Final Progress Report

Expanded Program in Occupational Injury and Illness Surveillance

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Michigan State University

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A. List of Terms and Abbreviations

AIHA - American Industrial Hygiene Association

AJIM – American Journal of Industrial Medicine

ANCA - Anti-neutrophilic cytoplasmic antibodies

BLS - Bureau of Labor Statistics

CAOM - Compensation Advisory Organization of Michigan

CET - MIOSHA Consultation, Education and Training

CFOI - Census of Fatal Occupational Illnesses

COPD – Chronic Obstructive Pulmonary Disease

CPWR - Center for Construction Research and Training

CSTE - Council of State and Territorial Epidemiologists

DPLD - Diffuse Parenchymal Lung Disease

EINs - Employer Identification Numbers

EPA – Environmental Protection Agency

FACE – Fatality Assessment and Control Evaluation

FRA – Federal Railroad Administration

FTE - full time equivalents

HP – Hypersensitivity pneumonitis

ICD-CM - International Classification of Disease, Clinical Modification

I&I Log - Injury and Illness Log

IH - Industrial hygiene

IRR – Incidence investigative reports

LEO – Labor and Economic Opportunity

LEV – Levenshtien algorithm

MAF - Michigan Accident Fund

MAPS - Michigan Automated Prescription System

MDARD – Michigan Department of Agriculture and Rural Development

MDHHS – Michigan Department of Health and Human Services

MAAS - Michigan Asthma and Allergy Society

MiEMSIS -Michigan Emergency Medicine Services Information System

MIFACE - Michigan Fatality Assessment and Control Evaluation

MIOSHA – Michigan Occupational Safety and Health Administration

MiPC – Michigan Poison center

MOEMA - Michigan Occupational and Environmental Medicine Association

MSC – Michigan Safety Council

MSHA – Mine Safety and Health Administration

MSU - Michigan State University

MTS – Michigan Thoracic Society

MWF – Metal working fluids

NIOSH - National Institute for Occupational Safety and Health

NAICS - North American Industry Classification System

NOIRS - National Occupational Injury Research Symposium

NORA – National Occupational Research Agenda

NORS - National Outbreak Reporting System

NPPTL - National Personal Protective Technology Laboratory NPPTL

NTA – National Trucking Association

NTSB – National Transportation Safety Board

OD – Occupational disease

OHI – Occupational health indicator

OEM - Occupational and Environmental Medicine

OLD – Occupational lung disease

OSHA - Occupational Safety and Health Administration

PEL – Permissible exposure limit

PAC – Pesticide Advisory Committee

QCEW - Quarterly Census of Employment and Wages

REL – Recommended exposure limit

SDS - supplementary data system

SENSOR – Sentinel Event Notification System for Occupational Risks

SOII - Survey of Occupational Injury and Illnesses

Spider - SENSOR Pesticide Incident Data Entry and Reporting

TB – Tuberculosis

VA – Veteran's Administration

VMA - Veterinary Medical Association

WC - Workers' Compensation

WDCA - Workers' Disability Compensation Agency

WCRI – Workers' Compensation Research Institute

WR – Work-related

WRA – Work-related asthma

B. Abstract

MSU in conjunction with MIOSHA and MDHHS has been conducting state-based occupational injury and illness surveillance since 1988. The activity generated the occupational indicators, data on elevated blood leads, specific non-fatal injuries (e.g., burns), ten special projects and expanded surveillance programs for: (1) occupational lung disease; (2) acute work-related pesticide injuries and illness; and (3) work-related acute traumatic fatalities. Since initiation of multi-source surveillance, cases of work-related asthma, cases of acute pesticide poisoning, cases of silicosis and other lung diseases, elevated blood lead levels, and both acute fatal and non-fatal traumatic injuries have been confirmed. This case-based surveillance initiated follow-back enforcement MIOSHA inspections in the worksites. These inspections have included interviews

