recorded in a database. This effort allowed the Center to identify trends and emerging issues in AFF injuries and fatalities across the nation and inform research and outreach.
5. Assure compliance with all Human Subjects approvals, fiscal and progress reports and other funding agency requirements.
    a. All Human Subjects approvals and Animal Welfare Protection Assurances were secured and provided to NIOSH in response to 'just in time' requests.
    b. The Center Program Manager maintained contact information and a tracking schedule for all institutional review board (IRB) approvals and renewals.
    c. Continuation approval letters were provided to NIOSH with Year-end reports.
    d. The Center staff prepared, solicited IAC review and comments, and submitted an "evidence" package for the external review of the AFF program, as requested.
    e. All annual reports and progress reports were completed and submitted on time.

**Conclusions**

High level professionals in agricultural safety and health can be engaged in a complex Center program as advisors, investigators, and key staff members. Those partners can broaden the reach of Center findings and resources through their respective networks. Partners can also be influential in identifying new opportunities, emerging issues, and progressive collaborators. An experienced administrative faculty/staff team can manage a multi-site, multidisciplinary portfolio of research and outreach. An organized calendar of IRB renewals, reporting deadlines and other important dates can ensure that all grant responsibilities are met on time. Logic models are an effective tool for monitoring project and core progress during a grant cycle. They serve as a visual summary and help advisors to gauge progress toward intended aims and outcomes.

**<u>Outputs</u>**

- Annual reports, progress reports and bi-annual process reports
- Carryover requests
- Conference presentations & board meeting presentations
- Google Alert database

- Grant applications: Trade Adjustment Assistance Community College and Career Training; U01 grant application; ASHCA grant application; Houston Livestock Show and Rodeo
- Mobile-friendly evaluation data-entry website
- Publications
    - Newbill S, Wickman A, Brown C, Helitzer D: [May 10, 2017] Hierarchical Logic Models as a Tool to Evaluate Programmatic Initiatives: Practical Solutions to Identified Problems. Journal of Community Medicine and Health Education. doi: 10.4172/2161-0711.1000522
    - Cooper S, Shipp EM, del Junco DJ, Cooper CJ, Bautista LE, Levin J: [2016] Cardiovascular Disease Risk Factors in Hispanic Adolescents in South Texas. Southern Medical Journal 109(2): 130-136.
    - Levin J, Gilmore K, Wickman A, Shepherd S, Shipp E, Nonnenmann M, Carruth A: [2016] Workplace Safety Interventions for Commercial Fishermen of the Gulf. Journal of Agromedicine 21(2): 178-89.
    - Levin J, Bowling J, Wickman A, Harris M: [2016] A Brief Report Describing the Union of Medical Training and Agricultural Health. Journal of Agromedicine 21(1): 123-126.
    - Levin J, Curry W, Shepherd S, Nalbone J, Nonnenmann M: [2015] Hearing Loss and Noise Exposure among Commercial Fishermen in the Gulf Coast. Journal of Occupational and Environmental Medicine 58(3): 306-13, 2015.
    - Carruth AK, Levin JL: [2014] Cultural Influences on Safety Training Among Vietnamese Shrimp Fishermen. Journal of Agromedicine 19(2): 207-208.
    - Liebman AK, Wiggins MF, Fraser C, Levin JL, Sidebottom J, Arcury TA: [(2013] Occupational Health Outcomes for Workers in the Agricultural, Forestry and Fishing Sector. American Journal of Industrial Medicine 56(8):975-84.
    - Quandt SA, Kucera KL, Haynes C, Klein BG, Langley R, Agnew M, Levin JL, Howard T, Nussbaum MA: [2013] Occupational Health Outcomes for Workers in the Agricultural, Forestry and Fishing Sector; Implications for Immigrant Workers in the Southeastern US. American Journal of Industrial Medicine 56(8): 940-959.
    - Grzywacz J, Lipscomb H, Casanova V, Neis B, Fraser C, Monaghan P, Vallejos Q: [2013] Organization of Work in Agricultural, Forestry and Fishing Sector in the US Southeast: Implications for Immigrant Workers' Occupational Safety and Health. American Journal of Industrial Medicine 56(8): 925-39.
    - Levin JL, Gilmore K, Carruth AK, Wickman AJ, Shepherd S, Gallardo G, Nonnenmann M: [2012] Helping Gulf Shrimpers Adopt Safety Measures: Importance of Partnerships and Research to Practice. Journal of Agromedicine 17(1): 15-21.

**Outcomes**

- The infrastructure for the SW Ag Center is primed for continuity.
- The IAC & EAC function effectively to guide Center management and the integration of components.
- The carefully designed and revised strategic plan reflects research results, emerging regional issues, changing priorities, and the evolved capacity of the Center.
- Additional resources were secured for agricultural safety and health endeavors.
- Opportunities for capacity building were recognized and addressed through Center support.
- Research findings have been disseminated through scientific and popular press and translated for worker adoption.
- The Feasibility/Pilot Study Program successfully supports innovative research and responds to emerging opportunities.

# Feasibility Projects and Emerging Issues Core
# Co-PIs: Jeffrey L. Levin, MD, MSPH and Vanessa Casanova, PhD

## Project Description


### Abstract

There is great diversity of production in the agriculture, forestry and fishing (AFF) sector in the region (AR, LA, NM, OK, and TX) served by the Southwest Center for Agricultural Health, Injury Prevention, and Education (SW Ag Center). Production trends are constantly shifting as a result of markets, weather, and food demands. Similarly, the demographics of the AFF workforce are constantly changing. Despite the strides that have been made, there is still a significant need to characterize risks, understand how research findings can be disseminated in ways that motivate behavior change, influence the organization of work, and prepare information that is appropriate in language and culture so that improved practices can be understood and adopted. The SW Ag Center identified and responded to emerging issues that impacted the health and safety of AFF workers. Program innovations included the identification and pairing of established researchers with junior investigators in related or complementary fields to promote team science and mentorship.


### Background

The SW Ag Center funded thirteen feasibility studies in the 2011-2016 funding cycle. The studies funded represent a broad array of disciplines and institutions. Six studies were undertaken by investigators in Texas, two in New Mexico, three in Oklahoma, and one in Arkansas. One study was awarded to an investigator outside the region with a geographic interest in Public Health Region 6. Three studies were classified as basic research studies, four surveillance research studies, two intervention research studies and four translational research studies. All studies funded in this cycle were submitted in response to general feasibility studies request for applications. All investigators identified and worked with a mentor for the duration of their projects.

### Aims

1. Identify new/junior researchers to conduct small, innovative research, education, translation and intervention projects in AFF occupational safety and health.
2. Support small research projects that provide data to validate innovative approaches to improve AFF occupational safety and health that lead to further research.
3. Establish mentoring relationships between new and established scientists to build capacity for AFF occupational safety and health researchers.
4. Identify opportunities and support new researchers conducting small projects that augment larger projects (past and current) conducted by the SW Ag Center.
5. Engage members of the Internal Advisory Committee (IAC), External Advisory Committee (EAC) and stakeholders to identify changing trends and emerging issues, as well as, potential partners for the SW Ag Center to engage in investigative projects.

### Methods

The feasibility/pilot studies and emerging issues core (FP and EI) of the SW Ag Center was supported by a network infrastructure tied to the IAC, EAC, and funded projects. The program recruited and mentored new/junior researchers to explore the application of research, intervention, education, or translational science to reduce injury and illness among workers in the AFF sector and developed small research projects that responded to recommendations from past or current Center supported projects to encourage cross-disciplinary approaches to

translational work. The program was promoted throughout the region through personal visits to academic campuses from Center staff. These personal visits led to an increase in interest for the program from new partners including Texas Tech University and The University of Arkansas for Medical Sciences. Center staff was also deliberate in contacting institutions with safety and health programs, occupational medicine programs, and historically Black land grant universities. Between two and five FP projects were awarded each year of the five year funding cycle. Emerging issues were identified by Center leadership and advisors and were listed on the funding announcement as programmatic priorities.

**Mentorship Plan**

The Center's network of partners was asked to identify established research scientists in various disciplines, recognized for their research and advising skills, who could serve as mentors for junior investigators in AFF occupational safety and health. In most cases, however, feasibility studies PIs identified their own mentors. Each applicant was required to submit a letter of support from their mentor as well as a mentoring plan. The mentoring plan included a description of how the mentor would work with the PI to facilitate the development of research skills and manuscripts. It also included the appropriateness of the mentor's research qualifications, the extent of the mentor's role in providing guidance and advice to the PI, as well as a description of his or her prior mentoring experience. In the case where PIs were unable to identify a mentor, Center staff facilitated contact with potential mentors based on the necessary skills needed by the PI. Cross-disciplinary research was also highly encouraged.

**Findings**

Thirteen feasibility projects were funded over the SW Ag Center's 2011-2016 cycle. Each of the studies responded directly to the aims of the program, the Center's strategic goals, and National Occupational Research Agenda (NORA) goals. Each PI was mentored by an experienced agricultural safety and health researcher. Of the thirteen PIs, four have been funded as project PIs in the 2016-2021 cycle (three with SW Ag Center; one with the Florida Center) which serves as a testament to the goals and aims established for this core. A summary of each project follows.

**Year 2 Projects**

**Identification and Characterization of Data Sources for Logger Injuries and Fatalities in Three States (Responds to Aims 1, 3, 5)**

***PI:*** Hasanat Alamgir, PhD, Professor, University of Texas Health Science Center at Houston, School of Public Health, San Antonio Regional Campus

***Mentor:*** Sharon P. Cooper, PhD, Professor and Regional Dean (retired), University of Texas Health Science Center at Houston, School of Public Health, San Antonio Regional Campus

***Description:*** The primary objective of this pilot research study was to identify and characterize the existing surveillance data sources in order to generate useful information for planning and developing safer forestry activities, protecting worker health from the hazards associated with logging work.

***Project Outputs:***

Alamgir H, Martinez-Pachon, Cooper S, Levin JL: [2014] The Critical Need for Improved Enumeration and Surveillance of the Logging Workforce. Journal of Agromedicine 19(2):74-77.
Alamgir H, Cooper S, Levin JL: [2014] Identification and Characterization of Data Sources for Logger Injuries and Fatalities. Journal of Agromedicine 19(2):201-202.

**Injury Risk Assessment among East Texas Forestry Workers (Responds to Aims 1, 2, 3, 4)**

***PI:*** David Douphrate*, PhD, MPT, MBA, Assistant Professor, University of Texas Health Science Center at Houston, School of Public Health, San Antonio Regional Campus

***Mentor:*** Jeffrey Levin, MD, MSPH, Professor and Chair, University of Texas Health Science Center at Tyler

***Description:*** The objective of this study was to identify and compare physical exposures associated with different logging and forestry tasks. In addition to determining the prevalence of musculoskeletal symptoms among workers, the study explored the prevalence, causes, and consequences of fatigue among logging workers, especially forestry workers and logging truck drivers. This study gathered pilot data about fatigue experience and possible contributors to fatigue, particularly work-related contributors, in order to explore the relationship of these factors with self-reported adverse outcomes like near-misses, work-related injuries, and lost-time injuries. Specific aims included the following: 1) identify workplace risk factors that are associated with musculoskeletal symptoms among logging and forestry workers in Federal Region 6; 2) determine a 12-month period prevalence of musculoskeletal symptoms among logging and forestry workers; and 3) determine the prevalence, causes, and consequences of fatigue among logging and forestry workers.

***Project Outputs:*** Pilot data for U01 grant; pilot data for large scale Ag Center project (2016-2021), Exposures to Physical Risk Factors and Musculoskeletal Symptoms among Logging Machine Operators in the Ark-La-Tex Region.

Rodriguez A, Douphrate D, Casanova V, Levin J. Work-related musculoskeletal symptoms among loggers in the Ark-La-Tex region. In preparation.

**Tractor Seating for Paraplegia (Responds to Aims 1, 2, 3)**

***PI:*** Carla Wilhite, DOT, MNM, BSOT, Assistant Professor, School of Medicine, University of New Mexico Health Sciences Center

***Mentor:*** Janet Poole, OTR/L, FAOTA, Professor, School of Medicine, University of New Mexico Health Sciences Center

***Description:*** The goal of this pilot study was to observe the effect of seating pressure on individuals with paraplegia in New Mexico seated on a typical contour tractor seat and then on four intervention cushions. The outcome of the study was to derive measurable and meaningful data for comparing tractor seating conditions intra-subject and inter-subject, and report significant findings. New knowledge was derived that will aid in creating prevention and intervention methods for agricultural machinery operators with paraplegia in NM and elsewhere fostering stronger collaboration between SW Ag Center members and AgrAbility projects and AgrAbility professional needing evidence-based information, building research capacity related to health and safety in working farming and ranching populations impacted by disability conditions.

***Project Outputs:*** This study resulted in presentation of a paper at the International Society of Agricultural Safety and Health, invited presentation of research at the National AgrAbility Project, poster at a University of New Mexico Research Day for occupational therapy graduate students, submission of poster to the American Occupational Therapy 2016 conference, and two manuscripts in peer-reviewed journals. As a direct result of the study, additional intramural funding was obtained through a competitive process through the Health Sciences Center at the University of New Mexico to obtain a professional pressure mapping system ($28,000 instrument). The research has also generated interest with ROHO innovation researchers who have volunteered time and effort to design prototype air cushion seating supports to replace the contour foam seat for research.

C.S. Wilhite, W. Field, M. Jaramillo, and K. Sullivan. Comparisons of Agricultural Seating for Paraplegia. Journal of Agricultural Safety and Health. 23(1): 23-37.
C.S. Wilhite, W.E. Field, and M. Jaramillo. Tractor Seating for Operators with Paraplegia. Assistive Technology: The Official Journal of RESNA. 2016.

