FINAL PROGRESS REPORT

North Carolina Occupational Health and Safety Surveillance Program

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List of Terms and Abbreviations

ACS	American Community Survey
BLS	Bureau of Labor Statistics
BRACE	Building Resilience against Climate Effects
BRFSS	Behavioral Risk Factor Surveillance System
CDB	Communicable Disease Branch
CFOI	Census of Fatal Occupational Injuries
CO	Carbon monoxide
CPS	Current Population Survey
CSTE	Council of State and Territorial Epidemiologists
DHHS	Department of Health and Human Services
DOL	Department of Labor
DPH	Division of Public Health
EBLL	Elevated Blood Lead Level
ED	Emergency department
EPA	Environmental Protection Agency
FARS	Fatality Analysis Reporting System
HP 2020	Healthy People, 2020
IH	Industrial hygiene
IIF	Injury, illness, and fatality
I/O	Industry and Occupation
MOU	Memorandum of understanding
NC	North Carolina
NCDACS	North Carolina Department of Agriculture and Consumer Services
NC DETECT	North Carolina Disease Event Tracking and Epidemiologic Collection Tool
NC HP2020	Healthy North Carolina, 2020
NCIC	North Carolina Industrial Commission
NCPC	North Carolina Poison Control
NCTR	NC Trauma Registry
NIOSH	National Institute for Occupational Safety and Health
OEEB	Occupational and Environmental Epidemiology Branch
OHI	Occupational Health Indicator(s)
OHIP	Occupational Health Internship Program
OHN	Occupational Health Nurse
OHSP	Occupational Health Surveillance Program
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OSU	Occupational Surveillance Unit
PHPR	Public Health Preparedness and Response
PI	Principal Investigator
SENSOR	Sentinel Event Notification System for Occupational Risk

SOII	Survey of Occupational Injuries and Illnesses
SouthON	Southeastern States Occupational Network
UNC	University of North Carolina at Chapel Hill
US	United States

Abstract (500 words or less)

Work conditions can have a negative impact on health. Although rates of work-related injuries and deaths are declining in North Carolina, these adverse outcomes still persist. These incidents are preventable, and successful approaches for making workplaces safer begin with having data necessary to improve understanding of the workplace conditions leading to these outcomes. Occupational surveillance can provide important tools to accomplish this. The overall goal of the North Carolina Occupational Health Surveillance Program (OHSP) is to enhance North Carolina's capabilities to characterize occupational risks to health in greater detail, focusing on state-identified priority areas, and use what is learned to develop targeted interventions and other prevention strategies with the help of partners. Better surveillance and improved response capacity will help North Carolina make an impact in the workplace, with the overall goal of reducing workplace injury and death, close persistent gaps in NC occupational health surveillance, and reduce the disproportionate burden from workplace injury and illness on vulnerable worker populations through leveraging more comprehensive, collaborative partnerships and resources for workplace interventions. The NC OHSP is housed within the Occupational and Environmental Epidemiology Branch (OEEB) of the NC Department of Health and Human Services (DHHS), Division of Public Health (DPH). From 2015 to 2021, NC OHSP used an approach based on recommendations outlined in the *Guidelines for Minimum and Comprehensive State-Based Public Health Activities in Occupational Safety and Health*, which includes the three core functions of public health: assessment, policy development, and assurance. The program secured access to occupational health data from a broad range of sources, including existing data from national and state sources, and case-based data from previously established collaborations. The program applied findings from trend reports of workers' health status to establish priorities for further investigation. An advisory group was established with representatives from various disciplines in occupational health, which included regulatory, research, safety, and health, agromedicine, epidemiology, academia, and health promotion at the state and national level. Opportunities for outreach, intervention, and other prevention strategies were identified through data findings, existing public health infrastructure, and/or emerging occupational health issues and initiatives arising from in-state, out-of-state, or national collaborations. Priority focus areas for future OHSP surveillance projects were also identified for the next funding period. These priority areas identified for the next funding cycle included reducing persistently high rates of musculoskeletal disorders and other work-related injuries and fatalities in the agriculture, construction, and transportation/warehousing industry sectors; reducing occupational heat-related illness among farmworkers in North Carolina; reducing fatalities and serious injuries associated with transportation-related incidents; and the need for expanded case-based pesticide exposure surveillance. Ongoing occupational surveillance will allow North Carolina to identify the extent,

severity, and patterns of work-related morbidity and mortality; make recommendations to increase awareness of workplace hazards among workers in the state; and ultimately, reduce work-related injuries, illnesses, and deaths in North Carolina.

SECTION 1

Significant or Key Findings.

Through analysis of occupational health data, fostering of key stakeholder partnerships, and data driven outreach and interventions, the NC Occupational Health Surveillance Program (OHSP) has found the following significant findings for each aim.

Aim 1. Assessment through collection, analysis and reporting of occupational illness and injury data. NC is home to several industries with high potential to expose workers to lead dust (battery manufacturing and recycling, law enforcement, and gun range operators), pesticides (agriculture), carbon monoxide (construction and renovation), and life-threatening heat (agriculture, construction, manufacturing, and renovation). In addition, the COVID-19 pandemic highlighted disparities in worker infection prevention among workers in essential services such as healthcare, meat processing, corrections, manufacturing, and grocery and restaurant services.

Aim 2. Promotion of occupational health policy and programs through development of partnerships. Through a partnership with the NC Poison Control Center, NC OSHP was able to promote case monitoring, follow-up, and education of workers who were poisoned by carbon monoxide or pesticides. NC OHSP was able to leverage partnerships with NC Communicable Disease Branch (CDB) to incorporate industry and occupation into COVID-19 case investigation data collection procedures, improving characterization of workplace clusters and development of tailored guidance for each industry. NC OHSP and CDB worked together to create prevention, testing, and vaccination guidance to meet the needs of employers during the COVID-19 pandemic.

Aim 3. Assure protection of the workforce through intervention and prevention strategies.

NC OHSP administered several surveys to better understand the needs of today's workers for prevention and worksite interventions. Key findings from these surveys included: a lack of safety training and awareness of occupational health resources among university housekeeping employees, a lack of training on lead poisoning prevention from ammunition among law enforcement officials, and a lack of paid time off for essential workers during the COVID-19 pandemic.

Translation of Findings

NC OHSP drafted and partnered with NC DHHS Communications to publish press releases, infographics, fact sheets, and guidance documents on occupational exposure and disease prevention including carbon monoxide, lead, and pesticide poisoning prevention and COVID-19 infection prevention. The industrial hygiene (IH) team has created and delivered a series of trainings to first responders on opioid exposure prevention, in response to the opioid overdose epidemic. The IH team and occupational health nurse conducted individual phone and onsite consultations with both employees and employers to advise on best practices for improving worker health and improving health equity among essential workers.

Research Outcomes/Impact.

The NC OHSP has utilized a foundation of partnerships and surveillance data resources to explore state-identified occupational health priority exposures, conditions, and vulnerable worker populations. Key intermediate outcomes that the NC OHSP has accomplished include:

1. Monitoring and providing advice on prevention of acute pesticide poisonings and elevated blood lead levels (EBLL) in adults (https://epi.dph.ncdhhs.gov/oee/figures.html).

2. Integrating adult and prenatal blood lead test results into NCLEAD, a comprehensive system for case reporting and follow-up of elevated blood lead levels and lead exposures.

3. Improving case-based monitoring and follow-up of occupational carbon monoxide (CO) poisonings.

4. Adding collection of employment information into COVID-19 case monitoring system, NCCOVID.

5. Adding carbon monoxide poisonings to the state's occupational health policy for reportable injuries, illness, and exposures.

6. Lowering the reportable blood lead level for adults to allow for a more complete picture of adult blood lead levels in NC.

7. Establishing key partnerships with other NIOSH-funded occupational surveillance entities in the state (e.g. occupational safety and health education and research centers, occupational fatalities assessment programs, workers compensation data custodians) for a more comprehensive state occupational surveillance network.

8. Describing in greater detail the burden of work-related injuries, illnesses, and fatalities through trends over time.

9. Addressing NC specific occupational illnesses, such as heat-related illness.

10. Characterizing and better describing disparities in occupational health utilizing existing US Census and American Community Survey data.

11. Highlighting disparities in occupational health by surveying a sample of vulnerable workers to acquire information on levels of access to healthcare and experiences of workplace harassment and discrimination.

12. Assembling an occupational consultative unit that can provide insight on health and safety to vulnerable workers and small businesses and respond to incidents of chemical releases and resulting poisonings for state-reportable conditions and emerging health hazards, such as opioid-related poisonings and the global COVID-19 pandemic.

SECTION 2

Scientific Report.

BACKGROUND

When this project was proposed, North Carolina (NC) was the tenth largest state in the country and employed over 4.2 million workers[1,2]. It had experienced an 18% population growth from 2000 to 2010 with another 10% growth projected for the next 10 years[1,3]. Major reasons for this growth were the marked increase of people migrating from other states or from outside the country[1]. Migration from foreign countries presents unique safety and health challenges as foreign-born immigrant workers may be unaware of local laws or received poor or very little formal training in their native language regarding worker safety and health protection[4]. The NC economy has transitioned from more labor-intensive industries (e.g. textiles, furniture) to knowledge-based or service-related industries, (e.g. education and health services, retail trade)[1]. The economic recession accelerated this transition[1]. Despite this, hazardous industries like manufacturing remain one of the top four employers in the state, contributing 18% to the state's annual gross domestic product[1]. Four of the ten largest private manufacturing employers in NC are swine and poultry product processing plants[5]. It has been documented that meat process facilities have some of the highest rates of occupational injuries and illness of any manufacturing sector[6]. Healthcare and social assistance is another large NC employer with high rates of nonfatal occupational injuries occurring in the public and private sector[7]. The top five NC occupations in terms of employment are office and administrative support, sales, food preparation and serving, production, and transportation and materials moving. Occupations with the most workers also often pay low wages[1]. Each of these occupations is characterized by low wages, earning less than $31,000 annually[1]. Minority and immigrant workers are often employed in these and labor-intensive, high-risk jobs that tend to have greater exposure to hazards in the workplace[8,9]. NC has other unique features that put workers at risk for harm. NC has a robust agricultural economy, the United States Department of Agriculture (USDA) National Agricultural Statistics Service ranking it first in the nation for production of tobacco and poultry/eggs, and second for hogs/pigs, cut Christmas trees, and turkeys[10]. Agriculture is considered one of the most hazardous industry sectors. NC also uses large amounts of pesticides for these agricultural activities[11]. Due to its geographical location, NC experiences high summer temperatures due to excessive humidity. This hazard puts outdoor workers (e.g. farm workers) at risk for heat-related injury and illness[12,13]. In 2013 NC had 35,170 migrant and 23,745 seasonal farmworkers[14].

Work conditions can negatively impact health. Although rates of work-related injuries and deaths are declining in North Carolina, non-fatal and fatal occupational injuries still persist[7]. In 2012, over 96,200 workers became ill or injured on the job and 146 workers died on the job in NC[2,7]. In 2010, NC rates were higher than national rates for pneumoconioses and work-related fatalities, amputations, burns, and pesticide exposures[15]. There are also persistent negative trends, in which rates of work-related injury and illness have remained consistently higher in certain industry sectors, racial/ethnic groups, or working conditions as compared to others. For

instance, rates of non-fatal work-related injuries have consistently been highest in transportation/warehousing, education/health services, and government industry sectors[7]. Rates of fatal occupational injuries have remained persistently high in agriculture, transportation and warehousing, and construction industry sectors[7]. NC trends reflect national trends[16]. Hispanic workers persistently have the highest rates of occupational fatalities as compared to other racial/ethnic groups in NC, and deaths occur primarily within the agricultural industry sector, which corresponds with other findings[4,9,17,18]. Fatal work-related incidents among self-employed workers were over three times that of wage and salary workers in 2011[17]. Evidence suggests that self-employed workers are often employed in higher-risk industries such as construction and transportation/warehousing[19]. Various industries continue to use lead in their production process. Rates of elevated blood lead levels have declined over time in NC but workers continue to be over exposed to lead[20]. Workplace injuries result in substantial economic and human costs. In 2011, NC employers spent over $1.4 billion in workers' compensation insurance, representing a 40% increase from 2002[21]. Work-related injury and illness can also result in disability, lost wages, and changes in the quality of life for workers and their families.