of fellow workers. There has been 100% reporting from the 134 acute care hospitals in the state. A quarterly newsletter (four/year) has been written and mailed out to approximately 3,300-targeted physicians and health care professionals. Two hundred and three annual reports and 51 hazard alerts have been disseminated. Presentations and display booths at medical meetings, the publication of findings in the medical literature, postings on our website (oem.msu.edu), Twitter, and Facebook, the NIOSH Science Blog, the NIOSH Clearinghouse and notices through the Michigan medical licensing board were all performed as part of our dissemination of information. We worked with NIOSH, CSTE, other states, trade organizations and unions. Data were also made available on an interactive website (https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_78428---,00.html#:~:text=The%20Michigan%20Environmental%20Health%20Tracking,on%).The above active outreach encouraged reporting and educated employers, employees and health care professionals about hazards. We evaluated the effectiveness of our effort to improve working conditions. Innovations included expanding our educational outreach and ensuring that we addressed the hazards of vulnerable populations and minorities, as well as temporary workers and youth. New activity included expanding surveillance to include exposure surveillance, additional nonfatal traumatic injuries, projects on under-reporting, evaluation of MIOSHA inspections for following up reported cases and projects on special populations and industrial sectors.

The work conducted addressed all ten NORA industry sectors and two of the cross-sector programs; surveillance and traumatic injury.

We completed all our aims (See section **D.1.b.)**.This project was relevant to public health, and specifically occupational health, because it addressed all three core functions in public health: collection and analysis of data, building partnerships to promote the goal of reducing occupational illness, and assuring efforts to prevent additional work-related injuries and illness. We ensured that the surveillance data were of high quality, that stakeholders and the general public were aware and had access to the data, and that the data is available for intervention and prevention activities.

SECTION 1

C.1. Significant Findings: Three institutions have conducted NIOSH-funded occupational injury and illness surveillance in Michigan: the Occupational Health Surveillance Center at MSU; MIOSHA in LEO; and MDHHS. The project consisted of both population and case-based surveillance and included: production of OHIs; collection, analysis and dissemination of data from occupational disease reports and existing data sources; maintenance and enhancement of mandatory occupational disease reporting; and case-based surveillance and interventions for work-related asthma, silicosis and other occupational lung diseases, work-related acute traumatic fatalities, work-related amputations, work-related burns, work-related crushing injuries, work-related skull fractures and acute work-related pesticide illnesses. Additional conditions under

surveillance included: elevated blood and urine arsenic, cadmium and mercury, carbon monoxide poisoning and elevated carboxyhemoglobin levels and mesothelioma.

Michigan confirmed 486 cases of work-related asthma (WRA) (42 are awaiting confirmation pending interview), 950 deaths from acute traumatic work-related injuries; 41 cases of silicosis (three are awaiting confirmation pending interview); 1291 cases of other occupational lung diseases; 356 cases of acute pesticide illnesses; 2,365 work-related amputations, 9,085 work-related burns, 7,563 work-related crushing injuries, 4,595 work-related acute hospitalizations and 2,709 work-related skull fractures in the last six years.

C.2.Translation of Findings: Our surveillance project was modeled after the original NIOSH, SENSOR model. In that original model, sentinel providers report to a Surveillance Center. This Surveillance Center receives reports, interacts with providers, analyzes the data and directs intervention activities toward the individual cases, co-workers and the work site from which cases are reported. As originally envisioned, this Surveillance Center could be in a state agency or a university. The model developed in Michigan housed the Surveillance Center in an academic institution, Michigan State University. Intervention was carried out by LEO, through its state OSHA enforcement staff, OSHA consultative staff and education staff. Based on our experience in conducting occupational injury and illness surveillance in Michigan, the collaborative arrangement between LEO and MSU has proven to be a highly effective means to conduct such surveillance. It has allowed us to generate both population and case-based data that can be used to target intervention activity. The data generated by our surveillance system expands on what is available from the BLS national employer-based system and fills in many of the gaps in that system. The surveillance data were directly linked to the state agency that has both regulatory responsibilities and a strong consultative program in occupational safety and health. The data generated by the surveillance system has directed hundreds of enforcement investigations and have been used to set strategic goals for the agency. This project has developed a successful occupational injury and illness surveillance program that is both a model for the federal government as well other states. The data/reports we have developed are available on our website, https://oem.msu.edu, at the MDHHS MiTracking website; https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_78428---,00.html#:~:text=The%20Michigan%20Environmental%20Health%20Tracking,on% and the NIOSH Clearinghouse website, https://wwwn.cdc.gov/niosh-statedocs/.