## Year 3 Projects

### Reaching South Texas Agriculture Workers through Lower Rio Grande Valley FQHCs (Responds to Aims 1, 2, 3)

***PI:*** Sharon Huff, MD, MS, Assistant Professor, Occupational Health Sciences, University of Texas Health Science Center at Tyler
***Mentors:*** Vanessa Casanova, PhD, MS, Associate Professor, Occupational Health Sciences, University of Texas Health Science Center at Tyler
I-Kuan Hung, PhD, Assistant Professor, Geographic Information Systems, Stephen F. Austin State University
***Description:*** Data on farmworker injuries and illnesses is not adequately tracked and there is limited information on the number and types of workers at risk. Securing valid, timely data regarding the characteristics of this workforce is important to develop targeted evidence-based interventions. Social, cultural, and physiologic factors make these workers more susceptible to injury or illness but also compromise workers' ability to access resources, such as health care. Resident physicians working at federally qualified health centers (FQHCs) in South Texas where there is significant agricultural activity report that self-identified agricultural workers are not coming forward at local clinics and systems of identifying agricultural workers and capturing meaningful occupational data are limited. The goals of this study was to gain better understanding of where the agricultural workers who reside in South Texas live, work, and access medical care and to design a clinic-based data capture system that will effectively capture the characteristics of this population.

### Health and Safety Issues in Organic Farming: A Qualitative Study (Responds to Aims 1, 2, 3)

***PI/Mentor:*** Francisco Soto Mas, MD, PhD, MPH, Associate Professor, Family & Community Medicine, University of New Mexico
***Mentees:***

- Carla Sue Wilhite, PhD. Assistant Professor, Occupational Therapy Program, University of New Mexico School of Medicine
- Rose Rohrer, PhD student, Department of Sociology, University of New Mexico
- Eric Tomalá, PhD student, American Studies Department, University of New Mexico
- Anabel Johnson, Public Health student, MPH Program, University of New Mexico School of Medicine
- Nadine Guerrero-Pezzano, Graduate student, Occupational Therapy Program, University of New Mexico School of Medicine
- Holly Brause, PhD student, Department of Sociology, University of New Mexico

***Description:*** The overall aim of this qualitative study was to identify and typify health and safety risks in organic farming, specifically among small producers. Data were collected through semi-structured interviews, unobtrusive observations, and review of public documents. Objectives included: a) develop a semi-structured bilingual interview script that captures perceived health and safety risks in organic farming among both producers –employers- and workers – employees; b) identify actual injuries and assess perceived health and safety risks in organic farming in Central New Mexico by interviewing 10 small producers and 20 farmworkers; and d)

compile and analyze observational data on the environmental and working conditions of small organic farming in Central New Mexico.

***Project Outputs:***

- Farming as a vocation: identity and community building among small-scale organic farmers in the middle Rio Grande valley. *2015 Western Social Science Association Conference*, Portland, OR, April, 2015.
- The organic farming study*. 2015 New Mexico Shared Knowledge Conference*, Albuquerque, NM, April, 2015.
- Central New Mexico Organic Farmers: A Holistic Perspective to Health and Safety*. New Mexico Public Health Association 2015 Annual Conference*, Albuquerque, NM, March 2015.
- Health & Safety Issues in Organic Farming: An Exploratory Qualitative Study in Central New Mexico. *2014 New Mexico Shared Knowledge Conference*, Albuquerque, NM, April, 2014.

**Identification of Novel Pro-Inflammatory Small Molecules in Poultry Dust (Responds to Aims 1, 3, 4)**

***PI:*** Rena Saito*, PhD, Assistant Professor, University of Texas Health Science Center at Tyler, Occupational Health Sciences

***Mentor:*** Vijay Boggaram, PhD, Professor of Molecular Biology, University of Texas Health Science Center at Tyler

***Description:*** The overall goal of this collaborative project between the University of Texas Health Science Center at Tyler and Colorado State University was to identify inflammatory agents in agricultural dust. To meet this goal, aqueous extracts of agricultural poultry dust were fractionated using reverse phase liquid chromatography (LC) and fractions applied to cell cultures to determine interleukin-8 levels as a marker of inflammation. The significance of this project is to fill in the knowledge gap of other non-endotoxin pro-inflammatory small organic molecules that are present in poultry dust. The understanding of which molecules may be contributing to respiratory impairment may indicate the source and potentially provide a means of intervention to reduce their presence and the inflammatory activity of the dust.

***Project outputs:*** High inflammatory activity in dust extracts between 50 and 100 kDa was detected. Although we were not able to identify corresponding proteins in this fraction using LC-QTOF-MS, we found that unknown proteins in this fraction may play a role in acute and chronic respiratory diseases among poultry workers.

**Latino Youth Development in an Agricultural Context (Responds to Aims 1, 2, 3)**

***PI:*** Michael Merten*, PhD, Associate Professor, College of Human Sciences, Oklahoma State University

***Mentor:*** Joseph Grzywacz, PhD, Professor, College of Human Sciences, Oklahoma State University

***Description:*** The aims of the project were achieved through a nested study design involving two components. The first component is a survey of Latino adolescents to determine the feasibility of collecting in-depth survey data from adolescents of immigrant Latinos, and whether youth development outcomes vary by their exposure to farm work. The second component is nested biomarker study wherein first-morning void urine specimens will be collected from a targeted subsample of youth.

***Project Outputs:***

Grzywacz JG, Merten MJ, Belden J: [2014] Pesticide Exposure Biomonitoring Using Sweat Patches: A Pilot Study. Funded by Southwest Center for Agricultural Health, Injury Prevention and Education, 09-30-2014 through 09-29-2015.

Brown L, Merten MJ: [2015] Latino youth development in an agricultural context. Paper presented at the Annual Conference of the Oklahoma Council on Family Relations, Tulsa,OK.

**Forces Experienced by the Human Body During Grain Entrapment and Rescue (Responds to Aims 1, 2, 3)**

***PI:*** Kevin Moore, BS, ChE, MBA, Research Engineer, Agricultural Sciences and Natural Resources, Oklahoma State University

***Mentor:*** Carol Jones, PhD, PE, Associate Professor, Agricultural Sciences and Natural Resources, Oklahoma State University

***Description:*** Agriculture is consistently recognized by the U.S. Bureau of Labor as one of the most dangerous working environments. According to Purdue University there were at least 38 grain entrapments in 2014, 17 of which resulted in death. Both of these figures have been on the rise during the past three years. While previous studies have measured the vertical pull required to extract a manikin from grain, there is limited information on the pressure experienced by entrapment victims. The objective of this project was to measure the pressure on the chest and back of a manikin buried in grain.

***Project Outputs:***

Based on preliminary results, mean pressure on the chest was positively correlated with depth and exhibited a significant linear trend for all grains. Average mean pressures ranged from 2.2 – 4.5 kPa. Mean pressure on the back was positively correlated with depth and exhibited significant linear and quadratic trends for wheat and canola and a significant linear trend for soybeans. Average mean pressures ranged from 1.9 – 4.3 kPa.

This work was instrumental in gaining support from Itasca International, Inc. for the Itasca Education Partnership (IEP) program. This program provides a license to the PFC software, which will be used to model entrapment forces in a grain bin. Derrick Blanksma of Itasca is serving as a mentor on this project. The PI is also exploring potential collaborations with Dr. Dirk Maier of Kansas State University and Christopher Harner of Berkley Agribusiness Risk Specialists.

The results of this project have been disseminated through the following presentations:

- Moore, K.G., Jones, C.L. 2016. Grain Bin Entrapment – Pressure Measurement. GEAPS (The Grain Elevator and Processing Society) Exchange in Austin, TX on March 1-2, Invited presentation.
- Moore, K. G., Jones, C. L. 2015. Pressure Measurement on the Chest and Back of a Grain Entrapment Victim. Accepted for poster presentation at the International Grain Quality and Food Security Conference. Manhattan, KS. August 3-6, 2015.
- Moore, K. G. 2015. Pressure on the Chest and Back of a Manikin Buried in Grain. Accepted for presentation at the ISASH Annual Conference. Normal, IL. June 21-25, 2015.
- Moore, K. G. 2015. Grain Bin Entrapment – Pressure Measurement. Presented at the NC-213 Annual Meeting. Kansas City, MO. February 18-19, 2015. Plus poster.
- Moore, K. G. 2014. Forces Experienced During Grain Entrapment. Presented at the ASABE International Meeting. Montreal, Quebec. July 13-16, 2014.

## Year 4 Projects

**Pesticide Exposure Biomonitoring Using Sweat Patches: A Pilot Study (Responds to Aims 2, 3)**

***PI:*** Joseph G. Grzywacz*, PhD, Professor College of Human Sciences, Oklahoma State University

***Mentor:*** Dana Boyd Barr, PhD, Professor, Rollins School of Public Health, Emory University

***Description:*** The goal of this study was to determine the feasibility of using sweat patches for biomonitoring pesticide exposure among immigrant Latino farmworkers. The aims of this feasibility study were to: (1) develop and assess the accuracy and precision of laboratory techniques used to measure pesticide metabolites from sweat patches: (2) document challenges and problems experienced by Latino farmworkers in using (opening, applying, wearing removing, and storing) the sweat patches; and (3) determine the level of variance in concentrations of pesticide metabolites obtained from urine that is explained by concentrations of pesticide obtained from sweat. We conducted a value-leveraged project wherein this project built off another Southwest Agricultural Health and Safety Center-funded grant that collected first morning void urine samples across 7 consecutive days from a sample of Latino adolescents employed in agriculture (N=60). We collected additional sweat samples from a subsample (n=20) of participants providing daily urine samples. The proposed work involved a combination of both laboratory and field procedures, and the subsequent integration will result in a highly translational project with substantial potential occupational health impact.
***Project Outputs:***
Preliminary data for comprehensive project funded in 2016-2021 Ag Center cycle (M. Merten, PI).

## Year 5 Projects

### Improving Public Health Surveillance of Occupational Injuries in Agriculture (Responds to Aims 1, 2, 3)

***PI:*** Victor Cardenas, MD, PhD, MPH, Associate Professor, University of Arkansas for Medical Sciences, Fay W. Boozman College of Public Health
***Mentor:*** Lorann Stallones, PhD, MPH, Professor, Colorado School of Public Health, Department of Epidemiology
***Description:*** There are no previous reports on the occurrence of farm tractor-related injuries in Arkansas at the state level. The authors contributed to establishing a coalition for occupational injury and disease surveillance and control in the agriculture, forestry and fishing sector. They developed and applied a simple text string algorithm to ascertain farm tractor-related injuries and compared results to existing reported fatalities by the Centers for Disease Control and Prevention and the Census of Fatal Occupational Injuries.
***Project Outcomes:*** The text string search increased the ascertainment of fatal farm tractor-related injuries by at least 68% and that increase was statistically significant (*P*-value<0.02). The descriptive analysis of the records showed a significantly increased risk among men above retirement age, significantly lower risk for women and during the winter, peaks during the summer, more the farmers from the Mississippi Delta area, and a high death to case ratio (35%). About one-third of the fatal farm tractor-related injuries were due to over-turn.
The use of the algorithm can improve ascertainment of fatal farm tractor-related injuries in the State. The death records were found to be rich in data on the circumstances of the occurrence of the injury, which can be translated into action to improve policy-making to improve the safety of the Arkansan farmers.

### Heat And Health: Developing Vulnerability Indicators For Agricultural Workers Along Texas-Mexico Border (Responds to Aims 1, 2, 3)

***PI:*** Kai Zhang, PhD, Assistant Professor, University of Texas Health Science Center at Houston, School of Public Health
***Mentor:*** George Delclos, MD, MPH, PhD, Professor, University of Texas Health Science Center at Houston, School of Public Health
***Description:*** Although agricultural workers living along Texas-Mexico border are highly vulnerable to ambient heat because of their working conditions and hot summer, heat effects on

them have not been studied. Effects of heat on daily death counts among agricultural workers were estimated by taking advantage of deaths records from Texas Department of State Health Service. Because occupational information in death records are largely missing during 1990-2010, daily weather and death records visit datasets in Cameron, El Paso and Hidalgo, and Rio Valley (Starr County, Hidalgo County, Willacy County, and Cameron County) were combined for the summer of the period 2011-2013. Poisson regression was used to estimate the associations between heat and heat waves and daily all-cause mortality among agricultural workers. Analysis was conducted to evaluate the impact of different heat wave definitions.
***Project Outcomes:*** The fitted non-linear associations between heat and temperature vary with counties. We did not observe that risk in mortality increases statically significantly at high temperatures for three counties and Rio Valley, likely to very small sample size. We also did not observe statistically significant effects estimate of heat waves on mortality compared to normal days. Our findings are consistent with different heat wave definitions. The study appears to be the first to link heat effects with mortality among agricultural workers living along the US-Mexico border. Although we did find statistically significant impact of heat and heat waves on mortality, this research provides some insights for further studies.

**Development of Guidelines to Conduct a MSFW Enumeration Profiles Study (Responds to Aims 1, 3, 5)**
***PI:*** Alice C. Larson, PhD, Larson Assistant Services
***Mentor:*** Dr. Larson will serve as mentor to students and investigators with an interest in enumeration studies
***Description:*** This Feasibility/Pilot Project documented research processes which have successfully been employed in a series of 18 state-specific reports which supply the localized denominator data necessary for conducting occupational health and safety research on the vulnerable population of migrant and seasonal farmworkers (MSFWs). Without this basic information, needs, status, service assistance, and intervention effectiveness cannot be measured. Population estimates are needed for any occupational health and safety research conducted with the vulnerable population MSFWs to measure need and evaluate success.
***Project Outcomes:*** This project started the process that will lead to continuation of a well-respected and utilized method for developing county-level estimates, establishing it in an academic mentoring system to train student researchers.