SPECIFIC AIMS

Work conditions can negatively impact health. Although rates of work-related injuries and deaths are declining in North Carolina, non-fatal and fatal occupational injuries still persist. These incidents are preventable and successful approaches to making work places safer and begin with having the data necessary to understand the problem. Surveillance provides the tool to accomplish this goal. Ongoing data collection and analysis allows states to assess the extent and severity of workplace injury and illness, to identify workers and occupations at greatest risk, to establish research and prevention priorities and to measure the effectiveness of prevention activities and make recommendations for improvement. North Carolina used a previous award to establish a basic occupational surveillance program which focused on building capacity (staff and resources), identifying useful data sources, compiling baseline statistics on worker health, building a network of collaborators and outlining priority focus areas for research and intervention. During this project cycle, OHSP built on previous work and enhance the state's ability to describe occupational risks to health in more depth and to use what is learned to develop targeted interventions and develop other prevention strategies, with the help of partners. Better surveillance and response will help North Carolina make an impact in the workplace with the overall goal of reducing workplace injury and death. The approach is based on recommendations outlined in the Guidelines for Minimum and Comprehensive State-Based Public Health Activities in Occupational Safety and Health (CDC, 2008) which includes three core functions of public health: Health assessment, policy development, and assurance. This project aimed to conduct comprehensive surveillance activities as follows:

Aim 1. Assessment through collection, analysis and reporting of occupational illness and injury data.

1a. Routinely collect and analyze occupational injury and illness data using existing data sets and case-based data (to include state-identified priority area).

1b. Identify trends and research focus areas needing further investigation.

1c. Use alternative data sources to study research focus areas and help identify injury risk factors.

1d. Disseminate findings through appropriate channels.

Aim 2. Promotion of occupational health policy and programs through development of partnerships.

2a. Maintain and continue to develop a committed network of in-state collaborators.

2b. Engage with outside state partners to promote regional collaboration and best practices.

Aim 3. Assure protection of the workforce through intervention and prevention strategies.

3a. Implement data-driven interventions that focus on high-risk groups and conditions (to include state-identified priority area).

3b. Assemble an integrated team of in-house occupational safety and health professionals to provide investigation and outreach services.

3c. Promote enforcement of state regulations by evaluating the effectiveness of regulatory programs designed to reduce workplace risks.

METHODOLOGY

Methods were based on recommendations in the Guidelines for Minimum and Comprehensive State-Based Public Health Activities in Occupational Safety and Health (Attachment 4), and those required in the funding announcement. North Carolina aimed to conduct both minimum and comprehensive surveillance activities in this project. Methods are also aligned with priority-setting guidance provided by Healthy People (HP) 2020 Occupational Safety and Health (OSH) objectives. HP 2020 is an initiative developed by the US Department of Health and Human Services to improve public health. Ten Occupational Safety and Health objectives have been developed to guide efforts to protect worker health (Attachment 5).

1. Assessment through collection and analysis of occupational illness and injury data

1a. Routinely collect and analyze occupational injury and illness data using existing data sets and case-based data (state-identified priority area)

There are 21 CSTE Occupational Health Indicators (Attachment 1). The program will continue annual collection and reporting of OHI data for 19 of the 21 indicators including data for Indicator 13: Elevated Blood Lead among Adults. The program is unable to complete Indicators Five and Eight because workers' compensation data from the North Carolina Industrial Commission are not available at this time. The program will enhance indicator use in the following ways: OHIs will be completed for incomplete (unfunded) years from 2004 through 2007. Trends analyses will be conducted. Stratifications will also be done with select indicators, using available variables, to tease out responsible events for injury and susceptible racial and ethnic groups, occupations and industries with a focus on those indicators that are linked with Healthy People 2020 objectives. For example, Healthy People 2020 objective OSH – 3: "Reduce non-fatal injuries" is linked to OHI #1: "Non-Fatal Work-Related Injuries and Illnesses Reported by Employers." This indicator will also give the program a way of looking more closely at over-exertion or repetitive motion injuries (HP 2020 OSH – 3). Detailed analyses yield more insight on why injuries occur, which can be used to develop prevention strategies. Data will be shared annually with CSTE for aggregate national data and comparison with other states when possible.

State-added Indicator: Occupational Heat-Related Illness

The program developed a work-related heat illness indicator as previously described with the SouthON workgroup. The climate in the southeast and concerns over projected temperature changes associated with climate change prompted this project. NC has witnessed increasing patterns in heat-related mortality in the workplace. Nationally, from 1992 to 2006, the majority of deaths among field crop workers (57%) occurred in California, Florida, and North Carolina[12]. North Carolina had the highest annualized rate of heat-related deaths. The indicator utilizes emergency room and hospital discharge data to calculate counts, rates, and percentages of work-related heat illness. Data can be stratified by basic demographic variables, location, diagnosis, co-morbidities, and time of year. The indicator will serve to provide baseline information to gauge the impact of heat on worker health and to help form prevention messages.

1b. Identify trends and research focus areas requiring further investigation

Research focus areas will be identified from OHI data through comparing state rates to national rates, identifying trends over time, and stratifying work-related injury and illness data by select demographics. Healthy People 2020 OSH objectives will also be used to guide surveillance efforts and priority setting. Research focus areas may also arise from unexpected state-based public health emerging issues, NIOSH initiatives, advisory group concerns or SouthON. Based on previous work, several research priority areas have already been identified that require new or continuing exploration in the form of in-depth analyses. These priority areas had persistently high rates of injury or death over time, such as farm injury, transportation-related injury, construction-related injury, or rates that exceed the national rate, such as acute pesticide-related injury and illness. Certain racial/ethnic groups and occupational groups have been identified as high-risk. Based on work-related fatality statistics collected for

2007 through 2011, occupational fatality rates among Hispanics were higher as compared to all other racial/ethnic groups for all years. For 2011, fatalities occurred three times more often among self-employed persons than wage and salary workers[17].

1c. Use alternative data sources to study research focus areas and help identify injury risk factors

The OHIs alone are not a comprehensive occupational surveillance program but provide a basic foundation for describing work-related injury and illness and are to be used in conjunction with other occupational health surveillance activities[36]. Developing and/or exploring use of new and alternative data sources is necessary to learn about risk factors for injury, essential for targeted interventions, and to obtain more complete injury counts.

Farm-Related Injuries

Farming is a major industry in North Carolina but is also one the most dangerous. Based on trends seen with earlier OHI work and in-depth fatality analysis, the highest fatality rates are persistently seen in the Agriculture, Forestry and Fishing and Hunting industry sector in NC[15,17]. In previous years, the program targeted this sector for more in-depth analysis to learn more about the magnitude, extent, and risk factors for injury. Preliminary work with East Carolina University (ECU) resulted in the documentation of the usefulness of emergency department data to estimate farm injury incidents in North Carolina. Methods devised were useful in providing crude estimates, but limitations included undercounts and limited circumstantial data. Proposed follow-up work to this study includes comparing counts and rates utilizing emergency department data with Bureau of Labor Statistics, Survey of Occupational Illnesses and Injuries (SOII) counts to determine the extent of gaps and doing analyses with other data sources that contain farm injury data, such as ambulance run data and medical examiners' death certificate data, to help better characterize farm injuries. East Carolina University has stipulated it will supply faculty and student help for this project. This project is in line with Healthy People 2020 OSH Objective 1.5: "Reduce deaths from work-related injuries in agriculture, forestry, fishing and hunting," and OSH-2.2: "Reduce work-related injuries treated in emergency departments."

Transportation-Related Injuries

Based on 2011 fatality statistics compiled by the program, transportation incidents accounted for most work-related deaths[17]. The largest proportion of these incidents were due to roadway incidents involving motorized land vehicles. The program will utilize Fatality Analysis Reporting System (FARS) data to obtain more detailed information on work-related fatal motor vehicle crashes. It is a national census database administered by the National Highway Traffic Safety Administration and provides detailed data on fatal motor vehicle injury crashes[37]. The goal is to try and document the frequency, severity, contributing events, and high-risk groups. Data will be shared with the Advisory Group to determine how and with whom to share the data to make an impact. This project is in line with Healthy People 2020 OSH Objective 1.4: "Reduce deaths from work-related injuries in transportation and warehousing."

Construction-Related Injuries

Construction is also considered a high hazard industry[18,19]. According to North Carolina 2011 fatality data, the construction sector had the third highest fatality rate compared to other industry sectors[17]. In order to obtain more detailed data about the risk factors for construction industries, the program submitted a proposal in 2014 to an insurance company that serves builders. Builders Mutual Insurance Company (BM) is one of the largest private insurance companies administering and collecting data on workers' compensation claims for workers in the homebuilding construction industry[38]. The proposal asks BM to establish a data-sharing agreement, allowing access to workers' compensation data for more detailed, descriptive data of circumstances surrounding work-related injuries for workers in the construction industry. This project is in line with Healthy People 2020 OSH-1.3: "Reduce deaths from work-related injuries in construction."

NC Trauma Registry (NCTR): The North Carolina Trauma Registry collects data on trauma patients and facilitates development of trauma surveillance systems[39]. The program aims to access and analyze NCTR data for more detailed descriptions of circumstances surrounding injury cases of work-related falls, motor vehicle crashes, farm injury, and construction-related injuries. The NCTR has an online application for requesting datasets, which will be completed to access the data.

Acute Pesticide-Related Injury and Illness Case-Based Surveillance

Acute pesticide injury and illness is a state-identified priority for the Fundamental-Plus program. Concerns about pesticide exposure have been discussed. Further, according to OHI data, rates are high in NC compared to the US[15]. NC surveillance data suggest exposures are occurring most frequently among high-risk groups to include farmworkers40. Surveillance system components, operation and outreach formats were described previously in the Preliminary Studies Section. To be more effective in making an impact, the program needs to be enhanced in two ways: increased reporting of pesticide cases especially among farmworker populations and increased follow-back among exposed workers with focus placed on the same group. Case follow-back and investigation are essential for learning about how workers are exposed and this information provides the basis for determining intervention and policy change priorities. Increased reporting: Based on available reports, for the period of 2007 – 2012 there were a total of 230 confirmed work-related pesticide poisoning cases identified in the NC Pesticide Incident Surveillance Program database of which approximately 35 (15%) were farmworkers or farm laborers. Given the number of migrant and seasonal farm workers estimated to be in North Carolina in 2012 is 54,940[14], there is thought to be underreporting of pesticide poisonings, especially among farmworkers. Increased follow-back: The program's follow-back protocols require that each work-related case is interviewed with a NIOSH-based questionnaire. Currently the interview success rate is approximately 50%. Reasons for the gap include: timeliness of calls (workers are at work during the day), language barriers, no returned calls, or, once called, case does not want to be interviewed, or there is no working phone

number. In 2013, 49% of the missed interviews involved event descriptions referring to farmworkers, landscapers and pest control operators (order based on frequency).

Method and Anticipated Outputs: The program is proposing to increase the number of reports and successful interview follow-backs with exposed workers, especially farmworkers, by supplementing current surveillance program staff with a part-time, bilingual Public Health Program Consultant to complete all work-related interviews in the central office and/or in the field. Ideally, the candidate will be familiar with the farmworker community. They will be recruited with the help of the NC Farmworker Health Program who is familiar with the target population and candidate pools with prerequisite skills. A dedicated, bilingual staff member will enable the program to increase case finding, timely interview attempts (e.g. after work hours), help facilitate interviews that have to be done with Spanish-speakers, and help coordinate interviews for large investigations in the field with multiple workers involved. This position will also accompany the North Carolina Department of Agriculture on investigations of work-related cases. Collaboration with farmworker advocacy groups and legal services will be essential to gain access to the target population for initial contacts and follow-back. The program already has relationships with such groups: NC Farmworker Health Program, NC Community Health Center Association, Student Action with Farmworkers, NC Fields, NC Agromedicine Institute and Legal Aid of North Carolina.

Case identification and follow-back and investigation are evidence-based strategies that are outlined in the guidance document "Pesticide- Related Illness and Injury Surveillance, A How-To Guide for State-Based Programs[35]. Expected outputs were as follows: Position will establish themselves as a report/interview contact person for the Surveillance program with key groups and be trained on interviewing (Year 1); Will attempt to interview 100% of requests using protocols during and after normal work hours (Year 1- 5); will share completed interviews with program research assistant for data entry (Year 1- 5); Will attempt to increase number of reports from occupational sources 10% (Year 5); will attempt to increase interview success rate to 65% (Year 5); will meet with the surveillance data coordinator every two weeks to report on deliverables.