C.3. Outcomes/Impact

C.3.a. Potential Outcomes: Michigan OSHA, using State and Federal OSHA funds, has conducted IH inspections; 819 for WRA, 92 for silicosis and 49 for other work-related lung disease, 308 amputations, 321 for burns, 151 for crushing injuries, 116 for hospitalizations and 69 for skull fractures in the last six years. Another 35 on-site investigations for acute traumatic

fatalities were conducted by MSU. As part of the MIOSHA WRA inspections, MSU has interviewed 376 co-workers of the index cases; 58 of the 376 (15.4%) had daily or weekly chest tightness, shortness of breath, wheezing or new onset asthma in relation to their work.

C.3.b. Intermediate Outcomes: We have highlighted the risk of asthma from exposure to welding fume and metal working fluids, the risk of silicosis from hydraulic fracturing, the link between silicosis and chronic renal disease, the link between silicosis and connective tissue disease, and spirometry results among individuals in the silicosis registry. We have collaborated with other states to highlight the risk of asthma from cleaning agents, isocyanates and at swimming facilities. We have used our data to estimate the percentage of asthma in adults that is work-related, produced national estimates on the incidence of silicosis and have evaluated the changes in the workplace after an OSHA follow back inspection of an index case. In addition, we have integrated WRA into the state's overall asthma strategic plan. We have used our data to complement known deficiencies in the existing national systems based on employer reporting in the BLS Annual Survey.

We compiled the surveillance data each year and issued 48 condition-specific annual reports, 43 hazard alerts and 22 newsletters. NIOSH has repeatedly used Michigan surveillance data and investigations in the NIOSH Chart book, the World Report and NIOSH hazard alerts. We wrote 45 papers and book chapters for the peer-reviewed literature and six abstracts. We have delivered 49 presentations at medical conferences on conditions under surveillance and 105 educational presentations to worker groups.

C.3.c. End Outcomes: There has been a decrease in the number of individuals in Michigan with WRA caused by isocyanates (since 1994), metal-working fluids (since 1992) and all low molecular weight agents combined (since 2000). The MI Surveillance program was instituted in 1988 and has spent considerable effort in enforcement and educational outreach to companies, physicians and employees in addressing work-related asthma caused by these substances. This has been described as a success story on the CSTE web site: http://c.ymcdn.com/sites/cste.site-ym.com/resource/resmgr/Occupational_Health_Success_Stories/OHSuccessStoryMichigan1final.pdf

Since 2001, the number of work-related fatalities has decreased from a high of 174 in 2001 to 163 work-related fatalities in 2019, a reduction of 6%. These decreases may be partially attributable to MIFACE educational prevention outreach efforts.

The number of cases of silicosis in Michigan has been decreasing since 1991. The MI Surveillance program began in 1988 and has spent considerable effort in outreach to companies, physicians and employees in addressing silicosis, through both enforcement investigations as well as through educational media.

Section 2

D.1. Scientific Report

D.1.a. Background

There were four components to the project, each project had its own background.

D.1.a.1. Overall: The March 2020 Current Employment Estimate for Michigan (prior to COVID-19) was 4.694 million nonfarm employees (https://www.bls.gov/regions/midwest/michigan.htm). The United States Department of Agriculture (USDA) Census of Agriculture estimates 80,000 farm operators and 77,000 hired farm workers, including migrant/seasonal farm workers in Michigan (Michiganhttps://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/Michigan/miv1.pdf). Like the rest of the United States, there has been a shift to a service economy. However, unlike many other states, manufacturing, particularly vehicular manufacturing, remains a major component of the Michigan workforce (618,600, 13.2% of total workforce).