**A Novel Diagnostic Approach to Traumatic Brain Injuries in Agricultural Workers (Responds to Aims 1, 2, 3)**
***PI:*** Joseph Neary, PhD, MS, VetMB, MA, Assistant Professor, College of Agricultural Sciences and Natural Resources, Texas Tech University
***Mentor:*** Annette Sobel, MD, MS, FAAFP, FAsMA, P.E., Associate Professor, Department of Medical Education, Texas Tech University
***Description:*** The goal of this study was to undertake a preliminary evaluation of visual pursuit technology as a tool for the timely detection of traumatic brain injuries (TBI). Collegiate rodeo athletes served as our study population because the injuries incurred are analogous to the many horse-related TBI sustained by workers in the agricultural sector. One bull rider (Subject) and one, recently injured, bull rider (Control) were followed over the course of 3-rodeo events. Visual pursuit testing was compared with a gold standard measure of head trauma (MRI) and computerized cognitive testing, which currently serves as the 'field-side' measure of cognitive impairment sustained during sporting activities. We hypothesized that visual pursuit technology is more sensitive to TBI than the current standard, computerized cognitive tests. During the study, the Subject received one blow to the head, of sufficient magnitude to potentially cause a TBI. Despite this, however, none of the technologies employed detected any change in cognitive status.

***Project Outcomes:*** There was no change in visual pursuit or cognitive performance, and changes observed by magnetic resonance imaging were negligible. Verbal memory was impaired in both Subject and Control and appeared to deteriorate in the Subject through the study. This suggests that repeated TBI in rough stock athletes and, consequently, workers in the AFF industries, may have deleterious long term effects on verbal memory.

**Assessment of Sun-Safety Behaviors and Knowledge of Sun Protection and Skin Cancer in the Farmworker Population of South Texas**

***PI:*** Shaadi Khademi, MD, MS, Assistant Professor of Occupational Medicine, Department of Occupational and Environmental Health Sciences, The University of Texas Health Science Center at Tyler

***Mentor:*** Vanessa Casanova, PhD, MS, Associate Professor of Occupational and Environmental Health Sciences, The University of Texas Health Science Center at Tyler

***Project Description*:** The Hispanic population is more likely to believe their risk for skin cancer is below average and less likely to take preventive measures compared to more fair-skinned individuals. The incidence of melanoma has increased among US Hispanics by over 11% from 1992 to 2011. In fact, Hispanics are more likely to be diagnosed with later stage and larger melanomas, increasing morbidity and mortality. About 25% of the 2012 US Hispanic workforce, which includes farmworkers were employed in industries that involve significant amounts of occupational UV exposure, which includes farmworkers. The aim of this study was to identify sun-protective behaviors, knowledge of sun safety and skin cancer, willingness to seek medical care for new or worsening skin lesions or moles, as well as potential barriers that may exist in the predominantly Hispanic, Spanish-speaking south Texas farmworker population. The goal was to also assess whether there were significant differences in responses within this population by gender, age, and years of work. Data was obtained via questionnaires administered to 100 Hispanic farmworkers, aged 18-75, at two different field sites in the south Texas region. Survey answers were anonymous and unidentified, and only general demographics were obtained. Basic statistical analyses and cross-tabulation were performed using SPSS. Pearson Chi square testing was used to determine whether there were significant differences by gender, age, and years of work.

***Project Outcomes:*** The majority (78% or higher) reported use of long sleeve shirts, long pants, and wide-brimmed hats, while the majority (66% or higher) reported that they did not wear sunglasses or sunscreen. For those who reported “no” to use of the types of sun protection noted above, the key reasons identified for why not were “not comfortable” and “too warm to wear”. Significant differences were seen between males and females with respect to use of long sleeve shirts ($p=.003$) and long pants ($p=.029$). 100% of females reported use of long sleeve shirts and long pants versus 70.7% and 82.7% in males, respectively. The majority (69% or higher) answered correctly on true and false questions about sunscreen except that 62% agreed with the statement that sunscreen is not affected by perspiration. Of note, while this was true of the minority of participants, 22% still reported true to the statement that the Latino population does not get skin cancer. The majority recognized an abnormal mole (69%) and skin cancer (92 and 94%) photographically, reported true to statements that moles (84%) and skin cancer (100%) can be dangerous and that you can die from skin cancer (94%), and endorsed that they would see a doctor if they had a mole that was changing with time (91%) or a new or worsening skin lesion (96%). Significant differences were also seen for several questionnaire responses by years of work (<5 years, >=15 and <15, and >=15).

The data still suggests a need for education in this population about sun safety, especially use of sunscreen, the least reported sun-protective behavior. Overall, while they demonstrated good knowledge of skin cancer, some participants still thought Latinos do not get skin cancer or were not able to recognize an abnormal mole photographically. Better skin cancer education, as well

as ideas for overcoming identified barriers to sun-safety behavior and the seeking of medical care, are needed to promote better health outcomes.

**Denotes pilot/feasibility studies investigators funded as project PIs in the current funding cycle.*

**Conclusions**

This program proposed a strategy that engaged a network of partners to expand the number of competent, pioneering researchers conducting innovative AFF health and safety investigations. This program design has built AFF research capacity for multi-disciplinary team science that has been rewarding for investigators, students, and mentors. The feasibility/pilot program as proposed, has proven to be a cost-effective approach by validating methods, generating high quality date for larger studies, demonstrating effectiveness of translation materials, and exploring appropriate responses to emerging issues as they arise.

# Outreach Core
# Co-PIs: Jeffrey L. Levin, MD, MSPH and Ann Carruth, DNS

## Project Description


### Abstract
Agricultural, forestry and fishing (AFF) production, as well as the associated workforce, is diverse in U.S. Public Health Region 6. Operations are largely mechanized and workers in each sector of agriculture face different risks for injuries, fatalities, and illnesses. Over the last century, workers have also transformed into a culturally, linguistically, and educationally diverse population. In order to respond appropriately to the safety and health needs within the region, the Outreach Core focused on priority areas that were not addressed through one of the Center's research projects. This strategy also expanded our network of strategic partners.

The Southwest Center for Agricultural Health, Injury Prevention, and Education (SW Ag Center) maximized efficiency within the outreach program by engaging strategic partners and their respective networks to conduct topic/population based initiatives and to communicate and disseminate intervention findings, best practices, tools, approaches, technologies, guidelines, and policies while building capacity at multiple levels. Established relationships with other National Institute for Occupational Health and Safety (NIOSH) funded agricultural research centers, vocational agriculture teachers, cooperative extension, universities, farm bureau, state agencies, occupational health clinics, and trade associations were enhanced and additional connections were forged with people and groups who served as catalysts for health and safety outreach in the region. Partners were essential to guiding outreach priorities, supporting local events, identifying emerging issues, securing access to underserved and understudied populations, and expanding the SW Ag Center impact.


### Background
According to the 2007 Census of Agriculture, over 650,000 tractors were on farms in the five state region - AR, LA, NM, OK, TX, served by the SW Ag Center. Agricultural tractors and machinery accounted for 23% of fatalities among youth (1995 - 2002) according to NIOSH, 2009. Production of large livestock was and continues to be significant in the SW Ag Center region; demonstration of best practices for animal handling is an effective strategy to keep both humans and animals from injury (Grandin 2001). Despite a plethora of educational materials for pesticide safety education, this exposure still contributes to acute and chronic health issues for agricultural workers. There has been a significant change in the trend of farm ownership in the SW Ag Center region. In Texas, 35% of operators started their present operation within the last ten years, and the number of small farms in the region increased by 25% compared with 1% nationally (USDA 2007). New Mexico and Texas are 1$^{st}$ and 3$^{rd}$ respectively among states for the highest percentage of Hispanic principal farm operators. Language and cultural barriers to education and safety training commonly exist. Hispanic youth are also at risk for injuries on U.S. farms; 77 died between 1995 and 2002 (CDC 2010). The Outreach Core was designed with these issues in mind.

### Aims
1. Develop a structured communication network of partners to identify regional safety and health needs and to disseminate prevention/intervention findings, best practices, tools, approaches, technologies, guidelines, and policies.
2. Enhance the capacity of regional agricultural educators, producers, and stakeholders as well as community competence to sustain SW Ag Center initiated outreach projects.

3. Identify outreach and education interventions through topic/population based initiatives that will serve as models for the promotion of safe and healthy work behaviors.
4. Increase awareness of AFF safety and health careers among students, current researchers, educators and social scientists.

**Methods**

The outreach program adopted a dual approach: (1) structured communication and dissemination, and (2) topic or population focused initiatives. This approach sought to maximize the reach and impact of outreach initiatives and build capacity at multiple levels within the strategic partner network.

Communication with Stakeholders: Structured messages distributed by the SW Ag Center included a quarterly newsletter-*Cultivation*, monthly safety blasts, and brief safety reminders for national campaigns. Newsletters and safety blasts incorporated new evidence-based techniques, tools, and programs that integrated health protection and promotion. In collaboration with the other NIOSH Ag Centers, special campaigns were designed for National Farm Safety and Health Week and National Agriculture Day. The Center's website was updated weekly and served as a resource for upcoming events, educational resources, regional data, past and current research projects, feasibility study announcements, internship opportunities and biographies of the Center PIs, staff, internal advisors and external advisors. The Center expanded awareness and availability of materials through the enhanced communication network and through targeted distribution to previously underserved populations including migrant and community health centers, migrant education network, community health fairs and farm bureau safety coordinators. In addition, new materials were promoted at multiple conferences and across diverse audiences.

Topic or Population Based Initiatives: Although, agricultural production is diverse in the region, several areas posed greater risk for operators and hired workers and capitalized on the strength and expertise of the SW Ag Center staff and researchers. The topics and populations identified for focused initiatives included: (1) tractors and agricultural machinery; (2) livestock; (3) pesticides and agricultural chemicals; (4) new or inexperienced AFF workers; and (5) Latino AFF workers. External Advisory Committee (EAC) members helped to ensure programs were aligned with the Center strategic plan and national objectives.

Capacity was built at multiple levels during the development of outreach programs and more directly through formal internship programs. The SW Ag Center partnered with the Noble Foundation to jointly sponsor an agricultural safety focused internship. In collaboration with the Noble Foundation, the Center offered one internship per year to an outstanding student in the region. Intern applicants were accepted from various disciplines, including the social sciences, in order to raise awareness and interest in AFF careers. Interns participated in on-going research and outreach activities as well as initiated new contacts and educational opportunities.

**Findings (by aim)**

1. Develop a structured communication network of partners to identify regional safety and health needs and to disseminate prevention/intervention findings, best practices, tools, approaches, technologies, guidelines, and policies.
    a. The contact database was updated monthly with new partners.
    b. Seasonally relevant safety articles were written and distributed monthly to an average of 1,200 contacts. Topics ranged from tractor safety to stress management. See https://www.uthealth.org/southwest-center-agricultural-health-injury-prevention-education/monthly-safety-blasts for archived monthly blasts.

c. Cultivation, the Center's newsletter, was developed and emailed to partners quarterly. The newsletters included a 'From the Director' piece describing current issues in AFF safety and health, a section to highlight Center researchers or advisors, a calendar of events and new relevant resources. Refer to https://www.uthealth.org/southwest-center-agricultural-health-injury-prevention-education/archived-newsletters for past newsletters.
d. Monthly blasts, newsletters and other pertinent AFF safety and health information is posted to the Center's Facebook page and Twitter account.
e. The Center's website is updated weekly with new resources, upcoming events and announcements.
f. The Center initiated a cross-center collaboration to create a joint YouTube channel focusing on AFF safety and health videos. The channel now has over 100 videos, 121,000 views, 268,00 minutes watched and 608 subscribers.

2. Enhance the capacity of regional agricultural educators, producers, and stakeholders as well as community competence to sustain SW Ag Center initiated outreach projects.
    a. Four interns were engaged in the agricultural safety internship program jointly sponsored by the Ag Center and the Noble Foundation.
    b. In 2016, the Center supported two interns through the Occupational Health Internship Program. They conducted a research study on safety issues for nursery workers.
    c. A graduate student at the University of Texas Health Science Center at Houston-San Antonio campus represented the Center by exhibiting on Bites, Stings and Venomous Things at a Migrant Health Fair in San Antonio.
3. Identify outreach and education interventions through topic/population based initiatives that will serve as models for the promotion of safe and healthy work behaviors.
    a. The SW Ag Center applied for and received a small grant from the Houston Livestock Show and Rodeo to duplicate and disseminate the Right from the Start video to all Texas AgriLife Extension Agents and all Texas Agricultural Science teachers. Carryover funds were later dedicated to repeat the duplication and dissemination process in the other four states of the region.
    b. The SW Ag Center engaged a Master Trainer to lead the National Safe Tractor and Machinery Operator Course for new landowners, agricultural science teachers and extension agents in Texas and Oklahoma. The existing training materials were adapted for the adult, new landowner audience by a qualified advisory group.
    c. The Center engaged a former farmworker to deliver a presentation on pesticide safety to Hispanic farmworkers during a community health fair.
    d. Center Director, Dr. Levin, delivered a presentation on heat related illness to multiple audiences. Two presentations were delivered at Employer Forums in Texas and New Mexico where producers learned how to design their own heat illness prevention plans. The third presentation was made to professionals at the Society of Toxicology conference in San Antonio.
    e. Logging and forestry stakeholders from Texas, Louisiana and Arkansas convened in Texarkana, TX to prioritize topics for a tailgate training series. The group not only discussed health and safety priorities, but also the most effective methods for adult education delivery. Stakeholder recommendations were used to create 21 educational modules. The modules are currently under review by content experts. When the modules are finalized, the SW Ag Center will work with industry partners to create short videos to accompany the module topics. All resources will be available for free on the SW Ag Center website.

f. A testimonial video series was created to capture the personal stories of those who have been involved in occupational incidents. Videos are posted on the Ag Center's YouTube channel.