New Data Sources

Workers Compensation Data: In 2014, the program was successful in establishing communication with the NC Industrial Commission (NCIC) to address data sharing. One formal meeting has been held and the next step is to evaluate the quality of the data base and propose a data sharing MOU. The NCIC is the primary custodian for the Workers Compensation Lost Time Claim File database. The database is potentially useful for completing two OHIs and obtaining a close-to comprehensive data set on work injuries in North Carolina. Behavioral Risk Factor Surveillance System (BRFSS): This is a national survey coordinated by CDC conducted in states to assess preventive health practices, health behaviors, and health status (e.g. leading causes of death and disability such as cardiovascular disease, cancer, diabetes, and injuries). In 2014, the North Carolina occupational surveillance program was successful in inserting industry and occupation questions into the state survey which will allow the program to stratify health

behaviors and chronic diseases by industry and occupation. Public health chronic diseases partners are committed to collaborating on data analysis for wellness program targeting purposes. Health promotion goes hand in hand with health protection. Workers that are mentally and physically healthy are more productive and happier[41,42]. This project is in line with Health People 2020 OSH-9: "Increase the proportion of employees who have access to workplace programs that prevent or reduce employee stress."

Data Collection to Understand Occupational Health Disparities

Occupational health disparities within the workforce have become more apparent as the population becomes more diverse. It has been demonstrated that certain working populations, such as low-wage workers, immigrant workers, and certain racial/ethnic groups, are over-represented in high-hazard industries and occupations, putting members of these groups at higher risk for injuries[8]. Statistics are starting to suggest this trend is occurring in North Carolina. The program will conduct more in-depth analysis to evaluate disparities and then conduct field work to obtain more specific information. First, the program will replicate methods in the study: Occupational Health Disparities, A State Public Health-Based Approach[4]. This study used U.S. Census Current Population Survey (CPS) to calculate the percent by race/Hispanic ethnicity in occupational groups ranked by three measures for potential work-related health risks. Disparities by race and ethnicity were generated. Next, the program will utilize the American Community Survey (ACS) to obtain more detailed information on immigrants and their location. Its advantages are: it contains many descriptive variables related to work, demographics, economic data, location and immigration status (ACS citation). Lastly, field interviews of a sample of immigrant workers will be conducted in collaboration with the NC Refugee Assistance Program and the CSTE/Association of Occupational and Environmental Clinics (AOEC) Occupational Health Intern Program (OHIP). This data will help NC better understand the work experience of immigrants in North Carolina and identify education and training needs related to safety and health on the job. This will be modeled after the project completed by the New Hampshire Department of Health (NHDH)[43]. NHDH provided permission to use their survey tool and is shown in Attachment 7. To-date, collaborators have been secured to access immigrant workers and a study protocol is pending. Baseline analysis as described will be done prior to the field study.

1d. Develop reports and disseminate findings through appropriate channels

The program will produce reports or issue briefs summarizing work proposed in 1a – 1c of the methods section with dissemination to internal and external stakeholders. At least one report will be produced annually to be submitted to NIOSH. The report will include information on trends, emerging issues, and high-risk occupations, industries, and worker populations. Methods of dissemination and communication channels will be selected dependent on targeted groups and means to achieve the best distribution and to deliver the most impact. The website for North Carolina's occupational surveillance program will be maintained and updated regularly to include latest findings and reports. Results will also be disseminated through seminars and presentations at conferences and with partner agencies and reported through

national channels such as the NIOSH monthly newsletter. The program will complete annual reports required by NIOSH on status of grant deliverables.

2. Promotion of occupational health policy and programs through development of partnerships

2a. Maintain and continue to develop a committed network of in-state collaborators

NC OSU will continue to maintain and enhance the NC DPH Occupational Health Surveillance Advisory Group. The program will send out surveys to the group every three years to obtain feedback on the group's purpose and function. New alliances will be sought for research priority areas to assist with reaching targeted groups for prevention interventions. The program will work with academic partners to secure students to help with projects.

2b. Engage with outside state partners to promote regional collaboration and best practices.

The program will participate in required NIOSH meetings, on the CSTE Occupational Health Subcommittee and with SouthON.

3. Assure protection of the workforce through intervention and prevention strategies.

3a. Implement data-driven interventions that focus on high-risk groups and conditions (to include state identified priority area).

Ongoing data-driven interventions

Surveillance and investigation findings will be linked to intervention efforts through measures best suited to meet respective target audiences. These include: presentations, fact sheets, alerts, video story, website postings, and newsletter articles. Prevention plans will be based on available risk factors data, and partnerships to reach target populations and resources. Priority will be placed on research focus areas, vulnerable groups, and emergent public health issues.

Follow-back investigation/intervention for elevated blood lead in adults

Essential components and operation of the adult lead surveillance system have been described in the Preliminary Studies section. The project proposes to add a more comprehensive follow-back investigation/intervention component to the program. A part-time temporary person will be hired to do follow-back with workers based on protocols shown. The program will use existing industrial hygiene staff to conduct follow-back and site investigations with employers. Data from 2011 supports this initiative ($10,000 award). 2011 distribution of adult blood lead levels reported < 10 µg/dL= 4053; 10-24 µg/dL = 248; 25 – 39 µg/dL = 127; 40 – 49 µg/dL = 14; 50 – 59 µg/dL = 2; ≥ 60µg/dL = 4. This project supports Healthy People 2020 OSH-7: "Reduce the proportion of persons who have elevated blood lead concentrations from work exposures."

Follow-back protocol with workers:

BLL ≥ 10 µg/dL: Worker is mailed a letter with lead results and a fact sheet (English and Spanish) "Lead Facts Adult Blood Lead Testing." Letter is sent to every new case and for cases already in system that have not received a letter in 12 months. If worker is a female of childbearing age,

she receives a pamphlet regarding lead and pregnancy at least one time per year. BLL ≥ 50 µg/dL or cluster of ≥3 workers with BLL ≥ 40 µg/dL: Case receive same follow up as above and case is interviewed to discuss blood lead level, goal for BLL reduction, circumstances surrounding exposure, health effects, household members at risk, and ways to prevent exposure. Non-work-related cases receive same follow-up.

Follow-back protocol with employers:

BLL ≥ 40 µg/dL: Staff industrial hygienist (IH) calls employer to inform them of elevated blood lead test (s) and discusses sources of occupational lead exposure and reviews their OSHA regulation-based exposure control program. Employee names are withheld. The IH professional will attempt to resolve lead over-exposure issues over the telephone. A site visit is offered under these circumstances: IH is not satisfied with progress made with phone consult; employer is not familiar or not complying with OSHA standard and there is potential threat of future exposure; incident involves very elevated single BLL or group of exposed workers with high levels (e.g. ≥ 50 µg/dL). Preference may be given to small employers that don't have the resources for exposure evaluation and control. If employer accepts, will do on-site visit. If employer declines, will consider NC OSHA referral. Persistently high BLLs: Program will assemble a team of professionals from NC DPH OEEB, NC OSHA, the relevant county environmental health service and childhood lead program (given the possibility that some take-home exposure may have occurred) to seek a "team" solution to resolve situations where employers have persistently high BLLs over time.

State-identified Priority-Intervention: Pesticides

The program will use interview findings to build a more robust surveillance system and improve data quality. More specifically, the data will be used to influence and educate agency partners that control the safety and sanitation of the work environment, administer pesticide usage and training laws, provide medical evaluation and treatment for exposed workers and conduct pesticide safety training with workers and pesticide applicators. The program will use existing partnerships previously described. Influence should be done at all levels to make an impact but strengthening worker protection laws and policies are the most effective. Strategies are based on the approach found in the "Health Impact Pyramid[44]". This 5-tier model provides a framework to improve health. Actions are categorized as either: socioeconomic (Tier 1), those changing environmental context (Tier 2), interventions providing long-lasting protection (Tier 3), providing evidence-based clinical care (Tier 4), and providing counseling and education (Tier 5). Tier one and two interventions have the greatest potential for impact.

3b. Assemble an integrated team of in-house occupational safety and health professionals to provide investigation and outreach services.

The program will continue to participate in investigations of non-infectious disease clusters in the community and workplace as part of the OEEB Public Health Preparedness and Response Team. Components and purpose of this team has already been discussed. Targeted outreach will be developed for sentinel cases identified during investigations. The occupational health

nursing function and the industrial hygiene functions, exclusively, will agree on a strategic plan for the marketing and development of occupational health consultation services. The strategic planning process began in 2014 and will conclude in 2015. The goal of this integration is to help small and high-risk business with design of effective health and safety programs.

3c. Promote enforcement of state regulations by evaluating effectiveness of regulatory programs designed to reduce workplace risks.

Evaluation of NC Occupational Safety and Health Consultative Services Bureau (CSB) Program

The NC OSHA CSB provides, upon employer request, free on-site business visitation consultations services that are non-penalty, and enforcement-less to small employers and high-hazard establishments. These services help employers comply with OSHA standards for a safe and healthy workplace[45]. The CSB has invited the OHSP to evaluate the impact of CSB consultative services. A recent study has also been conducted to evaluate OSHA impact in California[46]. The figure below is an outline of the basic evaluation strategy. Descriptions of employers will include data regarding industry type, size of establishments by number of employees, types of hazards identified, and basic demographic information. Depending on results of descriptive profiles for both samples, if Sample B is observed to have higher compliance scores than Sample A, then policy recommendations can be made for increasing follow-up visitations. However, if Samples A and B are observed to not have significantly different scores, recommendations can be made to modify consultative visitation practices. Results can potentially be used to inform and improve OSHA inspection policies to improve effectiveness of OSHA visitation services and modify consultative visitation practices as needed. The Carolina Collaborative for Research on Work and Health has committed to supplying technical consultation of the study and a student intern.

OHSP has developed an evaluation approach using the CDC Framework for Program Evaluation in Public Health as a model. Evaluation is crucial for building a stronger evidence-based program that is responsive to the needs of the public, demonstrates success, and applies continuous quality improvement. The program will use a Work Plan to keep track of accomplished deliverables. Findings of the evaluation will be used to assess effectiveness of the overall program and as a tool to continue quality improvement.

RESULTS AND DISCUSSION

The North Carolina (NC) Occupational Health Surveillance Program (OHSP) operates from within the Occupational and Environmental Epidemiology Branch (OEEB) of the NC Department of Health and Human Services, Division of Public Health. The OHSP compiles and uses occupational surveillance data to characterize occupational risks to health in greater detail, and to assist in the development of initiatives to prevent work-related injuries and illnesses by describing problem areas impacting NC workers and identifying priorities for interventions. Outcomes resulting from these efforts contribute to decreasing the health risks of occupational injuries and illnesses. Outputs and outcomes are listed below by Project Year, then by OHSP's

aims as recommended by the *Guidelines for Minimum and Comprehensive State-Based Public Health Activities in Occupational Safety and Health*.

Year 1 Major Accomplishments and Outputs (July 1, 2015- June 30, 2016)

Aim 1. Assessment of occupational injuries, illnesses, and vulnerable worker groups through the collection, analysis and reporting of occupational surveillance data.

OCCUPATIONAL HEALTH INDICATORS (OHI)

The OHSP collects occupational health indicator (OHI) data from existing state and national sources and has collaborated with the Southeastern States Occupational Network (SouthON) to design methods for, and collect data on a state-added OHI for occupational heat-related illness. This OHI was added to the core set of recommended indicators for occupational health surveillance in March 2016 as Indicator #24: "Occupational Heat-Related ED Visits". In August 2015, OHSP used this data to publish a report describing work-related heat illness trends in North Carolina from 2007 through 2011 using hospital discharge and ED visit data. Results were provided to stakeholders, posted to the OEEB website, and provided to the NC Climate-Related Health Advisory Group of the North Carolina Building Resilience Against Climate Effects (BRACE) program. OHSP will continue annual surveillance of occupational HRI as a state-added indicator, and as a part of its routine collection and distribution of OHI data findings.

Twenty-one of twenty-four OHIs for 2013, including Indicator #24, were compiled and submitted by OHSP in June 2016 to the National Institute for Occupational Safety and Health (NIOSH) for quality checks, and the Council of State and Territorial Epidemiologists (CSTE) for publication on their website. Additionally, OHSP collaborated with the University of North Carolina (UNC) at Chapel Hill, Gillings School of Global Public Health, which provided a graduate-level public health student intern to compile missing OHI data for years 2004 through 2007. These data were also submitted to NIOSH and CSTE.