In 2018, the BLS employer SOII estimated there were 104,800 work-related injuries and illnesses in Michigan (https://www.bls.gov/iif/oshstate.htm#MI). We have published multiple studies showing that the BLS data only represents an approximately 30-50% percentage of the true number of injured workers (Rosenman et al, 2006; Kica and Rosenman 2012; Largo and Rosenman, 2013; Kica and Rosenman, 2014; Largo and Rosenman, 2015; Kica and Rosenman, 2018). In 2018, the BLS CFOI reported 155 acute traumatic fatalities in Michigan, which matches the number we have identified in our FACE program. These work-related injuries and illnesses result in substantial human and economic costs for workers, employers, and society at large. In 2019, workers' compensation costs for direct wage replacement and medical care costs in Michigan were $450 million (https://www.michigan.gov/documents/leo/wdca_2019_Annual_Report_685356_7.pdf). We have published multiple studies that show that less than half of workers with a work-related injury file a workers' compensation claim (Biddle et al, 1998; Rosenman et al 2000; Rosenman et al; 2013).

Work-related injuries and illnesses can be prevented. Successful approaches to making workplaces safer and healthier begin with having the data necessary to understand the problem. Data are needed to determine the magnitude of work-related injuries and illnesses, identify workers at greatest risk, and establish prevention priorities. Strategies for collection, analysis and dissemination of these data include case reporting based on public health reporting mandates, sampling surveys, employer reporting compiled by the BLS, and retrospective analysis of administrative data. Each of these strategies alone has limitations because of limitations in the source data, lack of reliable trend data or comparison data, inability to use for case-based interventions, all of which hinder their usefulness for prevention and evaluation of prevention effectiveness. Multi-source surveillance systems help address these limitations. (See Azaroff et al., 2002; Rosenman et al., 2006; Kica and Rosenman 2012; Largo and Rosenman, 2013; Kica and Rosenman, 2014; Largo and Rosenman, 2015; Kica and Rosenman, 2018 for further discussion of these issues.)

One suggested approach for measuring the burden of disease/injury has been the calculation of "health indicators". A health indicator is a numerical value or statistic that helps measure the state of health in a community or group. Indicators can describe the health of a population (such as life expectancy, mortality, disease incidence or prevalence); determinants of health (such as

health behaviors, health risk factors, physical environments, and socioeconomic environments); and health care access, cost, quality, and use. Depending on the measure, a health indicator may be defined for a specific population, place, political jurisdiction, or geographic area. Health indicators rely on standardized definitions; thus, they can be used to track trends over time to indicate whether a parameter of health is getting better or worse and where to invest prevention resources. Selected health indicators in one state may be compared with those of other states, the whole U.S., or other countries. Therefore, even though OHIs likely underestimate the true magnitude of a problem, they do provide enough detail to identify some risk factors and are standardized across time and jurisdictions. Their simplicity and clarity provide added value because they can be calculated using fewer financial resources and can therefore be calculated across a larger number of jurisdictions.

In 2001, a workgroup of the CSTE undertook the development of a set of OHIs, modeled on indicator initiatives in injury and chronic disease control. This process resulted in the publication of a report in 2003 titled *Occupational Health Indicators*: *A Guide for Tracking Occupational Health Conditions and Their Determinants,* which has been periodically updated, most recently in April 2019 (https:/cdn.ymaws.com/www.cste.org/resource/resmgr/publications/OHI_Guidance_Manual_FINAL-2.pdf). In 2001, the CSTE workgroup selected 19 OHIs because of their importance to public health, the availability of obtainable statewide data in at least 50% of states, and the potential for intervention activities at the state level (Thomsen et al., 2007). The document provided a step-by-step process for generating individual state indicator data. Initially, 13 states (including Michigan) applied the step-by-step process to generate one year of data (2000) for each indicator and CSTE published the results in a report – *Putting Data to Work: Occupational Health Indicators from Thirteen Pilot States for 2000 (CSTE 2005).* Since then, CSTE has been collecting indicator data annually from collaborating states and compiling them on the CSTE website (https://www.cste.org/members/group.aspx?id=106668), as well as updating the guidance document. The most recent guidance document includes 25 OHIs and indicates the 10 that should not be used for state to state or state to national comparisons. It should be noted that the OHI approach became the model for development of the Nationally Consistent Data Measures now displayed on the CDC and State Environmental Public Health Tracking Network web portals.

Because of their accessibility, simplicity and uniformity, the OHIs have been adopted by NIOSH and promoted at the state level as a requirement for NIOSH-funded state-based occupational health surveillance. Through the process of obtaining data for each OHI and performing the required calculations, states have been able to easily generate baseline metrics for occupational health in their state that are comparable, in some cases, to OHIs in other states and nationally. Engagement in the process has also supported development of requisite infrastructure to support other occupational health surveillance strategies.