4. Increase awareness of AFF safety and health careers among students, current researchers, educators and social scientists.
    a. Presentations were delivered at universities and schools across the region including Stephen F. Austin University, Sam Houston State University, Texas A&M University-Commerce, Oklahoma State University, The University of Arkansas, Texas Tech, and Bullard High School to educate students on AFF safety and health professions. Ag Jobs and Ag Employers posters were developed and distributed to educators. The posters can be downloaded from the Center's website: https://www.uthealth.org/southwest-center-agricultural-health-injury-prevention-education/agricultural-safety-resources.
    b. Agricultural medicine trainings were held in 2014, 2015 and 2016. Occupational medicine residents and medical students attended these programs to learn more about the illness and injuries that frequently occur to AFF workers. 146 people have attended these trainings since 2014.

**Conclusions**

An organized Outreach Core can reach appropriate audiences with agricultural, occupational safety and health information through educational resources, presentations, trainings, social media, email and a current online presence. The success of the SW Ag Center Outreach Core is multiplied by an engaged network of partners, including advisors, educators, extension agents, association leaders and other relevant organizations.

**Outputs**

- 60 Monthly Blasts
- 20 Cultivation Newsletters
- Updated Bites, Stings and Venomous Things tip booklet
- Bites, Stings and Venomous Things tip booklet-Spanish version
- Logging and Forestry Safety Series
- Injury Testimonial Video Series-5 videos
- Social Media Kits for National Farm Safety & Health Week and National Agriculture Day
- Texas Agricultural Medicine Course (2014, 2015, 2016)
- Posters
    - Bites, Stings and Venomous Things poster
    - SW Ag Center general poster
- Fact Sheets
    - Annual state highlights for Center research and outreach
    - Commercial Shrimp Fishermen Research Impact Sheet
    - Right from the Start Impact Sheet
    - Program Performance One-Pager (NIOSH document)
- Selected Presentations
    - Stress Management, [some event to do with logging] 2016, Nykole Vance
    - Social Media Analytics, Nordic Meeting for Agricultural Occupational Health and Safety 2016, Amanda Wickman
    - Incorporating Health and Safety into Ag in the Classroom Lessons, Oklahoma Ag in the Classroom Conference 2016, Amanda Wickman
    - Texas Agricultural Medicine Course, International Society for Agricultural Safety and Health 2016, Amanda Wickman

- Tractor and Machinery Safety, New Landowner Education Series 2016-Harris County, Doug Simmerman
- Bites, Stings and Venomous Things, Midwest Stream Farmworker Health Forum 2015, Amanda Wickman
- 21st Century Data Collection through Google Alerts, International Society for Agricultural Safety and Health 2015, Amanda Wickman & Eva Shipp
- NIOSH Responds to Workforce Training Needs in U.S. Public Health Region 6, Association of Occupational Health Clinics 2014, Jeffrey Levin

**Outcomes**

- The Logging/Forestry Safety Series is used by Forestry Associations in Texas, Arkansas and Louisiana for continuing education. Selected educational messages from the series are printed in the Texas Logger Magazine and the Arkansas Timber Producers Association newsletter.
- The Right from the Start video series is used in Livestock Quality Assurance courses.
- Monthly blasts were used by Brian Triplett on a Radio Station in Red River County, TX.
- Monthly blasts were re-printed by Texas Area Health Education Centers, Hopkins County newsletter (TX), Arkansas Livestock, Colorado Livestock Association, Arkansas Cattle Business (6016), Arkansas Agri Education listserv (250), ASHCA News Brief, Farm and Ranch eXtension, LSU Ag Center listserv, Worker Protection Standard listserv (1767), Area X FFA teachers (150) and New Mexico Dairy Producers Association. Distribution numbers are listed in parentheses where known.
- SW Ag Center YouTube Channel Views 206,575;
  US Ag Centers YouTube Channel Views (SW Ag Center videos only) 8,680
- Facebook: 2,258 likes & reached over 20,000 people
- “The FRESCO charts look awesome. I have to admit, I have never seen this information compiled like that before. Your agency’s efforts certainly veered away from the non-descript & unassuming flyer hand-outs that so often end up in the waste basket as being unimportant. I think this information will be put more easily into perspective because of the use of personal anecdotes along with the life-saving information. Fabulous job!!!” - Eva Avila, Workforce Commission
- "I was pleased to see the HSC Fishing Vessel Safety Project concentrated on communications and Rule 5. It seemed that the lack of communications and the failure to keep a proper look-out contributed to nearly every collision/allision involving a commercial fishing vessel that I investigated in that area. I'm also pleased to see the materials relate to the people who own and operate commercial fishing vessels in the Gulf of Mexico. The project produced some great tools, I know if they are widely used by the CFV operators it will certainly reduce the number of serious collisions."- Troy Rentz, US Coast Guard 13th District
- "It provides very important information on how to identify stings and bites of poisonous bugs. I like that it includes pictures of the animals, symptoms and steps to first aid information." –Migrant Heat Start family
- “I learned SO much! Thanks a million!” –Hannah Smith, 2013 YouTube Viewer (Right from the Start: Beef Cattle)

# Research Core Projects

# Poultry Dust Exposure and Lung Inflammation
# PI: Vijayakumar Boggaram, Ph. D.

## Project Description

### Abstract

Workers in concentrated animal feeding operations (CAFO) are exposed to high levels of air-borne dust containing inorganic and organic components and bacteria and fungi. CAFO workers are at risk of developing chronic obstructive pulmonary disease (COPD). Despite rapid growth of poultry production in the US and the high prevalence and severity of respiratory illness among workers there is insufficient information on the effects of poultry dust on the pathogenesis of lung disease. This project is aimed at understanding mechanisms mediating inflammatory responses of lung epithelial cells to broiler chicken CAFO dust. Lung epithelial cells play major roles in the propagation and amplification of inflammatory responses. Cell lines and primary airway and alveolar epithelial cells and a mouse model will be employed to investigate mechanisms of inflammatory responses. Regulation of interleukin 8 (IL-8) levels will be studied to understand molecular mechanisms of inflammatory responses of lung epithelial cells. IL-8, a proinflammatory chemokine, has been implicated in the pathogenesis of lung diseases. In aim 1, the effects of broiler dust on the expression profiling of RNAs in lung epithelial cells will be determined by DNA microarray analysis. In aim 2, the importance of bioactive agents in broiler dust such as, endotoxin, peptidoglycan, β-glucan, and proteases for the induction of IL-8 levels will be analyzed using chemical/pharmacological inhibitors. The contributions of transcriptional and posttranscriptional mechanisms for IL-8 induction will be determined. In aim 3, the importance of reactive oxygen species (ROS) and protein kinase signaling pathways for broiler dust induction of IL-8 levels will be analyzed using chemical/pharmacological inhibitors. In aim 4, inhalation mouse model will be used to analyze the effects of broiler dust on lung inflammation and lung mechanics. The effects of inducers of Nrf2, a major antioxidant response regulator, on the attenuation of dust induced lung inflammation, and disrupted lung mechanics will also be studied in the mouse model. The project is expected to provide significant new information that could lead to the development of novel treatments for respiratory diseases associated with exposure to CAFO dust.

### Background

Poultry dust is a complex mixture of organic and inorganic components and contains bacteria, viruses and fungi. Workers in poultry production facilities are exposed to higher concentrations of aerosolized dust compared to other animal production workers and experience higher prevalence of lower and upper respiratory symptoms and lower baseline lung function. Although the prevalence and severity of respiratory illness is higher among poultry workers, compared to other animal farm workers, there is insufficient information on the effects of poultry dust on lung inflammatory responses and lung disease. Considering the rapid growth of poultry production world-wide and the risk for exposed workers to develop lung disease, it is very important to understand mechanisms mediating poultry dust induced lung inflammation and lung disease in order to develop new treatments.

Lung epithelial cells play major roles in the propagation and amplification of inflammatory responses. Our preliminary experiments demonstrated that exposure of lung epithelial cells to broiler facility dust extract increased the levels of interleukin-8 (IL-8) and interleukin 6 (IL-6), key proinflammatory chemokine/cytokines. The increase in IL-8 was associated with an increase in

IL-8 promoter activity and the induction of AP-1 and NF-κB and DNA binding activities. IL-8 increase was associated with oxidant stress and the activation of protein kinase C (PKC) and mitogen activated protein kinases (MAPK). On the basis of these data, we hypothesized that broiler dust induces inflammatory responses via reactive oxygen species (ROS) and activation of protein kinase signaling pathways to ultimately cause lung dysfunction and lung disease. This project will study IL-8 regulation as IL-8 is a prototypic proinflammatory chemotactic cytokine, and understanding IL-8 regulation may help in the understanding of inflammatory responses in general.

**Aims**

Specific Aim 1. Characterize changes in the expression profile of airway and alveolar epithelial cells in response to broiler dust.

Specific Aim 2. Determine the molecular mechanisms of interleukin 8 (IL-8) induction by broiler dust in airway and alveolar epithelial cells.

Specific Aim 3. Determine the role of oxidants and protein kinase signaling pathways in the induction of interleukin-8 (IL-8) by broiler dust in airway and alveolar epithelial cells.

Specific Aim 4. Determine the in vivo effects of exposure to chicken confinement dust on lung inflammatory responses and lung mechanics.

**Methods**

A549 alveolar and Beas2 bronchial epithelial cell lines and human primary small airway epithelial cells served as cell culture models to study mechanisms mediating broiler dust induction of inflammatory gene expression. C57BL6 mouse was used as an animal model to study lung inflammatory responses to broiler dust. Cells and mice were exposed to broiler dust in the form of aqueous dust extract. RNA expression was analyzed by real-time quantitative RT-PCR, and protein expression was analyzed by Western immunblotting and/or ELISA and immunohistochemical staining. The effects of broiler dust extract on gene expressing profiling in A549, Beas2B and THP-1 monocytic cells were studied by DNA microarray using Illumina Human HT-12 v4 bead array chips. Data of gene expression profiling were analyzed using Ingenuity Pathway Analysis Software to predict cellular pathways and cellular functions influenced by changes in gene expression. Transcriptional regulation of IL-8 gene was studied by transient transfection assay of IL-8-luciferase promoter plasmids and run-on nuclear transcription. The involvement of AP-1 and NF-κB in the regulation of IL-8 promoter activity was studied by mutational analysis and electrophoretic mobility shift assay. The importance of protein kinase signaling, protease activated receptors pathways and oxidative stress in the control of induction of IL-8 and other inflammatory gene expression were studied using pharmacological inhibitors. The effects of broiler dust on lung inflammatory gene expression and lung inflammatory responses were studied by exposing mice to dust extract via intranasal instillation. The effects on lung inflammatory gene expression were determined by ELISA on bronchoalveolar lavage, lung histology and immunohistochemical staining. The effects on lung mechanics were determined by FlexiVent measurements of lung volume, lung resistance and lung elastance.

## Findings

### Specific Aim 1. Characterize changes in the expression profile of airway and alveolar epithelial cells in response to broiler dust.

Treatment of A549 and Beas2B lung epithelial cells and THP-1 monocytic cells with broiler dust extract resulted in unique changes in gene expression profiles with induction of chemokines, cytokines, ICAM-1, PTGS2, and transcription factors such as AP-1, EGR1 and ATF3. Pathway analysis indicated that dust extract induced changes in gene expression influence functions related to cell growth and cell proliferation, cell death, cell survival and cell development.

### Specific Aim 2. Determine the molecular mechanisms of interleukin 8 (IL-8) induction by broiler dust in airway and alveolar epithelial cells.

Protein kinase C and MAPK activation is necessary for induction of IL-8 expression. IL-8 induction is mediated primarily by transcriptional mechanisms, without affecting mRNA stability, via increased AP-1 and NF-κB binding to IL-8 promoter. Endotoxin present in dust extract or nitric oxide (NO) production by cells may not act independently to induce IL-8 expression.

### Specific Aim 3. Determine the role of oxidants and protein kinase signaling pathways in the induction of IL-8 levels by broiler dust in airway and alveolar epithelial cells.

Broiler dust extracts contain trypsin- and elastase-like activities. These proteases activate protease activated receptors (PAR)-1 and 2 to induce IL-8 expression. Treatment of lung epithelial cells increases oxidative stress resulting in the induction of IL-8 and other inflammatory genes such as IL-6, IL-1β, CCL2, ICAM1, PTGS2 and TLR4. Protein kinase C and NF-κB activation was found to mediate protease and oxidative stress induction of inflammatory gene expression.

### Specific Aim 4. Determine the in vivo effects of exposure to chicken confinement dust on lung inflammatory responses and lung mechanics.