EXPOSURE CASE DATA – ELEVATED ADULT BLOOD LEAD LEVELS AND ACUTE PESTICIDE-RELATED ILLNESS

In October 2015, OHSP hired data processing staff to perform elevated adult blood lead level (EBLL) case surveillance data entry and case follow-back investigations with the NC Lead Program (formerly ABLES). The data processor completed the backlog of un-entered case data accumulated since September 2013 when NIOSH ABLES funding was discontinued, processed all 2014 EBLL case data for submission to NIOSH in 2016, and is currently imputing data for EBLL cases $\geq$10 µg/dL. Case follow-back activities involved contacting health clinics for missing information, mailing exposure prevention information to cases with EBLL ≥ 10 µg/dL, and attempting interviews with and referrals of cases of EBLL ≥ 40 µg/dL to OEE industrial hygienists for consultation with employers.

The OHSP has also hired a bilingual program consultant to assist with occupational acute pesticide-related injury and illness case surveillance follow-back activities, which include case data entry, contacting poison centers and clinics for medical records, and coordinating exposure investigations with the NC Department of Agriculture & Consumer Services. The program consultant is also responsible for developing relationships between the OHSP and farmworker advocacy groups, increasing the number of reported cases by 10%, and increasing the rate of successful follow-back interviews be 65% by 2020.

ADDITIONAL DATA SOURCES TO EXPLORE TRENDS AND EMERGING ISSUES

Previous work by the OHSP suggested the need to describe injuries related to work in the agricultural industry sector, and disparities associated with fatal work-related injury rates by race and ethnicity. OHSP identified fatal agricultural industry-related injuries and occupational health disparities as priorities for further investigation in Year One. To characterize injuries in the agricultural industry in greater detail, OHSP collaborated with the NC Agromedicine Institute and East Carolina University on a project to describe accidental farm-related fatalities in NC from 2009 through 2013, using death certificate data from the NC State Center for Health Statistics and the Office of the Chief Medical Examiner. OHSP also used US Census Current Population Survey employment data and Census of Fatal Occupational Injuries data to describe occupational health disparities by race/ethnicity, industry, occupation, and income in NC during 2013, and how these disparities may have contributed to work-related fatalities over an 11-year period (2003 through 2013). Results were published in reports distributed to stakeholders and result for the occupational health disparities were presented at the CSTE Annual Meeting in June 2016.

Aim 2. Promotion of occupational health policy and programs through the development of partnerships.

OHSP hosted its biannual Occupational Surveillance Advisory Group Meetings in November 2015, and May 2016. The program outlined and prioritized its 5-year plan for projects and deliverables, voted on priorities for Years One and Two, and solicited collaboration on projects from Advisory Group members. Advisory Group Members from UNC and East Carolina University have agreed to collaborate on projects involving assessment of occupational health disparities through providing technical expertise and student interns. Surveillance priorities for Year Two would include surveillance of NC Trauma registry data for traumatic transportation-related occupational injuries and establishing a workgroup to sample and interview subjects representing vulnerable worker populations to collect detailed data on occupational injury risk not provided in existing data sources. OHSP is also collaborating with OEEB in an effort to establish occupational carbon monoxide (CO) poisoning as a mandatory state reportable condition. This rule change to existing mandatory public health reporting would increase surveillance capacity, enabling OEEB to more effectively address the public health burden of CO poisoning in the workplace. OHSP worked with OEEB staff to provide data and help develop a case definition for work-related CO poisoning incidents during Year One.

3. *Assure protection of the workforce through intervention and prevention strategies.*

A crucial part of state surveillance is to use data results to inform interventions focused on identified. OHSP collaborated with OEEB epidemiologist to design and evaluate the usage of CO exposure prevention outreach information targeting first responders. Informative factsheets have been designed to target emergency medical personnel, providing useful tips for emergency personnel to recognize and avoid CO poisoning while at work. OHSP will work to develop similar factsheets targeting law enforcement and fire response personnel through collaboration with the NC Public Health Preparedness and Response (PHPR) Branch of the NC DPH. Factsheets will be disseminated to local fire and police stations, and usage of materials will be evaluated by OHSP by May 2016. Evaluation methods are pending development and will include a focus group.

Elevated blood lead levels (EBLL) in adults case surveillance

Follow-back investigation/intervention for cases of EBLL in adults:

Starting in 2016, all cases of workers reported to OEEB with BLL ≥10 µg/dL will be mailed a letter with BLL results and an informational factsheet in English or Spanish entitled, "Lead Facts Adult Blood Lead Testing". This information advises workers on how to get tested for BLL and decrease lead exposure. Mailings are sent to every new case reported during the current calendar year, and to existing cases who did not receive a mailing in over 12 months. Reported occupational EBLL cases identified as female aged 15-44 receive informational pamphlets regarding effects of lead exposure on pregnancy at least once per year. As of February 2016, 38 mailings have been completed. Additionally, workers with BLL ≥40 µg/dL will be interviewed to discuss risks of EBLL, goals for BLL reduction, circumstances surrounding exposure, health effects, household members at risk, and methods to prevent exposure. Non-work-related cases receive the same follow-up. Three interviews were attempted of the eight detected EBLL ≥40 µg/dL cases as of 2016. Only one interview was successfully completed.

Acute pesticide-related illness and injury case surveillance

To date, the PISP program consultant was trained on pesticide illness case state reporting requirements, interviewing methods, and was positioned as the point-of-contact for the program with 14 key stakeholder groups, which include data custodians, worker advocacy groups, and regulatory agency sections promoting migrant and farmworker health. Program consultant also attended annual meetings with regional NCDACS inspectors (agricultural and structural) to establish partnerships necessary to co-investigate cases of pesticide illness among farmworkers and solicited invitations to routine meetings and trainings to raise awareness about reporting among outreach workers. Awareness training is scheduled for outreach worker meetings hosted by the NC Farmworker Health Program in the Spring and Fall of 2016, quarterly meetings with the Farmworker Advocacy Network, and a meeting of the Department of Public Instruction Migrant Education group for March 2016, where over 100 outreach workers will be in attendance. The program consultant will accompany the PISP project director to three targeted migrant and community health centers to conduct education training with health providers and outreach workers prior to the 2016 growing season.

3b. Assemble an integrated team of in-house occupational safety and health professionals to provide investigation and outreach services. (Intermediate Outcomes)

In 2015, OEEB redistributed its industrial hygienist (IH) and occupational health nurse (OHN) consultation resources to perform consultation/site visit services targeting small businesses, local government, self-employed workers, and low-wage and minority workforces. The OEEB IH/OHN occupational consultation services were utilized to conduct case follow-back investigations for cases of elevated adult BLL> 40 µg/dL and persistently high cases of EBLL in adults. As of October 2015, IH resources for OEEB decreased by 50% due to program personnel resignation. OEEB will regain full IH capabilities by May 2016. Follow-back investigations with employers were initiated late 2015.

EBLL >40 µg/dL case investigations

Employers of workers with elevated adult BLL ≥40 µg/dL will receive calls from OEEB IH to discuss potential sources of occupational lead exposure, and to review the employers' OSHA regulation-based exposure control program. Employee identifications are withheld from the employers. IH consultants then attempt to resolve hazardous lead exposure issues via telephone consultation. Site visits are offered if: the IH is not satisfied with progress made via phone consultation; the employer is not familiar or not complying with OSHA standards which may result in potential future exposures; and/or the incident involves a single case of highly elevated BLL, or a group of exposed workers with high BLL (e.g. ≥ 50 µg/dL). Preference for consultation or site visit may be given to small employers without resources for exposure evaluation and control. If an employer accepts a site visit, OEEB will conduct an on-site visit. If the employer declines, OEEB will consider referring the case to NC OSHA.

In 2016, one follow-back investigation for BLL > 40 µg/dL was completed. A site visit was conducted at a lead reclamation plant 'Site X' in February 2016. This plant purchases lead ingots to crush and sell as lead powder. Site X had under 20 employees, but the NC LEAD program received EBLL case reports (≥40 µg/dL) for most of the site's employees for a two-year period prior to the site visit. The purpose of the site visit was to understand the extent and source of lead exposure, and help the company develop an exposure control plan. Routine IH employer referrals for workers with EBLL ≥40 µg/dL will begin May 2016, when the new OEEB IH begins employment.

Persistently high BLL case investigations

In September 2015, one follow-back investigation for cases of persistently high BLL was completed. Persistently high BLLs were detected over time in the children of three families whose fathers all worked at the same lead battery reclamation plant, 'Site Y'. OHSP assembled a team from OEEB, NC Department of Labor (DOL) OSHA, and the Children's Environmental Health Unit of the NC Environmental Health Section, NC DPH, to collaborate with the target county's local health departments to investigate this worksite. A site visit was conducted with OEEB OHN and IH staff, and the local county health director. Exposure control

recommendations were provided to the employer. To date, the company has made some efforts to control lead exposure in workers and possible take-home exposure to the workers' families. Child lead levels have not all been reduced; however, and the company has been advised that an OSHA referral may occur if exposure risk is not reduced at the plant. NC DPH has requested an exposure reduction plan and timeline from the company.

3c. Promote enforcement of state regulations by evaluating the effectiveness of regulatory programs designed to reduce workplace risks.

OHSP is collaborating with the OEEB CSTE Fellow to evaluate the visitation services function for the NC DOL Consultative Service Bureau (CSB). A meeting was held in December 2015 with the CSB bureau chief to outline priorities and objectives for evaluation. An evaluation protocol will be drafted by April/May 2016. OHSP will describe populations of businesses receiving CSB Visitation services by August 2016.

Year 2 Major Accomplishments and Outputs (July 1, 2016- June 30, 2017)

Aim 1. Assessment of occupational injuries, illnesses, and vulnerable worker groups through the collection, analysis and reporting of occupational surveillance data.

Occupational Health Indicators (OHI): Data for a total of twenty-two of the twenty-four OHI for Year 2014 were compiled by OHSP in June 2017 and reported to the National Institute for Occupational Safety and Health (NIOSH) and the Council of State and Territorial Epidemiologists (CSTE). In Summer of 2016, OHSP recruited a student intern from the University of North Carolina at Chapel Hill to collect missing NC OHI data for years 2004 through 2007. This data was complied with other available NC OHI data (2000 through 2013, for Indicators #1 through #20, and demographic information) to conduct trend analyses. Select results on OHI trends of fatal work-related injuries were presented as a poster at the NC Public Health Association Conference in September 2016. Comprehensive results were published in December 2016 in a report available on the OEEB website.

Case-Based Surveillance: OHSP has assembled two teams composed of new and current OEEB staff dedicated to case-based surveillance activities – a team of four staff dedicated to elevated blood lead level (EBLL) case surveillance activities that includes: a newly hired processing assistant for case data entry and follow-back with workers and clinics for missing information; an administrative assistant for electronic and hard-copy data collection; an industrial hygienist (IH) for site visits and investigation consultation; an occupational health nurse consultant for quality assurance on case data, conducting worker interviews and industry site visits with IH and developing outreach information; and (on occasion) a graduate-level public health student to compile bi-annual, summary report of state EBLL case data as part of a summer internship project. A report summarizing findings for EBLL 2015 data was completed in July 2016 and published on the OEEB website. Additionally, a total of two staff are dedicated to acute

pesticide-related poisoning surveillance: a newly hired social clinical research assistant to coordinate data collection, data entry and case investigations; and an occupational health nurse consultant to perform case data quality assurance, produce reports and coordinate outreach initiatives.

Additional Data Sources: OHSP has continued to explore factors contributing to disparities in occupational health among the North Carolina workforce. In Year Two, OHSP used the American Community Survey Public Use Microdata Sample to describe disparities by socioeconomic measures (e.g. race/ethnicity, English-speaking ability, poverty threshold, health insurance coverage, travel time to work, immigration status and education). An abstract summarizing select findings was submitted as an abstract and presented as a poster at the 2017 CSTE Annual Meeting in Boise, ID in June. Additionally, the OHSP plans to hire a social research assistant in August or September of 2017 to collect work experience data from a sample of a vulnerable working population in North Carolina (e.g. immigrant workers in high injury-risk industry sectors) using a survey instrument. This is a continuation of a multi-year project for OHSP to address occupational health disparities in North Carolina.