The concepts and implementation strategies that have evolved from these state-federal collaborations described above are the foundation of the ongoing collection of OHIs that will be performed in Michigan. Michigan is particularly well-positioned to maintain and enhance its OHI project because of its leadership in the CSTE OHI project, and its well-developed occupational health infrastructure and occupational health surveillance system.

The second approach to address surveillance limitations noted above is case-based surveillance of sentinel health events. This occupational health surveillance strategy, first proposed for occupational conditions in the late 1980's (Baker, 1989), is based on public health

statutory authority to require reporting of health conditions of public health concern and to authorize public health agencies to conduct follow-up investigations to identify and remediate conditions posing the same health threat to others. In Michigan, since the beginning of the NIOSH-funded SENSOR program in 1988, case-based systems have been developed for work-related amputations, work-related asthma, silicosis, other occupational lung diseases, work-related burns, carbon monoxide poisoning, work-related crushing injuries, farm-related injuries, fatal work-related injuries, hospitalizations where workers' compensation is the payer, pesticide illness/injury, work-related skull fractures, and elevated blood lead, blood and urine arsenic, blood and urine cadmium, and blood and urine mercury. Identification of the reported individuals and determining where the injury or illness occurred can identify specific locations for interventions to correct hazards. Accessing multiple data sources to identify work-related cases, with identifiers, results in more complete case ascertainment than one data source alone which then results in more comprehensive intervention strategies. Compilation of the case-based reports can identify industry- or exposure-wide issues that can lead to educational or policy interventions. Case-based surveillance of selected conditions can complement and provide greater understanding of conditions being tracked through the OHI approach, and they may suggest OHIs that should be added to the CSTE/NIOSH OHI list. Three of the specific conditions we have had under multi-source, case-based surveillance complement three OHIs – amputations, burns and elevated blood lead – and two may support the development of new OHIs – crushing injuries and skull fractures.

D.1.a.2. Occupational Lung Disease*:* The BLS employer SOII, markedly undercounts acute and chronic lung conditions such as WRA and silicosis (NAS, 2018). To estimate the burden of OLD, it is necessary to use administrative data bases, research studies and population-based surveys. In Michigan, OLD is consistently among the top five occupational diseases reported (Reilly et al., 2020); its prevention therefore remains a state priority. OLD is preventable, costly and often irreversible, with long-term direct and indirect social, economic and health effects (Ayres et al., 2011; Dodd and Mazurek, 2018; Furuya et al., 2018; Groenewold et al., 2019; LaSee and Reeb-Whitaker, 2020; Lau and Tarlo, 2019; Trivedi et al., 2014; Wong et al., 2017). The recommended primary approach to OLD surveillance is through state based programs (NAS, 2018). The OLDs have marked health disparities (Rosenman, 2016). There is ongoing interest in the recognition and management of OLD, such as WRA (Lau and Tarlo, 2019); pneumoconioses (Hoy et al., 2018) and where work exposures contribute to an important percentage of cases, such as COPD and hypersensitivity pneumonitis (HP) (Blanc et al., 2019) and bronchiolitis obliterans (Kreiss, 2013). Emerging OLD and exposures, as seen with COVID-19, emphasize the importance of comprehensive and responsive surveillance systems to recognize these new conditions/exposures and minimize morbidity and mortality.

D.1.a.2.a. Pneumoconioses: Because the pneumoconioses have specific ICD codes, administrative medical datasets such as Medicare have been used to estimate there are 3,260-7,105 cases of silicosis per year in the United States (Casey and Mazurek, 2019). We have used death certificates, hospital reporting and capture-recapture analysis to estimate there are 3,600 to 7,300 newly diagnosed cases of silicosis each year in the United States from 1987–1996 (Rosenman et al., 2003), and 5,586–11,674 cases from 1997–2003 (https://oem.msu.edu/images/annual_reports/2019-S-and-OLDS-Annual-Report-FINAL.pdf).