A single treatment of mice with broiler dust extract induced KC, IL-6 and TNF-α levels in bronchoalveolar lavage (BAL) and in lung homogenates in as little as 2 h, but did not increase cell counts or total protein concentration in BAL. However, daily treatment of mice for two weeks increased BAL cell count by greater than 2-fold, but did not increase BAL total protein concentration. Treatment also increased immunostaining for 4-hydroxynonenal and nitrotyrosine in lungs indicative of oxidative stress. Treatment for two weeks showed cellular infiltrates into airways and peribonchial cellular aggregates. Increased staining for cell surface markers for macrophages (Mac3), T-lymphocytes (CD3), B-lymphocytes (CD45R_B22) and neutrophils (Ly6G) were found. Preliminary data indicated that prolonged treatment reduced lung volume and elastance indicating negative effects on lung mechanics. Prior administration of 2-cyano-3, 12-dioxooleana-1, 9-dien-28-imidazolide (CDDO-Im), an activator of Nrf2 transcription factor, reduced levels of BAL KC, IL-6 and TNF-α levels in dust extract treated mice indicating the involvement of oxidative stress in the induction.

## Conclusions

Broiler dust is a potent inducer of lung inflammatory and immune response gene expression. Elevated cellular oxidative stress, and activation of protein kinase C (PKC) and mitogen activated protein kinase (MAPK) signaling pathways underlie induction of inflammatory and immune response gene expression. Endotoxin in broiler dust may not act independently to induce inflammatory and immune response gene expression, however, proteases present in broiler dust are important for the induction. Proteases activate protease-activated receptor (PAR)- 1 and -2 to induce interleukin-8 (IL-8) expression. Prolonged exposure of mice to broiler dust extract causes lung inflammation and reduces lung mechanics.

## Outputs

1. Gottipati K, Bandari S, Nonnenmann M. W, Levin JL, Dooley GP, Reynolds SJ, Boggaram V: [2015] Transcriptional and Protein Kinase Signaling Mechanisms Mediate Organic Dust Induction of IL-8 expression in Lung Epithelial and THP-1 Cells. American Journal of Physiology- Lung Cellular and Molecular Physiology 308: L11-L21.

**2.** Boggaram V, Loose DS, Gottipati K, Natarajan K, and Mitchell CT: [2016] Gene Expression Profiling of the Effects of Organic Dust in Lung Epithelial and THP-1 Cells Reveals Inductive Effects on Inflammatory Mediators. Physiological Genomics 48(4): 281-289.

3. Natarajan K, Gottipati K, Berhane K, Samten B, Pendurthi U, Boggaram V: [2016] Proteases and Oxidant Stress Control Organic Dust Induction of Inflammatory Gene Expression in Lung Epithelial Cells. Respiratory Research 17(1):137, 1-19.

4. Bandari SK. Regulation of interleukin-8 (IL-8) gene expression in THP-1 cells by organic dust. M. S. Thesis, Stephen F. Austin State University, 2012.

5. Mitchell C. Organic dust induced lung inflammatory responses in mice. M. S. Thesis, University of Texas Health Science Center at Tyler, 2015.

## Outcomes

1. Gottipati K, Bandari S, Nonnenmann M. W, Levin JL, Dooley GP, Reynolds SJ, Boggaram V: [2015] Transcriptional and Protein Kinase Signaling Mechanisms Mediate Organic Dust Induction of IL-8 expression in Lung Epithelial and THP-1 Cells. American Journal of Physiology- Lung Cellular and Molecular Physiology 308: L11-L21.

***Number of citations (Google Scholar): 6.***

**2.** Boggaram V, Loose DS, Gottipati K, Natarajan K, and Mitchell CT: [2016] Gene Expression Profiling of the Effects of Organic Dust in Lung Epithelial and THP-1 Cells Reveals Inductive Effects on Inflammatory Mediators. Physiological Genomics 48(4): 281-289.

***Number of citations (Google Scholar): 2.***

# Neuromotor Function and Work Injury Risk among Hispanic Adolescent Farmworkers
# PI: Eva M. Shipp, PhD

## Project Description


### Abstract
While high doses of pesticides are known to impair the neurological system, the impact of chronic low-dose exposure is largely unknown. This is of a particular concern for adolescents, who may be especially vulnerable to pesticides because their bodies and minds are still developing. A concern that accompanies pesticide exposure is high rates of injury among adolescent farmworkers. Given that pesticides are designed to damage the neurologic system, it is biologically plausible that they can increase the risk of injury through impairment of neuromotor function. The long-term goal of this research was to reduce the high rates of injury among adolescent farmworkers by intervening on main contributing causes. The specific objective of this project was to examine whether chronic, low-level exposure to pesticides is a major contributor to injury among adolescent farmworkers. Our central hypothesis was that chronic exposure to pesticides at low levels increases the risk of injury among adolescent farmworkers through sufficient impairment of neuromotor function. The rationale for this project was that our prior findings from a pilot study, which supported our hypothesis, needed to be replicated using more objective measures. Consequently, we conducted a five-year project (combined cross-sectional/cohort study) with Hispanic adolescents enrolled in Migrant Education in grades 6$^{th}$ through 12$^{th}$ along the Texas-Mexico border. We focused on postural sway length/area, a measure of the body's ability to maintain upright balance on a portable force plate system, as the main measure of motor function. It is an unbiased, noninvasive, measure that can detect early signs of neuromotor problems related to toxic exposures. Overall, strong associations between high exposure categories and increased postural sway parameters were not observed. There was some indication that subgroups, including younger participants with a longer history of farm work had increased sway parameters. This project successfully built research capacity with strategic partnerships and used study findings to carry out research to practice (r2p) activities with the community including pesticide safety training.


### Background
An increasing number of studies indicate that chronic exposure to pesticides at low doses may impair neuropsychological function in agricultural populations. Most available studies focus on adult farmers or farmworkers and their young children with very few concentrating on adolescents. Research during adolescence is needed because it is a complex developmental period wherein vulnerability to toxicants may be enhanced for various reasons. As a result, extrapolating findings from studies during other life stages may not be appropriate. The lack of data for adolescents also is problematic in terms of developing strategies for ensuring the health and safety of these vulnerable workers who support the agricultural economy in the U.S.

A concern that accompanies pesticide exposure is high rates of occupational injury among adolescent farmworkers, which are estimated to be over 20 per 100 full time equivalents (FTEs) (Shipp et al., 2012). Because pesticides are designed to damage the neurologic system, it is biologically plausible that they increase the risk of injury through impairment of neuromotor function. This hypothesis was examined by Whitworth and colleagues (2010) using self-reported data. Adolescent farmworkers who reported at least five symptoms of neurotoxicity were 8.75 (95% CI 1.89-40.54) times more likely to have an injury compared to those who reported zero to one symptom. Golub (2000) reviewed the impact of toxicants on prevalent adolescent health

problems including injury. Golub concluded that there was a significant need to *"examine the potential contribution of immunotoxicants and neurotoxicants to the high incidence of infection and injury in adolescents."* Nearly 20 years later, progress towards addressing this need is minimal.

**Aims (Revised)**

1r. Assess the feasibility of estimating the distribution at baseline and post-migration of acetylcholinesterase (AChE) levels, a biomarker of pesticide exposure, in adolescent farmworkers and non-farmworkers.
2r. Compare neuromotor function among adolescent farmworkers and non-farmworkers at baseline and post-migration by examining Hypothesis A (stated in the null).
Hypothesis A: There are no differences in mean postural sway length/area at baseline and post-migration, among adolescent farmworkers and non-farmworkers. The distribution of postural sway measures will be estimated under four test conditions to challenge or eliminate different afferents (e.g., visual, vestibular, and proprioceptive) relevant for postural stability.
3r. Determine if decreased neuromotor function is associated with an increased risk of acute injury among adolescent farmworkers by examining Hypothesis B (stated in the null).
Hypothesis B: There are no differences in the frequency of acute injury during a migration season when comparing adolescent farmworkers with larger versus smaller postural baseline sway length/area.

**Methods**

This cross-sectional/cohort hybrid study was conducted in Starr County, which is located along the Texas-Mexico border. The project was a collaborative effort conducted with Texas A&M AgriLife Extension, the county's 8 public junior high and high schools, and the University of Cincinnati. Given budget constraints, a different set of schools was targeted for each of three migration seasons. Parental consent and student assent were collected for each participant. Participants received a small gift (e.g., movie tickets, USB or string backpack with a school logo) for their time. Data were collected late spring (pre) and mid-fall (post). Each assessment required approximately 1 class period and involved a self-report, interviewer-administered survey and clinical measurements. We collected demographic and health data in addition to main variables such as work and injury in the last migration season. Survey instruments were based on prior studies funded by SW Ag Center and others (e.g., National Agricultural Workers Survey). Neuromotor function was measured via postural sway assessment (AccuSway Force Plate, AMTI, Watertown, MA; "Posture60" Copyright All Rights Reserved, University of Cincinnati, 1987-2010) and a grooved pegboard test (Model 32025, Lafayette Instrument Company, Inc., Lafayette, IN). Physical measurements, included blood pressure, weight, height, and foot size. Based on the community's request, we screened participants for high blood pressure and provided a list of community clinics to the parents of participants who screened positive. During the first year of the project, we piloted our data collection procedures before and after the migration season, which included an assessment of a portable test kit to measure acetylcholinesterase (AChE) in blood, a potential biomarker of pesticide exposure (Model 400 Test-mate ChE Kit EQM Research, Inc, Cincinnati, OH). All data were double entered (processed if sway data) to minimize entry errors and stored in a Microsoft Access database. Analyses were conducted with Stata/SE v. 14.0 (StataCorp LP, College Station, TX).

For the postural sway assessment, the protocol allows calculation of x-y coordinates of the center of pressure (CP) movement of the subject on the force plate. Participants will undergo a 30 second trial for four test conditions: EO: Eyes open on the force platform; EC: Eyes closed on force platform; FO: Eyes open on a 4 inch thick foam pad on the force platform; and FC:

Eyes closed on a 4 inch thick foam pad on the force platform. These tests were repeated in the reverse order. The mean of the two trials were averaged. The test protocol is designed to indirectly and non-invasively challenge or eliminate the contributions of the afferents (i.e. visual, vestibular and proprioceptive systems) relevant for postural balance. The outcome sway variables were sway area (SA in $cm^2$) and sway length (SL in cm). SL is the total distance traveled by CP during the test, and SA is the total area encompassed by the x-y plot of CP.

**Findings**

The overall sample size included 58 participants in pilot assessments and 520 participants enrolled in the main study (213 in season 1 of which 17 participated in the pilot; 186 in season 2; and 121 in season 3). During each data collection period, the response proportions ranged from 80-100% in middle schools and 71-80% in high schools. Of those participants, 331 completed both the pre- and post-assessments. Participants could take part in the pre- or post-assessments or both since the study included cross-sectional as well as cohort analyses. Depending on whether the assessment was pre- or post-migration, participants were 47-51% male and 98-99.5% Hispanic. Over half participated in farm work during their lifetime and 40% did so in the last year. Almost half who did farm work in the last year reported working with or around pesticides or fertilizer sprayers. Common crops were asparagus, corn, cotton, onion, potato, and watermelon. Common tasks were cutting, cleaning, harvesting, detasseling and hoeing. Common states were CA, IL, MN ND, and TX.

*Specific Aim 1*: The AChE assessment has two goals: (1) determine participation for the assessment since it required a fingerstick blood sample and (2) determine the distribution of AChE values among participants who regularly did and did not participate in farm work. Despite the invasive nature of the test, participation was high - 97.5% for the pre-migration test and 88.2% for the post-migration test. Average AChE values at pre- and post-migration were 3.7 (95% CI=3.4 - 4.0) U/mL and 3.7 (95% CI=3.5 -4.0) U/mL among males and 2.8 (95% CI=2.5-3.0) U/mL and 2.9 (95% CI=2.6-3.1) U/mL among females, respectively. Gender differences were statistically significant both at pre- and post-migration (p=0.00), which is expected given the literature for adults.

*Specific Aim 2*: Participants were classified into high versus low exposure groups based on the number of years of farm work experience. Low exposure included those who never participated in farm work and those in the $<25^{th}$ percentile for years of farm work. High exposure included all others. Condition F (eyes closed/on foam) provides the greatest challenge to the different afferents controlling postural balance. In other studies, it is the most useful for discriminating between those with and without postural control deficits. Among middle school participants, the high exposure group had higher SA and SL for condition F for all assessments. However, increases were small, up to 7% larger and not different statistically, but the sample size for middle school students was small. A similar pattern was observed for the grooved pegboard test. Those in the high exposure group took longer to complete all tasks compared to the low exposure group, but the findings were not statistically significant. For high school students, there were no clear patterns observed with respect to exposure group. Additionally given the literature on the impact of nail length on hand performance, we examined whether females with artificial fingernails, which tended to be very long, performed slower compared to those with natural fingernails. As an example, middle school, right-handed students with artificial nails placed pegs 20 seconds slower than their counterparts. This finding needs to be explored further since adolescents working with sharp implements could be placing themselves at an increased risk of injury without their knowledge. Differences were statistically significant ($\alpha<0.05$) (manuscript under review).

*Specific Aim 3*:
Next, the association of neuromotor function and injury risk was explored for post-assessments. Of the 434 participants who completed post-assessments, 58 reported a farm injury and 104 reported a non-farm injury. The top types of farm injuries included bruise or crush (20.7%), major cut (10.3%), and sprain or strain (6.9%)). The top affected body parts were upper limb (57.7%), lower limb (23.1%), and head (7.7%).The top types of other injuries included sprain or strain (25.0%), other injury (19.2%), and broken/fractured bone (11.5%). The top locations for other injuries were lower limb (45.7%; n=43) and upper limb (38.3%). Of all the participants, 13.4% reported a slip, trip, or fall (STF). Overall, we did not observe a pattern with respect to injury and sway parameters. For those who reported an STF, there was a 3.0 and 4.3 percent increase (not statistically significant) in SL and SA under condition F for participants compared to those who did not report a STF.