Aim 2. Promotion of occupational health policy and programs through the development of partnerships.

Advisory Group: OHSP hosted its biannual Occupational Surveillance Advisory Group Meetings in November 2016, and May 2017. The program presented findings for a site investigation involving take-home lead exposure affecting children of workers from a lead oxide manufacturing plant, reviewed the survey instrument to be used to collect worker experience data for describing occupational health disparities, solicited collaboration on projects from Advisory Group members, and voted on priority deliverables for Year Three. Priorities selected included exploring additional data sets for more occupational injury information, such as the NC Trauma Registry and the Behavioral Risk Factors Surveillance System.

Additional Partnerships: In January 2017, OHSP met with and established partnerships with the North Carolina Refugee Assistance Program (RAP) and the North Carolina Office of Minority Health and Health Disparities (OMHHD). These groups will be used as recruitment and distribution networks for work experience interview data and educational outreach information, respectively. Recruited social research assistant staff will train and work with community health workers and volunteers working with NC RAP and NC OMHHD networks to administer surveys in-person within workers' communities.

Policy Development: In Year Two, the OHSP collaborated with OEEB to pass an amendment, through the North Carolina Commission for Public Health, to the Occupational Health Surveillance rule 10A NCAC 41C .0702 under N.C. General Statute 130A to include carbon monoxide poisonings in the list of state reportable occupational health diseases, illnesses, and injuries. This rule amendment took affect April 2017 and requires all cases of occupational

carbon monoxide poisoning to be reported to OEEB within 15 working days of diagnosis. OHSP and OEEB have also negotiated a contract with the North Carolina Poison Control (NCPC) to provide weekly case data submissions to OEEB, with OHSP to sponsor the contract. OHSP plans to work with OEEB to evaluate if this reporting rule amendment has resulted in significant increases in the number and quality of CO poisoning reporting during Year Four of the OHSP's funding cycle.

Aim 3. Assure protection of the workforce through intervention and prevention strategies.

A crucial part of state surveillance is to use data analysis results to inform preventive interventions focused on identified priority risks to workers' health and safety. During Year Two, OHSP has performed outreach and interventions focused on prevention of elevated blood lead levels in adults and acute pesticide poisonings using its consultative IH and occupational health nurse functions within OEEB. These functions will continue performing consultation and site visitation services targeting small businesses, local government, self-employed workers, and low-wage and minority workforces throughout the program's entire funding cycle.

Adult EBLL Case Investigations and Outreach: May 2016, OEEB was notified by the NC DPH Children's Environmental Health Branch (CEHB) of elevated levels of blood lead levels >5µg/dL found in children of employees of a lead oxide manufacturing plant, Company X in Forsyth County, NC. Company X is also part of OHSP's EBLL surveillance network that submits monthly reports of employee BLL to OHSP. OHSP collaborated with the CEHB, the Forsyth County Health Department, and Company X management to attempt to decrease EBLL in both the employees and their children. Activities have included: finding and linking additional cases of EBLL in workers to EBLL records for children, multiple plant tours, over 20 employee interviews to gather behavior-linked exposure data, employee and management training, and meetings with Company X's corporate headquarters. A consultation meeting was also held with the NC OSH Consultative Services Bureau for lead level sampling. OHSP has continued to monitor EBLL among the Company X employees, and since OHSP and OEEB involvement, there have not been any new cases of EBLL reported among the Company X employees' children. Findings were submitted and accepted as an abstract presented at the 2017 Epidemic Intelligence Service Conference in Atlanta, GA in April, and as a Breakout Session presentation at the 2017 CSTE Annual Meeting in Boise, ID in June.

Acute pesticide-related poisoning prevention outreach: OHSP has detected several acute pesticide poisoning events triggering field investigations, which have included referrals from the NC Department of Agriculture and Consumer Services. Outreach activities have included meetings, seminars, courses taught, and workgroup initiatives with partner agencies including: the NC Cooperative Extension Annual Conference; the NC Pest Management Association, East Carolina University, NC State University, and the East Carolina University Agromedicine Institute to raise awareness regarding pesticide exposure prevention among pesticide applicators and occupational health workers.

Year 3 Major Accomplishments and Outputs (July 1, 2017- June 30, 2018)

Aim 1. Assessment of occupational injuries, illnesses, and vulnerable worker groups through the collection, analysis and reporting of occupational surveillance data.

Occupational Health Indicators (OHI): Data for twenty-one of the twenty-four OHI for Year 2015 were compiled and reported to the National Institute for Occupational Safety and Health (NIOSH) and the Council of State and Territorial Epidemiologists (CSTE) in June 2018. Data for Indicator #21: Asthma Among Adults Caused or Made Worse by Work were not collected this year due to North Carolina no longer collecting data in 2015 for the Behavioral Risk Factor Surveillance System Asthma Callback Survey, the primary data source for Indicator #21.

In May through August 2018, OHSP recruited a student intern from East Carolina University to analyze trends in North Carolina OHI data. Select indicators were compared to US rates and analyzed by demographics over time. Results will be published in a report available on the OEEB website in September 2018.

In 2017, the United Health Foundation (UHF) ranked North Carolina as the "tenth healthiest" state in the country for occupational fatalities in the construction, manufacturing, trade, transportation, utilities, and professional and business services industry sectors, with an overall steady decrease of fatality rates observed in all industry sectors since 2000. However, rates of occupational fatalities were not considered by racial/ethnic demographics, by income or by worker status, which may paint a different picture. Additionally, fatality rates were also not analyzed by UHF from the agriculture, forestry, fishing, and hunting; mining; education and health; leisure and hospitality and other services industry sectors. OHSP prepared an updated data report highlighting NC trends in occupational fatalities from 2007 through 2016 and compared trends in NC rates with US trends by select demographics and by select industry sectors. Overall occupational fatality rates in NC have increased since 2013 and have risen above national rates since 2015. Rates among workers aged 65 years and above, and workers identified as Hispanic/Latino have remained consistently higher than among workers of other age and racial/ethnicity groups, respectively. Occupational fatality rates among the agriculture, forestry, fishing, and hunting; transportation and warehousing; and the construction industry sectors have remained higher than overall fatality rates for all industry sectors across the entire ten-year period. More information from this report will be available in the Fall 2018 edition of the EpiNotes Newsletter publication for the Epidemiology Section of NCDPH.

Additional Data Sources: OHSP explored the NC Trauma Registry (NCTR) as a potential additional source of occupational health data providing information for cases of traumatic work-related injuries. NCTR data for a three-year period were analyzed to determine available occupational health-related information that may be used for highlighting trends in work-related injuries, and for the capacity to provide ongoing occupational health surveillance

information. Information available was similar in scope to hospitalization and emergency department visitation data used for OHI. However, NCTR data does not record industry and occupation information on a consistent basis. NCTR data may also be useful for providing additional information for investigating sentinel cases of traumatic work-related injury. However, more detailed circumstantial information related to cause and hazards associated with traumatic work-related injuries are not currently available. More detailed exploration of NCTR data in future years is necessary for evaluating its use for long-term occupational health surveillance.

OHSP has also partnered with various departments at the University of North Carolina at Chapel Hill (UNC) to collect detailed work experience information from a sample of vulnerable (low-income, immigrant/refugee, low-English-comprehension) workers in the state. The purpose of this project would be to use the information gathered to link workers with health and safety resources available at UNC and at NCDPH based on their reported needs. Data collection will begin in August/September 2018. This is a continuation of a multi-year project for OHSP to address occupational health disparities in North Carolina (see Aim 2 for more information).

Aim 2. Promotion of occupational health policy and programs through the development of partnerships.

Advisory Group & Local Partnerships: OHSP hosted its biannual Occupational Health Surveillance Advisory Group Meetings in November 2017 and May 2018. OHSP showcased findings from the NCTR exploration and data issue brief highlighting recent trends in occupational fatalities to its state partners. The Advisory Group also reviewed the methods and timeline for the project for collecting data from a sample of vulnerable workers for the assessment of occupational health disparities in North Carolina and voted on priority deliverables for Year Four. Assessment of transportation and construction-related occupational injuries was selected as a first and second priority, respectively.

In October 2017, OHSP established a partnership with the Fitness Breaks Program at UNC Chapel Hill through its partner representative with the Carolina Collaborative for Research on Work and Health, a current Advisory Group member. Fitness Breaks was established in 2014 at UNC as a worksite injury and obesity prevention intervention program working primarily with the housekeeping staff of the Facilities Services Division (FSD) at UNC. FSD employees are primarily foreign-born (including refugees from Myanmar and various South American countries) workers in low-wage occupations (e.g. housekeeping, grounds keeping), and are therefore a vulnerable population at high risk for occupational injury and workplace violence and discrimination. Fitness Breaks has agreed to partner with OHSP and FSD management to

collect work experience data from a sample of this population. Through this partnership, in January 2018, OHSP has also partnered with the UNC Work/Life and Wellness Program and UNC Office of Human Resources (HR). Since then, OHSP has worked with its Advisory Group and new partners to refine methods for data collection and the questionnaire to be used to collect work experience data from FSD workers. Data collection will begin in August 2018. Questionnaires will be translated into the native language of the participants through services provided by UNC HR. Results will be self-reported by FSD employees who volunteer to participate and will be compiled by OHSP.

Additional Partnerships (National): In October 2016, NC OHSP partnered with NIOSH and CSTE to assist in a national effort to improve estimates for silicosis occurrence in the US. NC OHSP submitted detailed silicosis hospitalization and mortality data to NIOSH in December 2016 using data from two OHI (Indicator #9: Pneumoconiosis Hospitalizations and Indicator #10: Pneumoconiosis Mortality). Results indicated a potential increased risk of accelerated illness from silica exposure in cases younger than 55 years of age occurring throughout the country, including in North Carolina. NIOSH has asked states including North Carolina to collect additional detailed exposure and worker demographic data for cases of silicosis under the age of 55 reported for NIOSH to improve the quality of its silicosis surveillance data. OHSP will submit collected data in Winter, 2018.

Policy Development: In 2016, the OHSP collaborated with OEEB to pass an amendment through the North Carolina Commission for Public Health to the Occupational Health Surveillance rule 10A NCAC 41C .0702 under N.C. General Statute 130A to include carbon monoxide poisonings in the list of state reportable occupational health diseases, illnesses, and injuries. This rule amendment officially took affect October 2017 and requires all cases of occupational carbon monoxide poisoning to be reported to OEEB within 15 working days of diagnosis. OEEB is currently receiving weekly data submissions from the NCPC. OHSP plans to work with OEEB to evaluate if this reporting rule amendment has resulted in a significant increase in the quality and quantity of CO poisoning reporting beginning in August 2018.

Aim 3. Assure protection of the workforce through intervention and prevention strategies.

OHSP continues to perform outreach and interventions focused on prevention of elevated blood lead levels (EBLL) in adults and acute pesticide poisonings using its consultative IH and occupational health nurse (OHN) functions within OEEB. These functions will continue performing consultation and site visitation services targeting small businesses, local government, self-employed workers, and low-wage and minority workforces throughout the program's entire funding cycle. The IH/OHN consultation functions have also provided outreach

at the Small Business Center Network to notify small businesses throughout NC of its function and has also provided opioid exposure prevention training for public services and first responder worker groups throughout the state.

Adult EBLL Case Investigations and Outreach: May 2016, OEEB was notified by the NC DPH Children's Environmental Health Branch that child cases of EBLL >5µg/dL were found in Forsyth County, NC, associated with employees of a lead oxide manufacturing plant (Company X) in the same county. Since then, OHSP and OEEB have conducted multiple site visits, EBLL case data collection and interventions for Company X to reduce lead exposure among its employees and their families. OHSP continues to monitor EBLL in Company X employees and cases of EBLL throughout the state. OHSP and OEE has also continued to distribute educational materials and provide consultation to workers and employers across the state on how to continue monitoring and reduce lead exposure while at work and at home.

Acute pesticide-related poisoning prevention outreach: OHSP has detected several acute pesticide poisoning events triggering field consultations and investigations, which have included referrals to the NC Department of Agriculture and Consumer Services. Outreach activities have included meetings, seminars, courses taught, and workgroup initiatives with partner agencies including: the Agricultural Aviation Association, East Carolina University, NC State University, and the East Carolina University Agromedicine Institute to raise awareness regarding pesticide exposure prevention among pesticide applicators.