We recently reported on the burden of silicosis in Michigan compiling 29 years of surveillance data (Reilly et. al., 2018). Michigan data documents an average annual incidence rate of silicosis among Blacks that is 5.2 times greater than whites and an incidence of tuberculosis (TB) among silicosis cases that was a thousand-fold greater than the general population (Reilly et. al., 2018). Michigan was historically one of the centers of the United States foundry industry; it continues to have 127 active foundries, 139 abrasive blasters, and 1,066 counter-top distributors/installers.

Two of the three Occupational Health Indicators where Michigan rates have increased over time are the age-adjusted mortality rate for all the pneumoconioses and for asbestosis. Annually, we receive approximately 650 reports of asbestos-related non-malignant radiograph parenchymal and pleural fibrosis and 100 cases of mesothelioma. MI had two major shipyards, now closed; however, the major exposures to asbestos in Michigan have been in manufacturing and construction.

D.1.a.2.b. Work-related Asthma: Because of a lack of a specific ICD code for WRA, administrative data bases such as Medicare or hospital discharge data cannot be used to count cases. However, estimates of burden for WRA can be derived from research studies (Balmes et al., 2003; Henneberger et al., 2011; Blanc et al., 2019) and population-based surveys (Lutzker et al, 2010). An estimated 16% (95% C.I.10–22%) of adults with asthma have new onset WRA (Balmes et al., 2003; Blanc et al 2019) and 21.5% have work aggravated asthma (Henneberger et al., 2011). Applying these percentages to the ~953,465 Michigan adults with asthma (michigan.gov/documents/mdhhs/2015-2017_MiBRFSS_Expanded_Race_Tables_667115_7.pdf), the estimated prevalence in Michigan of new-onset WRA is 152,554 (95% C.I. 95,347-209,762) and work aggravated asthma is an additional 204,995. Using capture-recapture, we previously estimated there were 228-801 new cases of WRA each year in Michigan (Henneberger et al., 1999). We recently reported on the burden of WRA in Michigan, compiling 31 years of surveillance data (Reilly et al., 2020).

Over 300 substances are documented to cause WRA (Rosenman and Beckett, 2015). Other substances can aggravate pre-existing asthma, causing increased symptoms, medication use and health care visits. OSHA PELs for most of these substances are not protective to prevent new-onset asthma or triggering of symptoms for individuals with pre-existing asthma. In Michigan, of 819 WRA workplace inspections conducted since 1988, only 11 specific asthma-causing agents during 30 inspections were above the PEL (Reilly et al., 2020).

The March 2020 Current Employment Estimate for Michigan prior to COVID-19, was 4.694 million non-farm employees (https://www.bls.gov/regions/midwest/michigan.htm). Although Michigan continues to have a large Manufacturing work force (625,769 (13.2%)), like the rest of the United States, there has been a shift to a service economy. In Michigan 44.3% of the workforce is in the Service Sector; 804,700 (17.1%) in Trade Transportation, Utilities; 676,000 (14.4%) in Education and Health Services; 435,000 (9.3%) in Leisure and Hospitality; and 164,000 (3.5%) in Other Services. Cleaning agents are widely used in the Service sector. Over the past 30 years, the percentage of WRA cases associated with exposure to cleaning agents has increased from 5% to 20% (Reilly et al., 2020).

D.1.a.2.c. Chronic Obstructive Pulmonary Disease: Like WRA, because of a lack of specific ICD codes for work-related COPD, administrative data bases such as Medicare or hospital discharge data cannot be used to count cases. However, estimates of burden for COPD can be derived from research studies (Balmes et al., 2003; Blanc et al., 2019) and population-

based surveys (Lutzker et al, 2010). To estimate the prevalence of work-related COPD, we applied the estimate that 14% (95% CI=10–18) of COPD is attributable to work (Balmes et al.; Blanc et al., 2019, and Groenewold et al., 2018) to the 670,957 adults with COPD in Michigan (michigan.gov/documents/mdhhs/2015-2017_MiBRFSS_Expanded_Race_Tables_667115_7.pdf). The estimated prevalence of work-related COPD in Michigan is 93,933 (95% CI 67,096-120,722). In 2018, there were 5,868 deaths in Michigan from COPD. We applied the 14% (95% CI=10–18) attributable fraction estimate to the total number of deaths from COPD. In 2018, the estimated annual number of work-related COPD deaths in Michigan was 796 (95% CI 569-1,023).