**Conclusions**
In summary, this project demonstrated the value of strategic partnerships in conducting research with vulnerable working populations. Although invasive, the data supported that adolescents will participate in a fingerstick blood test to measure a biomarker of pesticide exposure. AChE levels differed by gender. This is similar to literature in adults, but this has not been widely documented in adolescents. Similarly, postural sway can be assessed in adolescents using a portable force plate protocol. Although not statistically significant, possibly due to a small sample size, middle school participants with high exposure to farm work may have increased postural sway. Sunwook and colleagues (2016) recently reported an association between farm work experience and larger sway parameters in adults. Finally, female participants with artificial fingernails may unknowingly place themselves at an increased risk of injury while doing tasks with their hands due to impaired hand performance.

## Outputs
After each assessment 10-20% of participants were referred to a healthcare provider for high blood pressure based on our screen program. The project supported the development of two training games: Blood Pressure and Pesticide Bingo. These were disseminated to the community by Texas A&M AgriLife Extension Service along with our report to participants. One pesticide safety reference database was produced. Ten students (2 undergraduate, 4 masters, and 4 doctoral students) were trained in data management, data collection, occupational and injury epidemiology. Two of the former doctoral students trained received a small research grant from the Southwest Rural Health Research Center at Texas A&M University to study environmental exposures and health outcomes utilizing surveillance data. Presentations and publications are listed below. Two additional manuscripts are under development.

Trueblood AB, Shipp EM, Ross J, Korenek K: [2017] Artificial Fingernails, Hand Performance, and the Potential for Injury Among Adolescent Females. International Journal of Injury Control and Safety Promotion, under review.

Trueblood AB, Shipp EM: [2017] Characteristics of Acute Occupational Pesticide Exposures in Texas Reported to Poison Centers, 2000-2015. Archives of Environmental & Occupational Health, in press.

Ross JA, Shipp EM, Trueblood AB, Bhattacharya A: [2016] Ergonomics and Beyond: Understanding How Chemical and Heat Exposures and Physical Exertions at Work Impact Functional Ability, Injury and Long-term Health. Human Factors 58 (5): 777-795.

Trueblood AB, Shipp EM, Bhattacharya A, Cox C, Horel S, Morado Y: [2016] Neuromotor Function and Work Injury Risk Among Hispanic Adolescent Farmworkers: Preliminary Findings. Poster Presentation: The 14th Annual Disparities in Health In America: Working Toward Social Justice Summer Workshop. Houston, TX.

Shipp EM, Bhattacharya A, Cox C, Maindale S, Jiang L, McDonald T: [2014] A study of neuromotor function and work injury risk among Hispanic adolescent farmworkers: pilot test findings. Journal of Agromedicine.19(2):239-40.
Shipp EM: [2013] Farmworker Adults & Adolescents: Occupational Hazards in TX Food Production. Oral Presentation: Society of Toxicology: 52nd Annual Meeting. San Antonio, TX.
Shipp EM, Bhattacharya A, Cox C, Maindale S, Jiang L, McDonald T: [2013] Neuromotor Function and Work Injury Risk among Hispanic Adolescent Farmworkers: Pilot Test Findings. Poster Presentation: North American Agricultural Safety Summit. Minneapolis, MN.

## Outcomes

Outcomes largely pertained to training based on the projects findings that adolescent farmworkers report working with and around pesticides, which highlights a continued emphasis on safety training. This was discussed during community meetings where school administrators and nurses developed strategies for utilizing the results of the study to improve their students' health. This included integrating the project's Blood Pressure Bingo and Pesticide Bingo into their community health fairs and events. At the end of the project, students in Starr Co. produced the Environmental Protection Agency "El Moscas y Los Pesticidas" pesticide safety training play. There were 200+ participants/attendees. In addition, the publication by Ross et al (2016) resulted in two citations so far (Drogomeretsky et al., 2017; Garcia et al., 2017).

## Cumulative Enrollment Tables

| | **Race** | | | | |
|---|---|---|---|---|---|
| | **Mexican-American, Latino, or Hispanic** | **American Indian or Alaskan Native** | **White, Non-Hispanic** | **Not Reported** | **Total** |
| **Year** | | | | | |
| **Year 1** | 212 | 0 | 0 | 1 | 213 |
| **Year 2** | 176 | 6 | 1 | 0 | 185 |
| **Year 3** | 119 | 0 | 0 | 0 | 119 |
| **Gender** | | | | | |
| **Male** | 244 | 5 | 0 | 0 | 249 |
| **Female** | 252 | 1 | 1 | 1 | 255 |
| **Not Reported** | 13 | 0 | 0 | 0 | 13 |
| **Grade Split** | | | | | |
| **Middle School** | 103 | 0 | 0 | 1 | 104 |
| **High School *** | 406 | 6 | 1 | 0 | 413 |
| **Total** | 509 | 6 | 1 | 1 | 517 |
| *Of the participants in High School, 75 were first sampled in middle school. | | | | | |

## References

Golub MS. [2000] Adolescent Health and the Environment. Environmental Health Perspectives, 108.4: 355.
Shipp EM, Cooper SP, del Junco DJ, Cooper CJ, Whitworth RE :[2013] Acute Occupational Injury among Adolescent Farmworkers from South Texas. Injury prevention, 19(4), 264-270.
Sunwook K., Nussbaum MA., Quandt SA., Laurienti PJ., & Arcury TA. [2016]. Effects of Lifetime Occupational Pesticide Exposure on Postural Control Among Farmworkers and Non-Farmworkers. Journal of Occupational and Environmental Medicine, 58(2), 133-139.
Whitworth KW, Shipp EM., Cooper SP, & Del Junco DJ. [2010]. A pilot study of symptoms of neurotoxicity and injury among adolescent farmworkers in Starr County, Texas. International Journal of Occupational and Environmental Health, 16(2), 132-138.

# Prevention/Intervention Core Project

# Marketing Safety and Health Among Vietnamese Commercial Fishermen
# PI: Ann K. Carruth, DNS, RN

## Project Description

### Abstract

Commercial fishing injury and mortality rates in occupational health are among the highest in the world. In 2007, fishing ranked first as the most dangerous job in America. The Gulf Coast ranks third only to Alaska and the Northeast in fishing fatalities; with the greatest number occurring in the Gulf of Mexico shrimp industry. This project advances Southwest Center for Agricultural Health, Injury Prevention, and Education's current project "*Innovative Approaches To Worker Health Protection Among Shrimp Fishermen of the Gulf Coast*" from its current goal of establishing awareness and adoption of safety and health behaviors among Vietnamese commercial fishermen to delivery of specific tailored communication messages, based on the development of a social marketing campaign to impact change in behaviors among a specific market segment, Vietnamese owners, captains, and deckhands. This proposal uses innovative methods for identifying strategic stakeholders and partnerships in the commercial shrimp industry, using community based participatory approaches to develop and test culturally appropriate socially marketed safety messages and message dissemination through various communication channels.

### Background

Fishing trades are among the most dangerous jobs in the world; in the United States, the occupational fatality rate for commercial fishers has reached 30 times as high as the overall occupational fatality rate. Of the 504 commercial fishing deaths that occurred across the United States between 2000 and 2009, 116, or 23%, occurred in the Gulf of Mexico, according to the CDC. Nearly half of these deaths were attributed to not wearing personal floatation devices (PFD). Human factors contributing to high fatality rates include fatigue, inexperience, and failure to utilize safety protocol and equipment. Safety practices recommended by the National Institute for Occupational Safety and Health (NIOSH) include the use of protective equipment including personal flotation devices (PFDs).

### Aims

This project addresses two Specific Aims:

*1.) Conduct community-based participatory research focus group sessions to establish a comprehensive baseline of Vietnamese fishermen knowledge, behaviors, cultural norms, unmet needs.*

**a.** Identify and quantify perceptions of environmental and behavior factors, barriers and motivators related to exposure pathways and vessel safety/risk mitigation in Gulf Coast Louisiana shrimp fishermen.

**b.** Establish target audience research to enhance understanding of the target audience characteristics, benefits and barriers, and preferred communication channels for influencing adoption of vessel safety and risk mitigation behaviors.

*2.) Design and test a multimodal social marketing campaign to increase vessel safety and risk mitigation behaviors among Vietnamese shrimp fishermen.*

**a.** Use audience research to plan market strategy, and pilot test, revise and launch a social marketing campaign.

**b.** Evaluate the impact of a social marketing campaign, Vessel Safety and Risk Mitigation Initiative, on risk mitigation behaviors.

## Methods

Motivators and Barriers of Target Audience

The goal of the Vietnamese Gulf Coast shrimper community-based participatory baseline assessment survey sought to quantitatively measure acculturation, social network communication channels, safety vessel culture, and environmental pathway exposures to examine the predictiveness of vessel safety and risk mitigation behaviors. The final Vietnamese Shrimper Risks and Safety Adoption survey averaged 30 minutes to administer and collected data organized into six (6) question domains. Specifically: (1) demographic descriptors; (2) work history and risks associated with work; (3) risk behaviors; (4) interpersonal and broader social network communication channels; (5) vessel safety culture and (6) behavior readiness for risk mitigation adoption.

Survey sites included targeted areas and events in the greater New Orleans region and parishes along the Gulf Coast. The majority of interviews were conducted in-person or in small groups at various sites, amounting to approximately 400-hours of interviewing time conducted over the course of 57 interviewing days. Specific interviewing sites included events, community nonprofit offices, as well as coffee shops, on the docks and boats and door-to-door, depending on where interviewees felt most comfortable. Surveys were available in both Vietnamese and English and interviewers provided a choice for respondents to complete them personally, or by having surveys read by one of the interviewers.

Pilot PFD evaluation

United States Coast Guard (USCG) safety inspection examiners in three fishing communities recruited 24 captains and deckhands from 9 vessels to complete a baseline survey. Members of the crew were then asked to wear three different PFDs for a minimum of 3 hours while shrimp fishing. Once the crew returned to shore, a follow-up survey was distributed. For each of the three types of PFDs: ski belt, inflatable belt, and inflatable suspender, crew members were asked to evaluate 11 PFD attributes: weight, tightness, constricting motion, chaffing skin, bulkiness, snagging gear, comfort, fit, interfering with work, donning and cleaning.

Social Marketing Campaign

To address the issue of high mortality rates of Gulf Coast fishermen, a social marketing campaign was designed to increase PFD usage among Vietnamese shrimpers. The creative campaign was based on prior formative research to better understand the target population (Vietnamese captains and deckhands) working in the Gulf. The campaign's concepts were tested with the target population to ensure the message and visual aspects of the campaign are relevant and impactful. Deckhand messaging occurred in New Orleans/Houma area; Captain messaging occurred in the Abbeville area and Alabama fishermen exposed to no marketing/messaging were surveyed for comparison. "Wear it to Be Safe" was designed and evaluated by Louisiana Public Health Institute. VIET, USCG safety examiners, LSU Sea Grant

agents conducted a boots on the ground campaign distributing t-shirts, flyers, posters, knives, and whistles to dockside, shrimp houses, coffee shops, churches and local community activity centers.

## Findings

Motivators and Barriers of Target Audience

339 participants participated in identifying motivators and barriers of wearing PFDs. Motivators for safety included wearing a PFD that fits my body (75.9%), one that does not get in the way (90%), one that is more comfortable (89.1%) and captain tells me to wear it (68.8%).

Pilot PFD evaluation

The PFD considered least constrictive of movement was the inflatable suspender (43.5%) compared to the inflatable belt (47.5%) and ski belt (28.3%). The inflatable suspender was rated to interfere the least with work compared to the other 2 types of PFDs. 54.2% ranked the suspender type PFD as very comfortable to wear. When assessing if they would wear all or most of the time: 20.8% of participants responded that they would wear the inflatable belt all or most of the time; compared to 50% for the ski belt and 66.7 % for the inflatable suspender. Respondents indicated they were willing to pay the most for the suspender type PFD. Fishermen were most likely to wear PFDs if the captain told them to, during bad weather, and working on or near the edge of the boat. Less than half of the respondents were influenced to wear any of the PFDs because “everyone else did”.

Social Marketing Campaign

100 surveys were completed in New Orleans and 104 completed in Abbeville area. The majority were men (94.1%). Only 9 respondents had children who are interested in fishing. 60.4% had $6^{th}$ -$12^{th}$ grade education. 49.0% were deckhands; 20.3% were captains, and the remaining were owners. 49.5% fished in the gulf rather than the bay 20.7%. Almost 30% fished both gulf and bay. 65.7% of crews were 3-4 people. When asked what percent of time fishermen wear PFDs, the most usage was noted during bad weather (24.1% wear all the time). Otherwise PFDs are never worn by over 50% of respondents while fishing (73%), anytime working on deck (67%), working alone on deck (55.7%), working during bad weather (29%) and transferring from one boat to another (68%). Among 48 crew members who wore suspender PFDs to evaluate their intention to wear PFDs in the future, both deckhands and captains reported increased use of PFDs from baseline survey.

## Conclusions

The “Wear it to be Safe Campaign” logo and messaging was evaluated as effective. The Social marketing campaign was effective in raising awareness of the need to wear PFDs. Interventions to increase PFD use in the fishing industry should be tailored to commercial shrimp fishing and focus on addressing the significant barriers to PFD use. Workers may increase PFD usage if they are familiarized with newer lighter weight PFDs that have been tested and accepted by their peers.