Year 4 Major Accomplishments and Outputs (July 1, 2018- June 30, 2019)

Aim 1. Assessment of occupational injuries, illnesses, and vulnerable worker groups through the collection, analysis and reporting of occupational surveillance data.

Occupational Health Indicators (OHI): Data for seventeen of the twenty-one reportable OHI for Year 2016 were compiled and reported to the National Institute for Occupational Safety and Health (NIOSH) and the Council of State and Territorial Epidemiologists (CSTE) in June 2019. Data for Indicator #5 and #8: State Workers Compensation Claims for Amputations and Carpal Tunnel Syndrome with Lost Work-Time are collected by NC but are currently unavailable to OHSP. Data for Indicator #13: Elevated Blood Lead Levels Among Adults will be collected and submitted at a later date. Data for Indicator #21: Asthma Among Adults Caused or Made Worse by Work were not collected this year due to North Carolina no longer collecting data in 2015 for the Behavioral Risk Factor Surveillance System Asthma Callback Survey, the primary data source for Indicator #21.

In May through August 2018, OHSP recruited a student intern from East Carolina University to analyze trends of interest in NC OHI data. Select indicators for trends in work-related hospitalizations and work-related burn hospitalizations were compared to US rates and analyzed by demographics over time. Results will be published in a report available on the OEEB website in Year 5.

Additional Data Sources:

Occupational Health Disparities: OHSP partnered with the University of North Carolina at Chapel Hill (UNC) Work Life & Wellness Program in February 2018 to describe the work experience of vulnerable workers, using a survey instrument to gather data. The workers are in low-income occupations with high risk for injury (e.g. housekeeping workers), have minimal English comprehension and limited means for access to occupational health resources. The purpose of this project was to use the work experience information gathered to better link workers with health and safety resources available at their employer and at NCDPH, and to help the employer improve provisions of health and safety resources and programs based on reported needs. Data collection was completed during February and March 2019 and data analysis will begin mid-Summer 2019 and extend until the end of Fall 2019. This is a continuation of a multi-year project for OHSP to address occupational health disparities in North Carolina among vulnerable working populations in industries at high risk for work-related injury and illness.

Occupational Carbon Monoxide (CO) Poisoning: North Carolina passed a public health surveillance statute requiring occupational CO poisoning cases to be reported to NCDPH within 15 working days of a CO poisoning hospital diagnosis effective October 2017. Since then, OHSP has compiled occupational CO poisoning data submitted weekly from the Carolinas Poison Center. OHSP plans to use this data for targeted health interventions for businesses in industry sectors most affected by occupational CO poisoning incidents.

Aim 2. Promotion of occupational health policy and programs through the development of partnerships.

Advisory Group & Local Partnerships: OHSP hosted its biannual Occupational Health Surveillance Advisory Group Meetings in November 2018 and May 2019. The program showcased the work by the NC State University Cooperative Extension Farmworker Health Program and Manos Unidas, a farmworker health advocacy program, to the Advisory Group involving aid provided for farmworkers during Hurricane Florence and Tropical Storm Michael in Fall 2018. Both groups made connections with Advisory Group members to enable collaborations on future projects. The Advisory Group also received updates on the progress of

the vulnerable worker health project, voted on priority deliverables for Year Five, and brainstormed potential priorities for future projects for future funding cycles. Assessment of transportation-related occupational injuries was selected as a priority in Year 5. Additionally, in June 2019, OHSP was asked to be part of a workgroup to reform and update the NC Department of Transportation's (DOT) Strategic Highway Safety Plan (SHSP). OHSP has since partnered with the NCDOT SHSP Demographics Emphasis Area Workgroup to advocate for the inclusion of industry and occupation data as part of the workgroup's data profile of transportation-related incidents in North Carolina.

Aim 3. Assure protection of the workforce through intervention and prevention strategies.

OHSP continues to perform outreach and interventions focused on prevention of elevated blood lead levels (EBLL) in adults and acute pesticide poisonings using its consultative industrial hygiene (IH) and occupational health nurse (OHN) functions within OEEB. These functions will continue performing consultation and site visitation services targeting small businesses, local government, self-employed workers, and low-wage and minority workforces throughout the program's entire funding cycle. The IH/OHN consultative functions also continue to provide opioid and methamphetamine exposure prevention training for public services workers and first responder worker groups throughout the state.

Adult EBLL Case Investigations and Outreach: OEEB continues its collaboration with the NC DPH Children's Environmental Health Branch and the Forsyth County Department of Public Health to monitor cases of elevated blood lead levels (EBLL) among employees of a lead oxide manufacturing plant and their children, and cases of EBLL throughout the state that include EBLLs reported at indoor shooting ranges. OHSP and OEE have continued to distribute educational materials and provide consultation to workers, employers and special needs populations (e.g. pregnant women) across the state on how to continue monitoring and reduce lead exposure while at work and at home.

Acute pesticide-related poisoning prevention outreach: OHSP has detected several acute pesticide poisoning events triggering field consultations and investigations, which have included referrals to the NC Department of Agriculture and Consumer Services. Outreach activities have included the OHN consultant serving as a member of the NC Structural Pest Control Committee, seminars and courses taught, and workgroup initiatives with partner agencies including: the Agricultural Aviation Association, East Carolina University and NC State University to raise awareness regarding pesticide exposure prevention for graduate students in toxicology programs and pesticide applicators in training and recertification programs.

Year 5 Major Accomplishments and Outputs (July 1, 2019- June 30, 2020)

NOTE: Starting in March 2020, OSHP was asked to directly assist with the NC DHHS COVID-19 pandemic response in North Carolina. As a result, many programmatic priorities and accomplishments have shifted. Resultant changes to regular programmatic functions are noted in ***RED for Years 5 and 6****.*

Aim 1*. Assessment of occupational injuries, illnesses, and vulnerable worker groups through the collection, analysis and reporting of occupational surveillance data.*

Occupational Health Indicators (OHI): Data for only 13 of the 21 reportable OHI for Year 2017 were compiled as of June 2020. Data for OHI using state hospital discharge or ED visit data have not been compiled due to state health statistics and related data resources being severely restricted as most have been directed towards the COVID-19 pandemic response. Completed OHI submission to the National Institute for Occupational Safety and Health (NIOSH) and the Council of State and Territorial Epidemiologists (CSTE) was also delayed due to NC OHSP's involvement in NC's COVID-19 pandemic response.

Additional Data Sources:

Occupational Health Disparities: OHSP partnered with the University of North Carolina at Chapel Hill (UNC) Work Life & Wellness Program in February 2018 to describe the work experience of vulnerable workers, using a survey instrument to gather data. The workers are in low-income occupations with high risk for injury (e.g. housekeeping workers), have minimal English comprehension and limited means for access to occupational health resources. The purpose of this project was to use the work experience information gathered to better link workers with health and safety resources available at their employer and at NCDPH, and to help the employer improve provisions of health and safety resources and programs based on reported needs. Following completed data collection in March 2019, OHSP hired a part-time temporary research assistant in August 2019 to compile and analyze data results. Results and initial recommendations were shared with employers in January 2020. This project is a continuation of a multi-year project for OHSP to address occupational health disparities in North Carolina among vulnerable working populations in industries at high risk for work-related injury and illness.

Adult Elevated Blood Lead Levels (EBLL) Surveillance: In August 2019, the NC Adult Blood Lead Epidemiologic Surveillance (ABLES) Program transitioned to fully electronic reporting, being converted from an Access database into a Maven web-based surveillance system, NCLEAD. In October 2019, electronic lab reporting features were enabled in NCLEAD to reduce the number of EBLL lab reports requiring manual entry. Additionally, in November 2019, over 1,800 duplicate reports in the NCLEAD system were addressed and corrected.

Occupational Carbon Monoxide (CO) Poisoning: North Carolina passed a public health surveillance statute requiring occupational CO poisoning cases to be reported to NCDPH within 15 working days of a CO poisoning hospital diagnosis effective October 2017. Since then, OHSP has compiled occupational CO poisoning data submitted weekly from North Carolina Poison Control (NCPC). OHSP renewed its data-sharing contract with NCPC in February 2020.

COVID-19-Related Occupational Surveillance: OHSP was asked to assist in the NCDHHS response to COVID-19 outbreaks associated with meat processing facilities. Since April 2020, OHSP contributes demographic statistics to weekly internal reports informing multiple division's outbreak response efforts, including the NC Secretary of Health and Human Services' office. Additionally, as of May 2020, OHSP successfully advocated for the inclusion of industry, occupation and work-related exposure data to be part of the North Carolina Electronic Disease Surveillance System (NCEDSS), the data system used by NCDPH for state COVID-19 surveillance. Data fields were included as open text fields, a format recommended by NIOSH and CSTE as part of best practices for occupational health surveillance. NC was one of the first states to accomplish the addition of these data elements to their COVID-19 surveillance system in this format.

Aim 2. *Promotion of occupational health policy and programs through the development of partnerships.*

Advisory Group & Local Partnerships: OHSP hosted its biannual Occupational Health Surveillance Advisory Group Meetings in November 2019 and showcased preliminary results from the occupational health disparities survey project; however, the May 2020 meeting was cancelled due to the COVID-19 pandemic. To continue work developing state data sources for transportation-related occupational health surveillance, OHSP also partnered with the NC Traffic Records Coordinating Committee (TRCC) of the UNC Highway Safety Research Center (HSRC) in October 2019. TRCC helps develop data resources to better characterize motor vehicle crashes in North Carolina. OHSP has partnered with the TRCC to advocate for the addition and collection of industry and occupation data alongside crash data and emergency/first responder data to enhance surveillance capabilities in NC for occupational transportation-related injuries.

National Partnerships: OHSP program manager showcased highlights of current trends in occupational injuries and illnesses in North Carolina at the Southeastern States Occupational Network Annual meeting in Birmingham, AL during February 2020. In June 2020, NCOHSP joined a national effort spearheaded by NIOSH to collect more detailed employment and work-related exposure information from reported COVID-19 cases using a telephone survey. The purpose of this project is to determine behavioral occupational circumstances associated with COVID-19 exposures and to identify strategies for controlling COVID-19 exposures in the workplace. NC was the first of five states selected to participate in this project. This project will be conducted over two years starting in August 2020.

Aim 3. *Assure protection of the workforce through intervention and prevention strategies.*

As of October 2019, personnel performing the occupational health nurse (OHN) consultation function in-kind has retired. After the loss of this key personnel, OHSP continued to perform limited outreach and interventions focused on prevention of adult EBLLs and acute pesticide poisonings, relying on its industrial hygiene consultation unit (IHC) within OEEB. The IHC unit has performed consultation and site visitation services targeting small businesses, local government, self-employed workers, and low-wage and minority workforces throughout the program's entire funding cycle. The IHC unit also continues to provide opioid and methamphetamine exposure prevention training for public services workers and first responders throughout the state. The IHC function has also expanded to perform site visitations at meat processing facilities to provide consultation on occupational interventions to prevent COVID-19 exposures.

Adult EBLL Case Investigations and Outreach: OEEB continues its collaboration with the NC DPH Children's Environmental Health Branch and the Forsyth County Department of Public Health to monitor EBLL cases among employees of a lead oxide manufacturing plant and their children, and cases of EBLL throughout the state that include EBLLs reported at indoor shooting ranges. OHSP and OEE have continued to distribute educational materials and provide consultation to workers, employers and other target populations (e.g. pregnant women) across the state on how to continue monitoring and reduce lead exposure while at work and at home. OEEB has partnered with a doctoral student at a local university to compile a list of local shooting ranges, create a poster to educate shooting range patrons about the health effects of lead poisoning and how to prevent lead exposure, and survey law enforcement professionals on their knowledge and beliefs about lead poisoning prevention. The capacity for regular EBLL prevention-related site visitations and consultations has been limited to once per month due to understaffing and response to the COVID-19 pandemic.

Acute pesticide-related poisoning prevention outreach: OHSP has detected several acute pesticide poisoning events triggering field consultations and investigations, which have included referrals to the NC Department of Agriculture and Consumer Services. Outreach activities have included the OHN consultant serving as a member of the NC Structural Pest Control Committee, seminars and courses taught, and workgroup initiatives with partner agencies including: the Agricultural Aviation Association, East Carolina University and NC State University to raise awareness regarding pesticide exposure prevention for graduate students in toxicology programs and pesticide applicators in training and recertification programs. The capacity for regular acute pesticide-poisoning prevention-related site visitations and consultations has been limited to once per month due to understaffing and response to the COVID-19 pandemic.