D.1.a.2.d. Hypersensitivity Pneumonitis : In addition to the potential for the occurrence of farmers' lung among the approximately 160,000 farm owners and hired hands in the Michigan agricultural industry (USDA, 2017), Michigan's substantial manufacturing base, particularly in vehicle manufacturing, has a large number of workers machining metals with MWF, who are at risk of developing HP. HP from exposure to MWF was first described in Michigan (Bernstein et al., 1995), and data from our surveillance system has contributed to our knowledge of this condition (Rosenman, 2009; Gupta and Rosenman, 2006). Each year approximately 200 individuals are discharged from Michigan hospitals with HP. Based on review of their medical records, 4-10% are known to be related to work exposures; the exposure causing HP was unknown for 57% of all the hospitalized cases.

D.1.a.2.e. COVID-19: COVID-19 is an example of how an OLD surveillance system can be integrated into general public health. COVID-19 has a predominantly respiratory component in those who become severely ill. Outbreaks attributed to workplace exposures have been reported throughout the United States across multiple industry sectors (Waltenburg et al., 2020; Bui et al., 2020). In Michigan, 30% of all COVID-19 deaths are among those in working ages. We analyzed 1,822 death certificates from the first COVID-19 death in Michigan on 3/10/20 through 6/23/20 among those aged 18-70. The highest number of COVID-19 deaths were among those working in manufacturing with 344 (22.7%), health care with 231 (17.6%) and retail trade with 126 (8.3%). Using 2018 Census American Community Survey (ACS) employment data (https://data.census.gov/mdat/#/search?ds=ACSPUMS1Y2018), industries with the highest COVID-19 mortality rates per 100,000 were military (11.8), other services (9.8) and transportation (4.3). Occupations with the highest COVID-19 mortality rates per 100,000 were transportation (10.0), protective services (5.4) and maintenance (3.8). Working-age Blacks had an overall nine fold greater rate of death than whites, with even higher ratios (20-80 fold) in selected occupations/industries (available at: oem.msu.edu, Fall 2020 PS News). Dr. Rosenman presented this data to the Governor's COVID task force in September 2020. Our analysis of calls to the Michigan Poison Center during the start of the pandemic found increased calls regarding disinfectants compared to the same time period a year prior (Rosenman et al., 2020).

D.1.a.3. Pesticides: Because of the benefits pesticides provide to protect the food supply and control disease vectors, they are widely used. It is recognized that pesticides can have adverse effects on human health. Individuals who are occupationally exposed potentially have higher exposure to pesticides because of frequent handling and concentration during application. There are 882 active ingredients in 15,171 different pesticide products registered for sale and use in Michigan

(https://www.michigan.gov/documents/mdard/2019_MDARD_Annual_Report_PPPM_683695_7.pdf). Pesticide use is regulated by the EPA; in some states, including Michigan, the EPA delegates its authority to enforce regulations to a state agency. In Michigan this agency is the Michigan Department of Agriculture and Rural Development (MDARD).

Agriculture is a major industry in Michigan with 52,194 farms, 80,000 farm operators and 77,000 hired workers. Hired workers include full time and migrant workers. (Michiganhttps://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/Michigan/miv1.pdf). Most individuals who work on farms in Michigan are not covered by the Michigan Occupational Safety and Health Administration (MIOSHA) due to their employment status (self-employed or family members) or if they are covered do not receive routine inspections because they work on farms with fewer than 11 employees. MDARD has lead responsibility in the state for oversight of pesticides, including pesticide registration, investigations into misuse, and training and enforcement of the Federal Worker Protection Standard, which regulates workplace standards for agricultural workers. An enforcement database documents all enforcement activities, including those in which human exposure and health impact data are collected. MDARD inspections in response to complaints about pesticide exposure are focused on issues of misuse based on the permissible uses listed on the label, record keeping, and possible violations of the Worker Protection Standard. Note that prior to the establishment of Michigan's pesticide surveillance system in 2001, there was no analysis of the MDARD data and potentially exposed individuals were referred to their medical care provider with no additional follow up.