## Outputs

*Articles*
Levin J, Gilmore K, Wickman A, Shepherd S, Shipp E, Nonnenmann M, Carruth A: [2016] Workplace Safety Interventions for Commercial Fishermen of the Gulf. Journal of Agromedicine 21(2): 178-89. DOI: 10.1080/1059924X.2016.1143430

*Proceedings*

Carruth AK, Levin JL, Creel E: [2017] Evaluation of PFDs by Vietnamese Commercial Fishermen in the Gulf of Mexico. STTI 28th International Nursing Research Congress, Dublin Ireland, July 27-31.

Levin JL, Carruth AK, Shepherd SB, Wickman AJ: [2016] Commercial Fishing Safety in the Gulf of Mexico and the Southwest Ag Center: The Decade in Review. Nordic Meeting on Agricultural Occupational Health and Safety, Denmark, August 24-26.

Carruth AK, Levin JL, Lincoln J, Sorensen J, Perkins R: [2016] Evaluation of PFDs by Vietnamese Commercial Fishermen in Gulf of Mexico. ISASH Annual Conference, Lexington Kentucky.

Carruth, AK, Levin JL, Sorensen J, Lincoln J: [2014] Motivators and Barriers of Wearing PFDs among Vietnamese Shrimp Fishermen. International Society for Agricultural Safety and Health annual conference, Omaha, Nebraska, June 22-26.

Carruth, AK, Levin, JL: [2013] Cultural Influences on Safety Training among Vietnamese Shrimp Fisherman. Agricultural Safety and Health Council of America-North American Agricultural Safety Summit, Minneapolis, MN, September 25-27.

Carruth, AK: [2012] Symposium Panel participant: The Role of Trusted Leaders in Influencing Vulnerable Workers. First Annual Workshop on Research Translation among Vulnerable Workers, Fort Collins CO, June 7.

## Outcomes

Social Marketing Campaign posters and flyers-“Wear it to Be Safe” (Vietnamese on one side and English on the other)

## Cumulative Enrollment Tables

| **PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race** | | | | |
|---|---|---|---|---|
| **Ethnic Category** | **Females** | **Males** | **Sex/Gender Unknown or Not Reported** | **Total** |
| Hispanic or Latino | | | | ** |
| Not Hispanic or Latino | | | | |

| | | | | |
|---|---|---|---|---|
| Unknown (individuals not reporting ethnicity) | | | | |
| **Ethnic Category: Total of All Subjects*** | | | | * |
| **Racial Categories** | | | | |
| American Indian/Alaska Native | | | | |
| Asian | 67 | 524 | | 591 |
| Native Hawaiian or Other Pacific Islander | | | | |
| Black or African American | | | | |
| White | | | | |
| More Than One Race | | | | |
| Unknown or Not Reported | | | | |
| **Racial Categories: Total of All Subjects*** | | | | * |

**PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)**

| Racial Categories | Females | Males | Sex/Gender Unknown or Not Reported | Total |
|---|---|---|---|---|
| American Indian or Alaska Native | | | | |
| Asian | **67** | 524 | | 591 |
| Native Hawaiian or Other Pacific Islander | | | | |
| Black or African American | | | | |
| White | | | | |
| More Than One Race | | | | |
| Unknown or Not Reported | | | | |
| **Racial Categories: Total of Hispanics or Latinos**** | | | | ** |

# Education/Translation Core Project

# Educational Approach to Increase Respirator Use among Broiler Chicken Growers
# PI: Matthew Nonnenmann, PhD, CIH

## Project Description


### Abstract
Broiler chicken workers in confined animal feeding operations are exposed to inhalation hazards that include dust, bacteria, fungi, endotoxin and ammonia. The broiler production is rapidly increasing in the U.S. and broiler workers or "growers" may not be aware of the inhalation hazards present in these broiler buildings or adequately trained to select and correctly use respiratory protection. Furthermore, growers may not know which tasks are more likely to warrant use of respiratory protection. This 5-year study is significant as we used novel tools to characterize personal exposure to inhalation hazards during daily tasks on broiler chicken farms. Specifically, we characterized bioaerosol exposure to a level of specificity that has not been used previously in exposure assessment science. We also evaluated administrative and engineering controls to reduce inhalation exposure and most importantly, we determined barriers to implementing health and safety research and activities among growers in the poultry industry using a qualitative approach.


### Background
Respiratory diseases are more common among agricultural workers compared to workers in other industries. Much attention has been given to evaluating exposure to aerosols and associated health effects among confined animal feeding operation (CAFO) workers; particularly the swine industry. Little attention, however, has been given to other sectors of agriculture which utilize CAFOs, particularly the poultry industry. CAFO style broiler chicken production has become the business model for many farms in the southern U.S. due to economies of scale. The number of these CAFO style broiler farms or “grower” operations has been increasing. Human and animal health concerns exist surrounding aerosols (*e.g.*, organic dusts) generated in these broiler farms. Some limited information is known about the respiratory hazards in the broiler industry and have reported exposures as high as 37.6 mg/m$^3$. However, prior to our study very little information was available about inhalation exposures specific to broiler chicken production in the US. Our work has found inhalable and respirable concentrations as high as 25.0 mg/m$^3$ and 1.2 mg/m$^3$, respectively during a daily task of “dead bird pick-up.” This task as well as others performed frequently during these final weeks of growth may result in substantial inhalation exposure to broiler dust and are above recommended exposure levels of 2.4 mg/m$^3$. Therefore, respiratory protection for growers is recommended. Additionally, educational, administrative and engineering interventions are needed to reduce inhalation exposures to dust, bioaerosols and ammonia among broiler chicken farm workers.

### Aims
1. Determine awareness of inhalation hazards in the broiler growing environment, as well as respirator usage and barriers to respirator use among broiler growers in the US, based on input from a stakeholder group that includes representatives from each group. (Modified Aim)
2. Assess levels of aerosolized broiler dust, endotoxin, bacteria, fungi and ammonia exposure among broiler growers using a task-based participatory approach.
3. Assess whether perceptions about health and safety research affected the willingness of poultry industry stakeholders to participate in research projects. (Modified Aim)

**Methods**
Aim 1. A standardized questionnaire was administered to broiler growers in Texas, Kentucky, Mississippi, and North Carolina using multiple modes for dissemination (*i.e.*, postal, hand-delivery, county offices). The questionnaire assessed perceptions of inhalation hazards (*e.g.*, dust) and use of respiratory protection (*i.e.*, respirators) among broiler chicken growers. Aim 2: standard industrial hygiene air sampling methodology was used to measure personal exposure dust, bioaerosols and ammonia during work in broiler chicken production. Perform a novel metagenomic analyses of microbiological DNA collected on personal inhalation samples of dust during work on broiler chicken farms. Compare the impact of administrative and engineering controls on exposure concentrations of dust and ammonia. Aim 3: anthropological techniques and computer-assisted telephone interviewing were used to assess whether perceptions about health and safety research affected the willingness of poultry industry stakeholders to participate in research projects.

**Findings**
A number of findings from this project will contribute to the body of knowledge regarding use of respiratory protection and inhalation exposures in broiler chicken production. Furthermore, we learned that some approaches currently marketed to reduce dust concentrations in broiler production are not effective. In addition, administrative controls appear to have some effect at reducing inhalation exposures; however, the exposures are still higher than other types of animal production. Finally, farmers appear not to trust the agenda of researchers especially related to health and safety research. Specifically, findings from Aim 1 revealed that the majority of respondents identified dust as an inhalation hazard in broiler chicken production. Furthermore, among respondents, 73% reported to have used a respirator in the last seven days during work in a poultry house. These findings suggest that growers understand that dust is an inhalation hazard and use respiratory protection to control inhalation exposures. However, these data are cross-sectional and the overall response rate to the questionnaire was 23%. Therefore, error may be present in the period prevalence estimates of respirator use. A summary of these findings have been published in a manuscript.

The findings from Aim 2 are still being analyzed but also include multiple publications and presentations. Inhalation exposures to dust are substantial and among the highest is animal production. Bioaerosols in the dust are diverse and include many species of bacteria, fungi and virus. These approach used to characterize these samples has broad application across the field of industrial hygiene and bioaerosol sampling. The findings from these studies warranted further research evaluating exposure control methodologies (*i.e.*, administrative and engineering). Two manuscripts have been published and three additional manuscripts are in under development.

Findings from Aim 3 revealed after in-depth interviews conducted with broiler chicken growers to understand their perceptions of public health research. Respondents indicated lack of trust in research and fear of bias. Respondents questions the legitimacy of public health research in agriculture. As the burden of illness and injury in agriculture remains high, despite considerable effort by public health researchers and practitioners, these findings should be considered when designing public health interventions.

**Conclusions and Plans**
Our findings suggest that broiler growers experience exposure to dust above recommended exposure concentrations. However, the majority of growers report using respiratory protection. Furthermore, some of the technologies marketed and used to control dust in broiler chicken production may not be effective. Lastly, broiler chicken growers report lack of trust in the research agenda when approached to participate in research studies. Future projects focused in

poultry production should spend considerable effort building relationships with the integrator companies and contract growers. Clear communication of project aims and how the study results will impact to increase the likelihood of success of the project aims.

Dr. Nonnenmann and his research team are applying information and methods learned from this study to ongoing work in the swine industry. Dr. Nonnenmann has continued interest in the One Health model (*i.e.*, interactions between the worker, animals and working environment) especially related to bioaerosol exposures and emerging infectious disease. A proposal is under development that will apply methodologies developed in this project to other target populations (i.e., health care workers and veterinarians) and industries.

**Outputs**

*Peer-Reviewed Publications*

1. O'Brien K, Chimenti M, Farnell M, Tabler T, Bair T, Bray J, Nonnenmann MW: [2016] High Throughput Genomic Sequencing of Bioaerosols in Broiler Chicken Production Facilities. Microbial Biotechnology. (DOI: 10.1111/1751-7915.12380), PMID 27470660.
2. Ischer S, Farnell M, Tabler T, O'Shaughnessy P, Nonnenmann MW: [2017] Evaluation of a Sprinkler Cooling System on Inhalable Dust and Ammonia Concentrations in Broiler Chicken Production. Journal of Occupational and Environmental Hygiene, 14 (1), 40-48.
3. Janssen B, Nonnenmann, M: [2017] New Institutional Theory and a Culture of Safety in Agriculture. Journal of Agromedicine, 22(1), 47-55.
4. Janssen B, Nonnenmann, M. (2017) Public health science in agriculture: Farmers' perspectives on respiratory protection research. Journal of Rural Studies, 55: 122-130.

*Conference Proceedings*

Nonnenmann M, Hussain A, Gilmore K, Bextine B, Dowd S, Ward W, Levin J: [2011] Culture-Independent Characterization of Bacteria in Poultry and Dairy Bioaerosols Using Pyrosequencing: A New Approach. American Industrial Hygiene Conference and Exposition, Portland, OR, May 16-19.

Nonnenmann M, Hussain A, Gilmore K, Ward W, Jerez S, Bray J, Levin J: [2011] Inhalable and Respirable Organic Dust Concentrations During Broiler Production. American Industrial Hygiene Conference and Exposition, Portland, OR, May 16-19.

Matthew W. Nonnenmann, Courtney Isbell, Joey Bray: [2013] Controlling Worker Exposure to Dust on Broiler Chicken Farms: Task-Modification Solutions. Agricultural Safety and Health Council of America, Minneapolis, MN, Feb 21-23.

Matthew W. Nonnenmann, Courtney Isbell, Joey Bray: [2014] Controlling Worker Exposure to Dust on Broiler Chicken Farms: Task-Modification Solutions. International Society for Agricultural Safety and Health, Omaha, NE, June 22-25.

Sarah A. Williams, Morgan Farnell, Tom Tabler, Matthew W. Nonnenmann: [2015] The Effects of a Sprinkler Cooling System on Dust Concentrations in Broiler Chicken Production. University of Iowa, College of Public Health Research Week, Iowa City, IA, April 7.

Sarah A. Williams, Morgan Farnell, Tom Tabler, Matthew W. Nonnenmann: [2015] The Effects of a Sprinkler Cooling System on Dust Concentrations in Broiler Chicken Production. American Industrial Hygiene Conference and Exposition, Salt Lake City, UT, May 30-June 4.

Nonnenmann MW, O'Brien K, Williams SA, Farnell M, Tabler T, Bray J: [2015] Characterization of Dust and Bioaerosol Exposure During Work Tasks in Broiler Chicken Production. American Industrial Hygiene Conference and Exposition, Salt Lake City, UT, May 30-June 4.

Williams SA, Farnell M, Tabler T, Nonnenmann MW: [2015] The Effects of a Sprinkler Cooling System on Dust Concentrations in Broiler Chicken Production. International Society for Agricultural Safety and Health, Normal, IL, June 21-24.

Williams SA, Farnell M, Tabler T, Nonnenmann MW: [2015] The Effects of a Sprinkler Cooling System on Dust Concentrations in Broiler Chicken Production. Midwest Regional Agricultural Safety and Health, Decorah, IA, November 17.

Boles, O'Brien K, Nonnenmann W: [2016] The Development and Optimization of a DNA Extraction Method for Aerosol Samples Collected using Polyvinylchloride Filter Media. American Industrial Hygiene Conference and Exposition, Baltimore, MD, May 21- 26.

O'Brien KM, Farnell M, Tabler T, Nonnenmann MW: [2016] Production Practices Associated with Personal Exposure to Inhalable Aerosols during Work in Broiler Chicken Production. American Industrial Hygiene Conference and Exposition, Baltimore, MD, May 21- 26.

O'Brien KM, Chimenti MS, Farnell M, Tabler T, Bair T, Bray JL, Nonnenmann MW: [2016] Evaluation of Poultry Dust Composition using Whole-Genome Shotgun Sequencing. International Society for Agricultural Safety and Health, Lexington, Kentucky

O'Brien K, Nonnenmann M: [2016] Evaluation of Occupational Exposure to Gases in a Turkey Infected with the Highly Pathogenic Avian Influenza A H5N2 virus in Iowa, USA. International Society for Agricultural Safety and Health, Lexington, Kentucky.