Occupational CO poisoning prevention outreach: OHSP uses the CO poisoning data reported by NCPC for targeted health interventions in businesses in industry sectors most affected by

occupational CO poisoning incidents, and to make referrals to NC OSHA for workplace inspections in the event of severe cases of occupational CO poisonings that result in over five consecutive cases, cases requiring medical treatment or deaths. During Year 5, the OEEB CO website was updated to include a new CO infographic and poster and updated information. The capacity for regular occupational CO prevention-related consultations and referrals to OSHA have been put on hold due to understaffing and response to the COVID-19 pandemic.

COVID-19-Related Workforce Protection Assurance: OHSP helped develop factsheets that provide information to meat processing workers and their families on COVID-19 symptomology, and recommendations for exposure prevention, how to seek medical care, testing resources and employee-related assistance in the event of a work-related COVID-19 exposure. OHSP is also evaluating the NCDHHS response to COVID-19 outbreaks in meat processing facilities and is providing monthly reports on metrics measuring response time and efficacy. OHSP has also designed messaging and provided consultation to DHHS workgroups strategizing best practices to address COVID-19 outbreaks in communities of historically marginalized populations.

Year 6 Major Accomplishments and Outputs (July 1, 2020- June 30, 2021)

***Aim 1**. Assessment of occupational injuries, illnesses, and vulnerable worker groups through the collection, analysis and reporting of occupational surveillance data.*

Occupational Health Indicators (OHI): Data for 2017 OHIs were corrected, resubmitted, and confirmed in May 2021.

Additional Data Sources:

Occupational Health Disparities: Dr. Dang compiled a Vulnerable Worker Survey Project report with research findings and presented it to project stakeholders and NC DHHS employees.

Adult Blood Lead Epidemiology and Surveillance (ABLES): OHSP helped develop and administer a survey to law enforcement officers on knowledge, attitudes, and beliefs of lead poisoning prevention. The results of this survey informed a poster on preventing lead poisoning in shooting ranges. OHSP submitted annual ABLES data extracts from the NCLEAD surveillance system for data collected 2018 through 2020 to NIOSH ABLES. OHSP continued quarterly lead data submissions to NC OSH for follow-up of companies with workers with EBL at or over 25 µg/dL, until April 2021, when NC DHHS legal team asked OHSP to stop data sharing until the new MOU was finalized. In NCLEAD, data were cleaned, and old cases were worked so that workflows are now mostly empty except for new cases. The ABLES staff worked with the NCLEAD developers to improve the workflows to ensure proper follow-up of adults with elevated blood lead levels and their employers.

Occupational Carbon Monoxide (CO) Poisoning: The OEEB Epidemiology Supervisor created SAS code for OHSP to easy read and compile the raw data files for occupational CO poisoning that NC Poison Control Center sends each week.

Aim 2. *Promotion of occupational health policy and programs through the development of partnerships.*

Advisory Group & Local Partnerships: NC OHSP updated the contract to partner with NC Poison Control to receive a direct feed of pesticide and occupational carbon monoxide poisoning cases. The Occupational Epidemiologist participated in the NC Traffic Records Coordinating Committee Meeting, guest lectured for a class on the methods of evaluating worker health at UNC and held the NC OHSP Advisory Committee meetings to gather feedback on statewide OH priorities for the new grant application.

National Partnerships: The environmental epidemiologist shared data with EPA and NIOSH on pesticide case of paraquat from July 2020 to inform prevention and participated in the APHA national conference and the SENSOR-pesticide program meeting in 2020. The occupational epidemiologist participated in SouthON and the NIOSH State Partners / CSTE Occupational Surveillance Subcommittee meetings. NC OHSP staff presented at the 2021 CSTE Conference on inclusion of industry and occupation into COVID-19 case surveillance as well as prenatal lead poisoning strategies. NC OHSP also participated in the NIOSH COVID-19 I/O Callback Survey project and collected 76 survey responses. (See Publications)

Aim 3. *Assure protection of the workforce through intervention and prevention strategies.*

The collaboration with NC DOL to evaluate their NC-PSH Consultative Services Bureau Business Visitation Services has been delayed to the next cycle. NC DHHS legal team is currently reviewing and revising the MOU with NC DOL, which has halted all activities and data exchanges between the two agencies, until the new agreement is approved.

Adult EBLL Case Investigations and Outreach: OEEB hired a new Occupational Health Nurse (OHN) Consultant in June 2020 to join the OHSP team and manage the ABLES program. OHSP staff helped to orient and train the OHN as well as a new data processor. Between the two new ABLES employees, they have completed follow-up on hundreds of cases in the past year. The data processor has sent mailings to around 700 pregnant women and women of childbearing age with elevated blood lead levels and adults (male and female) with EBL ≥ 10 µg/dL. The OHN has called over 600 workers with elevated blood lead levels and over 50 pregnant women to educate them on lead poisoning prevention. A report on ABLES industries with EBLS >=25ug/dL from 2016-2020 was shared with IH staff to inform their plan for industries needing more follow-up.

Acute pesticide-related poisoning prevention outreach: OSHP created guidance on safe use of disinfectants during COVID-19 after learning of reports of poisonings from disinfectant misuse. The environmental epidemiologist worked with a student intern to draft a summary of findings on childhood pesticide poisonings in NC, which is being written into a manuscript for publication in a peer reviewed journal.

Occupational CO poisoning prevention outreach: Weekly data feeds are examined for events that meet the criteria in the occupational CO poisoning SOP for reporting to NC OSH. Criteria for referral include the patient died, the patient received hyperbaric treatment, ≥ 3 people were hospitalized, the patient(s) were seriously injured, and/or there is indication of an occupational hazard. Three incidents were reported to Public Health Preparedness and Response to gather more information, and one incident was reported to NC OSH for follow-up. CO poisoning prevention press releases were sent out ahead of hurricane season 2020 as well as before the first projected freeze.

COVID-19-Related Workforce Protection Assurance: The OHSP Occupational Epidemiologist provided demographic information for meat processing facility outbreak cases weekly to the response team leaders, assisted with NIOCCS coding of the NC COVID case data, created a spreadsheet for the IH team to use when providing onsite COVID-19 consultations, and contributed to the development of the NIOSH COVID-19 I/O Callback survey development. The Epidemiology Supervisor managed vaccine allocation and coordination for meat processing facilities and occupational health providers (over 3100 employees vaccinated from 11 meat processing facilities). The IH Consultation teams conducted 21 onsite, COVID-19 prevention consultations at worksites across NC. Several OHSP staff drafted guidance for protection of workers during COVID-19 pandemic, including workplace specific guidance documents and trainings for correctional facilities, farms, and meat processing facilities on infection prevention, testing, and vaccination strategies. (See Publications) After adding industry and occupation fields to NCCOVID surveillance system, NC OHSP was granted funds through the NIOSH/ELC I/O Data Coding Project to continue to enhance I/O data collection in NC surveillance systems.

Other Outreach: The IH Consultation teams conducted 8 onsite indoor air quality consultations and 3 opioid exposure prevention training consultations at worksites across NC.

CONCLUSIONS

Over the past 6 years of NIOSH grant funding, the NC OHSP has made enormous strides in monitoring and informing improvements in occupational health in NC. Major successes include making occupational CO poisoning a reportable condition, integrating the adult lead data from the static ACCESS database to the more flexible and robust NCLEAD Maven based surveillance system with Childhood Lead, creating a Prenatal Lead module in NCLEAD to allow for follow-up and investigation of prenatal lead exposures, increasing case based pesticide, carbon monoxide, and adult lead poisoning follow-up, informing interventions to prevent these poisonings, and incorporating occupation and industry into COVID-19 case surveillance. Despite several challenges in the past two years including staff turnover (occupational health nurse and occupational epidemiologist/ PI) and the COVID-19 pandemic, NC OHSP has met several of its

planned deliverables and has shifted priorities to assist with the COVID-19 pandemic, as necessary. NC OHSP has been a major driver of recommendations for prevention of COVID-19 outbreaks in workplaces, both for NC and nationally, and has contributed to national data collection efforts for monitoring of occupational illnesses such as adult lead poisoning and COVID-19 infection and has created a framework and developed partnerships for incorporating I/O data collection into other disease surveillance systems in the future.

REFERENCES (FOR SCIENTIFIC REPORT BACKGROUND)

1. North Carolina Department of Commerce. 2011 North Carolina Economic Index: A summary of North Carolina's Economic Strengths, Challenges, and Opportunities. (2011). Retrieved from: http://www.nccommerce.com/Portals/47/Documents/2011%20Economic%20Index%20(updated).pdf

2. United States Department of Labor, Bureau of Labor Statistics. Geographic Profile of Employment and Unemployment, 2012. (2013). Retrieved from: http://www.bls.gov/opub/gp/pdf/gp12full.pdf

3. North Carolina Office of State Budget and Management. North Carolina County/State Population Projections. Retrieved from: http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic_data/population_estimates/county_projections.shtm

4. Stanbury, M. & Rosenman, K. D. Occupational health disparities: a state public health-based approach. Am. J. Ind. Med. 57, 596–604 (2014).

5. North Carolina Department of Commerce. North Carolina's Top Employers. Retrieved from: http://www.nccommerce.com/lead/data-tools/industry/top-employers

6. United States Government Accountability Office & United States Congress Senate Committee on Health. Workplace Safety and Health: Safety in the Meat and Poultry Industry, While Improving, Could be Further Strengthened: Report to the Ranking Minority Member, Committee on Health, Education, Labor, and Pensions, US Senate. (United States Government Accountability Office, 2005).

7. United States Bureau of Labor Statistics. State Occupational Injuries, Illnesses, and Fatalities: North Carolina. Retrieved from: http://www.bls.gov/iif/oshstate.htm#NC

8. Panikkar, B. et al. Characterizing the low wage immigrant workforce: a comparative analysis of the health disparities among selected occupations in Somerville, Massachusetts. Am. J. Ind. Med. 57, 516–526 (2014).

9. Lipscomb, H. J., Loomis, D., McDonald, M. A., Argue, R. A. & Wing, S. A conceptual model of work and health disparities in the United States. Int. J. Health Serv. Plan. Adm. Eval. 36, 25–50 (2006).

10. United States Department of Agriculture, National Agricultural Statistics Service. 2013 State Agricultural Overview: North Carolina. Retrieved from: http://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH%20CAROLINA

11. United States Department of Agriculture, Census of Agriculture. Census of Agriculture - 2012 Census Volume 1, Chapter 1: State Level Data, North Carolina. Retrieved from: http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/North_Carolina/

12. Centers for Disease Control and Prevention. Heat-Related Deaths among Crop Workers -- United States, 1992--2006. Morb. Mortal. Wkly. Rep. 57, 649–653 (2008).

13. Mirabelli, M. C. & Richardson, D. B. Heat-Related Fatalities in North Carolina. Am. J. Public Health 95, 635–637 (2005).

14. North Carolina Department of Commerce. 2013 Estimate of Migrant and Seasonal Farmworkers During Peak Harvest by County. Retrieved from: http://www.ncfhp.org/Data/Sites/1/documents/esc-farmworker-estimates-2013-with-totals-by-county.pdf

15. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. North Carolina Occupational Health Trends, 2010: Putting Data to Work. Retrieved from: http://epi.publichealth.nc.gov/oee/oii/docs/OccupationalTrends2010.pdf

16. United States Bureau of Labor Statistics. Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data. Retrieved from: http://www.bls.gov/iif/oshcfoi1.htm

17. North Carolina Division of Public Health. Work-Related Fatalities in North Carolina, 2011 and Five-Year Trend (2007-2011). (2014). Retrieved from: http://epi.publichealth.nc.gov/oee/oii/docs/Fatalities.pdf

18. Levy, B. S., Wegman, D. H., Baron, S. L. & Sokas, R. K. Occupational and Environmental Health: Recognizing and Preventing Disease and Injury. (Oxford University Press, 2010).

19. Pegula, S. M. Occupational fatalities: self-employed workers and wage and salary workers. Mon. Lab Rev 127, 30 (2004).