Williams SA, Farnell M, Tabler T, Nonnenmann MW: [2015] The Effects of a Sprinkler Cooling System on Dust Concentrations in Broiler Chicken Production. [2016] Nordic Meeting 2016: Agricultural Occupational Health and Safety, Billund, Denmark, Aug 24-26.

O'Brien K, Chimenti M, Farnell M, Tabler T, Bair T, Bray J, Nonnenmann MW: [2016] Evaluation of Personal Exposure to Inhalable Dust, Endotoxin and Bioaerosols among Poultry Workers. Nordic Meeting 2016: Agricultural Occupational Health and Safety, Billund, Denmark, Aug 24-26.

O'Brien K, Nonnenmann MW: [2016] Evaluation of Occupational Exposure to Gases in a Turkey Infected with the Highly Pathogenic Avian Influenza A H5N2 virus in Iowa, USA. Nordic Meeting 2016: Agricultural Occupational Health and Safety, Billund, Denmark. Aug 24-26.

**Outcomes**

We have designed and adopted novel industrial hygiene measurements to assess inhalation hazards. Specifically, we have utilized molecular biology techniques (*i.e.*, metagenomic shotgun sequencing) to characterize bioaerosol exposures with a level of specificity not previously reported exposure science. These metrics will enable the development of additional sampling methodology and exposure controls based on the vulnerabilities of targeted to specific microorganisms. In addition, we have further characterized inhalation hazards and use of respiratory protection among workers in broiler chicken production. We have also evaluated the effectiveness of administrative and engineering approaches to reducing inhalation exposure to hazards in broiler chicken production. Future research should focus on developing novel

engineering interventions to reduce or eliminate exposure to inhalation hazards (*e.g.*, high airflow filtration and bioaerosol treatment). Lastly, we have reported opinions and perceptions among broiler growers about participating in health and safety research effort.

## Cumulative Enrollment Tables

| **PART A. TOTAL ENROLLMENT REPORT:** | **Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race** | | | |
|---|---|---|---|---|
| **Ethnic Category** | **Females** | **Males** | **Sex/Gender Unknown or Not Reported** | **Total** |
| Hispanic or Latino | | | | * |
| Not Hispanic or Latino | 35 | 210 | | 245 |
| Unknown (individuals not reporting ethnicity) | | | | |
| **Ethnic Category: Total of All Subjects*** | 35 | 210 | | 245 * |
| **Racial Categories** | | | | |
| American Indian/Alaska Native | | | | |
| Asian | | 17 | | 17 |
| Native Hawaiian or Other Pacific Islander | | | | |
| Black or African American | | 5 | | 5 |
| White | 35 | 188 | | 223 |
| More Than One Race | | | | |
| Unknown or Not Reported | | | | |
| **Racial Categories: Total of All Subjects*** | 35 | 210 | | 245 * |

| **PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)** | | | | |
|---|---|---|---|---|
| **Racial Categories** | **Females** | **Males** | **Sex/Gender Unknown or Not Reported** | **Total** |
| American Indian or Alaska Native | | | | |
| Asian | | | | |
| Native Hawaiian or Other Pacific Islander | | | | |
| Black or African American | | | | |
| White | | | | |
| More Than One Race | | | | |
| Unknown or Not Reported | | | | |
| **Racial Categories: Total of Hispanics or Latinos**** | | | | 0 * * |

# Evaluation Program, SW Ag Center
# PI: Deborah Helitzer, Sc.D.

## Project Description

### Abstract

The Southwest Center for Agricultural Health, Injury Prevention and Education (SW Ag Center) has consistently included evaluation of process and outcome measures to assess progress of the Center and its projects and to guide any adjustments needed to assure fidelity to achieving specific aims. Through the past funding cycle the Center's evaluation program utilized a standardized system to collect data from projects in the research, intervention and education cores. Additionally, the SW Ag Center has been an active participant in the Agricultural Center Evaluation multi-site evaluation program sponsored by NIOSH. This report covers the overview of the evaluation methods, processes and observed outcomes.

### Background

As part of the development of the proposal for the FY 2011-2016 project period, each of the cores and individual research projects prepared a logic model that outlined the factors that led to the conception of the project or core; the resources that were made available to the project or core, both financial and personnel; the proposed activities; anticipated short term outcomes; and long term impact. Each project or core articulated how it would help the SW Ag Center to achieve its goals, which in turn were developed to achieve NIOSH's goals for reducing injuries and deaths in people who had occupations in Agriculture, Fishing and Farming (AFF). Once the Center was funded, those logic models were reviewed and revised to reflect the proposed implementation of the units.

### Aims

The aims of the evaluation program were to:

1. Convene a stakeholder group to guide and respond to the evaluation team's work.
2. Develop a comprehensive evaluation program, that included process and outcome measures, designed to assess the degree to which the SW Ag Center and its cores and projects achieved its goals.
3. Collaborate with project-level staff and SW Ag Center staff to implement the evaluation plan.
4. Provide evaluation results to the SW Ag Center Advisory Board and center staff and PIs.
5. Make evaluation results available to the Internal Advisory Committee (IAC), External Advisory Committee (EAC), SW Ag Center, NIOSH and other stakeholders.
6. Offer training on evaluation research to students, community members and faculty in project-level venues and through SW Ag Center initiatives.

**Methods**

Multiple qualitative and quantitative methods were used in the evaluation. For the Process Evaluation, we employed quarterly progress reports from the Cores and the Research Projects, documenting their activities from the last quarter and the progress of the projects in achieving their own goals. For the Outcome Evaluation, we employed multiple qualitative and quantitative methods over the five year period of the program. Table 1 shows the SW Ag Center Summative Evaluation Plan methods, tied to each of the Intermediate Outcomes from the SW Ag Center logic model.

Table 1: SW Ag Center Summative Evaluation Plan Methods

| Intermediate Outcomes | Evaluation Data Sources |
|---|---|
| 1. Networks of strategic partners are developed and sustained throughout the region. | Social Network Analysis (SNA) network data only; stakeholder interviews; SW Ag Center and PI progress reports; supplemental survey |
| 2. Participation in the SW Ag Center fosters collaborative relationships among researchers to enhance team science. | SW Ag Center survey data only; stakeholder interviews; SW Ag Center and PI progress reports on activities in logic models; supplemental survey |
| 3. Stakeholders have access to various kinds of data; data are accurate, complete and usable. | SW Ag Center survey data |
| 4. Center will continue to be nationally recognized as a leader for AFF occupational safety and health in region. | SNA network and SW Ag Center survey data; Stakeholder interviews |
| 5. The SW Ag Center will address and impact the NIOSH goals for the Ag Center. | NIOSH list of goals linked to each project logic models; logic model publication |
| 6. New researchers will be trained in AFF occupational safety and health research and their capacity to address regional priorities will be enhanced by SW Ag Center training, mentoring and collaborative activities. | SNA survey network and SW Ag Center survey data; stakeholder interview; SW Ag Center and PI progress ports on activities in logic models; supplemental survey; and stakeholder telephone interviews. |

**Findings**

1. Networks of strategic partners are developed and sustained throughout the region.

Over five years, the evaluation documented that the SW Ag Center had developed networks of strategic partners. The partnerships grew and evolved over the project period. Some partnerships started during this project cycle but many had been developed and sustained in the multiple cycles of funding prior to the current one. Many networks were strengthened during this cycle: for example those with the Vietnamese fishermen:

> *"Community partnerships do allow effective communication of interventions and research findings to the local community. Community partnerships speed up the adoption of safety and health policies and practices at the local level by ensuring that the groups that need to aware of these safety and health policies are informed in a rapid and effective manner. This will lead to adoption of the practices sooner than if the policies had to come from agencies outside of the local community."*

> *"In Outreach, it is imperative to develop networks. Partners allow us to gain access to the populations we are trying to reach. They also give us credibility with producers. Partners also allow us to leverage resources to make a larger impact. Recently, all 10 Ag Centers collaborated to form a joint YouTube account. Our Center initiated this idea and Amanda currently leads the group. Since the Outreach plan is written broadly in order to address regional AFF, we can use Outreach funds to also support funded research by helping PIs to build rapport with their stakeholders.*

2. Participation in the SW Ag Center fosters collaborative relationships among researchers to enhance team science.

Collaborative relationships were formed in every sector. Over time, collaborations strengthened; the data show that the SW Ag Center was most highly collaborative with colleagues in other Ag Centers; less so with government colleagues and even less so with Education and Research Center (ERC) colleagues and AFF partners outside of academic settings. The data showed that partners believed that there had been either no improvement or some improvement in their ability to conduct team science as a result of participating in SW Ag Center research activities. This may have been because most of these colleagues were in other academic settings.

3. Stakeholders have access to various kinds of data; data are accurate, complete and usable.

The data indicate that the users of the dissemination products from the SW Ag Center believe they are accurate and complete. Abstracts, Articles, Brochures/booklets, curricula, fact sheets, manuals, presentations, reports and data, translated research findings and videos were seen to be usable; however there were some materials that were not. The evaluation team reported this to the Outreach Core and suggested that they reconsider the types of dissemination products that they produced and whether the list of products could be reduced, based on the feedback from the surveys and stakeholder interviews.

4. Center will continue to be nationally recognized as a leader for AFF occupational safety & health in region.

The SW Ag Center was considered to be a national/regional leader in the areas of commercial fishing, farm workers, including migrant and seasonal workers; and vulnerable populations.

Other areas where they are considered to be influential but not to hold leadership roles, included community health; dairy; forestry; heat stress; livestock; musculoskeletal injury prevention; pesticide safety; poultry; organic dust; and tractors and agricultural machinery. This list coincides closely with the research and dissemination projects of the SW Ag Center.

5. The SW Ag Center will address and impact the NIOSH goals for the Ag Center.

   SW Ag Center Research Projects support the goals of NORA Strategic Goals III, IV and V

- Neuromotor Function and Acute Injury Study
- Marketing Safety and Health Among Vietnamese Commercial Fishermen
- Poultry Dust and Lung Inflammation
- Educational Approach to Increase Respirator Use Among Broiler Chicken Workers

6. New researchers will be trained in AFF occupational safety and health research and their capacity to address regional priorities will be enhanced by SW Ag Center training, mentoring and collaborative activities.

Capacity development for research was found in many different areas addressed by the SW Ag Center. Capacity development was a focus of the outreach core, the AP core, and the feasibility/pilot studies. For example:

> *"We provide professional development at our annual in person board meeting. We have provided training on social network analysis and mentoring. We also invite local guests to attend the board meeting in order to introduce new groups/organizations to our Center and allow for networking. Center staff and faculty regularly visit with regional universities to promote Center-funded feasibility study opportunities and summer internships. We have visited Sam Houston State University, Texas A&M Commerce, Stephen F Austin University, Oklahoma State University and plan to visit Texas Tech in February 2015. This activity could fall under the AP Core, Outreach Core or Feasibility Studies Core."*

> *"We market our Feasibility/Pilot Studies program with in-person visits at universities throughout the region (eg. Texas A&M Rural School of Public Health in McAllen, Texas A&M Commerce, Oklahoma State University, Sam Houston State University, Texas Tech, University of Arkansas). We also offer to identify mentors to feasibility studies applicants. We provide concise and relevant feedback to unsuccessful applicants so that they may reapply in the following funding cycle. In the current funding cycle, we had four applications for funding, one of which was funded. The funded project has incorporated four researchers from varying disciplines into the study."*

Each of the SW Ag Center research projects trained new researchers. These researchers participated on the research at a variety of phases, either as students, interns, post-doctoral trainees, or research staff.

Finally, the pilot project recipients' list documents that many were new researchers or experienced researchers who were new to AFF research. Carla Wilhite (NM), Kevin Moore (OK), Sharon Huff (TX), Rena Saito (TX), and Shaadi Khademi (TX) were all early stage investigators. Francisco Soto Mas (NM), Michael Merten (OK), Victor Cardenas (AR), Kai Zhang (TX), and Joseph Neary (TX) were all experienced researchers who applied their training to an agricultural safety and health topic for the first time.

**Conclusions**

Overall, the evaluation shows that the SW Ag Center accomplished its outcome goals. As with any program, there were opportunities for improvement. The Center could reexamine its list of outreach materials to determine whether there were specific opportunities for reducing the types of materials to those found to be most useful. The SW Ag Center commissioned a study to examine how to engage early career researchers more actively and to judge the effectiveness of its work. That study showed that more hands on engagement by students with SW Ag Center personnel and activities would be useful.

## Outputs


1. **Helitzer DL**, Gilmore K, Benally J: [2012] Children's Safety on Native American Farms: Information and Recommendations. Journal of Agromedicine 17(2): 251-258. PMID: 22490038

2. **Helitzer D,** Hathorn G, Benally J, Ortega C: [2014] Culturally Relevant Model Program to Prevent and Reduce Agricultural Injuries. Journal of Agricultural Health and Safety 20(3): 175-198 PMID 25174150

3. CDC NIOSH Impact Paper "Use of Model Farmers Proves Effective in Increasing Safety Practices Among Navajo Agricultural Workers" http://www.cdc.gov/niosh/docs/2015-177/default.html
4. Newbill S, Wickman A, Brown C, **Helitzer D**: [May 2017] Hierarchical Logic Models as a Tool to Evaluate Programmatic Initiatives: Practical Solutions to Identified Problems. Journal of Community Medicine and Health Education.