20. NC Division of Public Health, Adult Blood Lead Epidemiology and Surveillance Program. Lead Update: Summary of findings from the ABLES Program for 2011. Retrieved from: http://epi.publichealth.nc.gov/oee/oii/docs/lead_update_2011.pdf

21. Sengupta, I., Baldwin, M. & Reno, V. Workers' Compensation: Benefits, Coverage, and Costs, 2011. Natl. Acad. Soc. Insur. (2013). Retrieved from: http://www.workcompcentral.com/pdf/2013/misc/nasiRptWkrsComp11v3b.pdf

22. Council of State and Territorial Epidemiologist (CSTE). Putting Data to Work: Occupational Health Indicators from Thirteen Pilot States for 2000. (2005). Retrieved from:

http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/OccupationalHealth/CSTEOHIndicators.pdf

23. Dang, G. T., Barros, N., Higgins, S. A., Langley, R. L. & Lipton, D. Descriptive Review of Asbestosis and Silicosis Hospitalization Trends in North Carolina. NC Med J 74, 368–375 (2013).

24. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. Work-Related Amputations in North Carolina, 2010. Retrieved from: http://epi.publichealth.nc.gov/oee/oii/docs/NCOSHA_v4.pdf

25. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. Occupational Health Trends in North Carolina, 2006. Retrieved from: http://epi.publichealth.nc.gov/oee/oii/docs/OccupationalTrends.pdf

26. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. Occupational Health Trends Report, North Carolina, 2003 – 2008. Retrieved from: http://epi.publichealth.nc.gov/oee/oii/docs/OccupationalTrends2003_2008.pdf

27. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. Occupational Health UPDATE: Summary of occupational health trends for North Carolina for 2009. Retrieved from: http://epi.publichealth.nc.gov/oee/oii/docs/OccupationalTrends2009.pdf

28. Castillo, D. N. & Higgins, S. Occupational injury in North Carolina. N. C. Med. J. 71, (2010).

29. Higgins, S., Barros, T. & Garrison, H. G. Injury and death on the farm: improving prevention through improved surveillance. N. C. Med. J. 72, 461–462, 464–465 (2011).

30. University of South Florida, Sunshine Education and Research Center. SouthON - Sunshine Education and Research Center - USF Health - Tampa, Florida. Retrieved from: http://health.usf.edu/publichealth/erc/SouthON.htm

31. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. Occupational Health. Retrieved from: http://epi.publichealth.nc.gov/oee/programs/oii.html

32. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. Carbon Monoxide. Retrieved from: http://epi.publichealth.nc.gov/oee/a_z/co.html

33. Grube, A., Donaldson, D., Kiely, T. & Wu, L. Pesticides Industry Sales and Usage: 2006 and 2007 Market Estimates. U. S. Environ. Prot. Agency (2011). Retrieved from: http://www.epa.gov/opp00001/pestsales/07pestsales/market_estimates2007.pdf

34. Roberts, R. & Reigart, J. Recognition and Management of Pesticide Poisonings. (United States Environmental Protection Agency, 2013). Retrieved from: http://www2.epa.gov/sites/production/files/documents/rmpp_6thed_final_lowresopt.pdf

35. National Institute for Occupational Safety and Health & Centers for Disease Control and Prevention. Pesticide-Related Illness and Injury Surveillance: A How-To Guide for State-Based Programs (2006-102). Retrieved from: http://www.cdc.gov/niosh/docs/2006-102/

36. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health & Council of State and Territorial Epidemiologist (CSTE). Guidelines for Minimum and Comprehensive State-Based Public Health Activities in Occupational Safety and Health (2008-148). Retrieved from: http://www.cdc.gov/niosh/docs/2008-148/

37. National Highway Traffic Safety Administration (NHTSA). Fatality Analysis Reporting System (FARS). Retrieved from: http://www.nhtsa.gov/FARS

38. Builders Mutual Insurance Company. Builders Mutual - Our Company. Retrieved from: https://www.buildersmutual.com/About_Builders_Mutual/

39. North Carolina Division of Health Services Regulation, Office of Emergency Medical Services. Trauma Education, Registry, and Research. Retrieved from: http://www.ncdhhs.gov/dhsr/ems/trauma/traumaregistry.html

40. North Carolina Division of Public Health, Occupational and Environmental Epidemiology Branch. Pesticide UPDATE: Summary of findings from the NC Pesticide Incident Surveillance Program, 2007 - 2009. (2012). Retrieved from: http://epi.publichealth.nc.gov/oee/pest/docs/PesticideUpdate.pdf

41. Aon Hewitt, the National Business Group on Health, and the Futures Company. The Consumer Health Mindset. (2014). Retrieved from: http://www.aon.com/attachments/human-capital-consulting/2014-02-17-consumer-health-mindset-final-report.pdf

42. Centers for Disease Control and Prevention & National Institute for Occupational Safety and Health. Making the Business Case - NIOSH Total Worker Health. Retrieved from: http://www.cdc.gov/niosh/twh/business.html

43. New Hampshire Division of Public Health Services. Occupational Health Surveillance Immigrant Survey Report, February 2013. Retrieved from: http://www.dhhs.nh.gov/dphs/hsdm/ohs/documents/ohsimmigrant2013.pdf

44. Frieden, T. R. A Framework for Public Health Action: The Health Impact Pyramid. Am. J. Public Health 100, 590–595 (2010).

45. North Carolina Department of Labor. Consultative Services Bureau. Retrieved from: http://www.nclabor.com/osha/consult/consult.htm

46. Levine, D. I., Toffel, M. W. & Johnson, M. S. Randomized Government Safety Inspections Reduce Worker Injuries with No Detectable Job Loss. Science, 336, 907–911 (2012).

Publications

Reports, Peer-Reviewed Articles, and Abstracts.

Gaetz, K; Dang, GTT; McClure, E; Christensen, A; Mehta, U; Guidry, V. (2021) Inclusion of Industry and Occupation Questions into COVID-19 Case Data Collection, North Carolina — March–December 2020. 2021 Counsel of State and Territorial Epidemiologists (CSTE) Conference. (Abstract)

Gaetz, K; Napier, M. (2021). Prenatal Lead: Creating Bridges to Prevent Lead Exposure Across the Life Course. 2021 Counsel of State and Territorial Epidemiologists (CSTE) Conference. (Abstract)

Gaetz, K; Christensen, A; Garcia, K; Guidry, V. (2021) North Carolina COVID-19 Workplace Exposure Callback Survey Results.

Christensen A, Jardel H & Chelminski J. (2020) *Acute Pesticide Poisonings in Children Less Than 6 Years Old – North Carolina, 2012–2017.* 2020 CSTE Annual Conference, Council of State and Territorial Epidemiologists, Seattle, WA, 28 June – 2 July. (Abstract)

Jernigan, J and Gaetz, K. "Poster for Preventing Lead Exposure in Shooting Ranges" (2020) NC DPH ABLES.

North Carolina Department of Health & Human Services. Carbon Monoxide. (2020) https://epi.dph.ncdhhs.gov/oee/a_z/co.html

Dang G, Gaetz K, Higgins S, et. al. (2019). Public Health Response to Occupational and Take-Home Lead Exposures Associated with a Lead Oxide Manufacturing Plant — North Carolina, 2016-2018. Council of State and Territorial Epidemiologists Annual Meeting. Raleigh, NC. (Abstract).

Gaetz, K. (2019) Panel on Exploring Integration of Blood Lead Surveillance Systems at the State Level. (Panel Discussion Participant). CSTE Conference, Raleigh, NC.

Higgins SA, Simons J. (2019) The Opioid Epidemic and the Role of the Occupational Health Nurse. Workplace Health and Safety. 2019 Jan;67(1):36-45. doi: 10.1177/2165079918796242. Epub 2018 Oct 10. PMID: 30305006.

Higgins, S. "Preventing Lead Exposure at Indoor Firing Ranges" (2019) NC DPH ABLES.

Dang G. (2018) Occupational Fatalities in North Carolina, 2007–2016. EpiNotes. NC Division of Public Health.

Higgins S and Dang GTT. (2018) North Carolina Adult Blood Lead Epidemiology Surveillance (ABLES) Program: Summary of Findings for 2017.

Higgins S and Rinsky J. (2018) NC Pesticide Illness and Injury Surveillance Program: Surveillance Findings 2012–2016.

Liu R, Alarcon WA, Calvert GM, et al. (2018) Acute Illnesses and Injuries Related to Total Release Foggers — 10 States, 2007–2015. MMWR Morb Mortal Wkly Rep 2018; 67:125–130. DOI: http://dx.doi.org/10.15585/mmwr.mm6704a4.

Rinsky JL, Higgins S, Angelon-Gaetz K, Hogan D, Lauffer P, Davies M, Fleischauer A, Musolin K, Gibbins J, MacFarquhar J, Moore Z. (2018) Occupational and Take-home Lead Exposure Among Lead Oxide Manufacturing Employees, North Carolina, 2016. Public Health Rep. Nov;133(6):700-706. doi: 10.1177/0033354918795442. Epub 2018 Sep 19. PMID: 30231234; PMCID: PMC6225875.

Higgins, S; Rodgers, M; Gaetz K. "Keeping Lead At Work; Prevent Take-Home Lead Exposure". (2018) NCDPH.

Dang GTT. (2017) Using the American Community Survey to Describe Factors Contributing to Occupational Health Disparities Among Hispanic/Latino Workers in North Carolina, 2010-2014. 2017 CSTE Annual Conference, Council of State and Territorial Epidemiologists, Boise, ID, 4-8 June. (Abstract)

Rinsky et al. (2017) Occupational and take-home lead exposure associated with a lead oxide manufacturing plant – North Carolina, 2016. 2017 EIS Conference, Epidemic Intelligence Service, Atlanta, GA, 24-27 April. (Abstract)

Dang GTT. (2016) *Describing Occupational Health Disparities in North Carolina, 2003-2013*. 2016 CSTE Annual Conference, Council of State and Territorial Epidemiologists, Anchorage, AK, 19-23 June. (Abstract)

Dang GTT. (2016) North Carolina Occupational Health Trends, 2000-2013.

Dang GTT. (June 2016) Occupational Health Disparities in North Carolina: A Brief Assessment.

Dang GTT. (June 2016) Assessment of Occupational Health Disparities in North Carolina, 2013, and Eleven-Year Trend (2003-2013).

Brinker, K., Jacobs, T., Shire, J., Bunn, T., Chalmers, J., Dang, G., Flammia, D., Higgins, S., Lackovic, M., Lavender, A. and Lewis, J.S. (2016) Fatal Work-Related Injuries: Southeastern United States, 2008-2011. Workplace health & safety, 64(4), pp.135-140.

Calvert GM, Beckman J, Prado JB, Bojes H, Schwartz A, Mulay P, Leinenkugel K, Higgins S, Lackovic M, Waltz J, Stover D, Moraga-McHaley S. (2016) Acute Occupational Pesticide-Related Illness and Injury -United States, 2007-2011. MMWR Morb Mortal Wkly Rep. 2016 Oct 14;63(55):11-16. doi: 10.15585/mmwr.mm6355a3. PMID: 27736824.

Dang GTT. (2015) *Occupational Heat-Related Illness in North Carolina, 2007-2011*. Occupational & Environmental Epidemiology Facts & Figures, North Carolina Division of Public Health. (Report)

Harduar-Morano L, Bunn TL, Lackovic M, Lavender A, Dang GT, Chalmers JJ, Li Y, Zhang L, Flammia DD. Occupational heat-related illness emergency department visits and inpatient hospitalizations in the southeast region, 2007-2011. Am J Ind Med. 2015 Oct;58(10):1114-25. doi: 10.1002/ajim.22504. Epub 2015 Aug 25. PMID: 26305997.

COVID-19 Guidance Documents and Trainings for Employers/ Employees

North Carolina Department of Health & Human Services. Interim Guidance for Manufacturing and Meat and Poultry Processing Plants (Updated August 20, 2021).

North Carolina Department of Health & Human Services. Interim General Guidance for Businesses and Organizations. (July 30, 2021)

North Carolina Department of Health & Human Services. Essential Recommendations Checklist for Farmers and their Employees. (November 6, 2020)

NC Department of Health and Human Services. COVID-19 Infection Prevention Recommendations for Jail and Detention Center Staff. (August 2020).

NC Department of Health and Human Services. Staffing Guidance for Local Confinement Facility (Jail) Administrators. (August 2020).

North Carolina Department of Health & Human Services. Interim Guidance for the Safe Application of Disinfectants. (July 17, 2020)

Gaetz, K. Coronavirus Disease (COVID-19) Infection Prevention in Jails. (2020) (Recorded webinar training). https://covid19.ncdhhs.gov/guidance#correctional-facilities