There are 6,700 privately certified agricultural pesticide applicators (number overlaps with farm operators/workers above) and another 16,100 commercially certified applicators in Michigan.

The March 2020 Current Employment Estimate for Michigan prior to COVID-19 was 4.694 million nonfarm employees (https://www.bls.gov/regions/midwest/michigan.htm). Like the rest of the United States, there has been a shift in Michigan to a service economy. In Michigan 44.3% of the workforce is in the service sector; 804,700 (17.1%) in Trade Transportation, Utilities; 676,000 (14.4%) in Education and Health Services; 435,000 (9.3%) in Leisure and Hospitality; and 164,000 (3.5%) in Other Services. Cleaners/janitors and housekeepers across all industries, food preparation and food service workers, and health care workers are potentially exposed to disinfectants which are an EPA-regulated category of pesticides (Rosenman et al, 2020a). The recommended protocol for increased disinfection because of COVID-19 has increased the use of disinfectants, and the number of calls to the Michigan Poison Center about disinfectants has doubled from 2019 to 2020 (Rosenman et al., 2020b). Finally, workers in any occupation have the potential to be exposed to pesticides through either direct use or from bystander exposure, when pesticides including disinfectants are applied.

D.1.a.4. Traumatic Fatalities: WR fatal injuries continue to be a serious issue in Michigan and throughout the United States. The Michigan FACE surveillance system has confirmed 2,722 deaths from work-related injuries from 2001 through 2019; 773 in the years in the current funding cycle (2015-2019) (data from 2020 are still being processed). Michigan averages 143 work-related fatalities per year. Nationally, the BLS-funded CFOI recorded 25,756 work-related fatalities from 2015-2019 (data from 2020 are still being processed). These deaths represent not just the tragic loss of worker lives but also a large economic burden on our country; a 2017 NIOSH analysis estimated that the economic cost of fatal occupational injuries from 2003-2010

exceeded $44 billion (NIOSH, 2017). There has been no clear downward trend in deaths either nationally or in Michigan, suggesting WR fatalities will be an ongoing and relevant problem in the future.

Surveillance findings underscore the limitations of relying on OSHA to investigate these WR deaths. Work-related fatal injuries often occur either in industries or circumstances outside of OSHA's jurisdiction, such as self-employed workers, or are due to causes not addressed by OSHA (e.g., homicides and on-the-road motor vehicle deaths). Following guidelines from the Federal OSHA program, only 704 (25.9%) of the 2,722 MI WR fatal injuries were considered "program-related" by MIOSHA program from 2001 through 2019; the remaining 2,018 deaths were not considered program-related and therefore were not inspected. The CFOI program offers a more comprehensive count of fatalities but does not offer in-depth information regarding the circumstances of fatal incidents that would be of use in generating preventative strategies for reducing fatalities in the future.

These fatal injuries are preventable. A successful program to prevent these deaths must combine a comprehensive collation of data on all WR fatalities, an in-depth assessment of the specific factors causing these deaths, and an effective dissemination of the information to parties who can effect health and safety changes in similar types of workplaces. The results of a comprehensive surveillance system and on-site investigation are needed not only to target educational intervention but also to identify needed regulatory and control technology changes. To meet the need for a fatality surveillance system with these features, NIOSH began the FACE program in 1983. NIOSH, in conjunction with the states, has developed a methodology for conducting investigations into fatal incidents and minimizing duplication with OSHA fatality investigations. This cooperation and collaboration between NIOSH and state-based programs has generated information about specific types of fatal injuries more quickly (due to a greater number of fatalities being investigated) and of a higher quality (due to the sharing of experience and expertise in investigating and recommending interventions) than if each program acted unilaterally. FACE investigations have provided aggregate data to identify high-risk industries and work practices as well as provided the stories or "faces" necessary to make the statistics real and influence change in the workplace. They have also served as an important vehicle for providing technical assistance to employers.

Since the purpose of the surveillance system and identification of the underlying causes of work-related fatal injuries is the prevention of additional fatalities, an emphasis on the identification of specific strategies to effect changes in controls and/or work practices and dissemination and translation of this information into user-friendly materials is an essential function of the program. As FACE is a research program and not an enforcement program, its purpose is not to assess compliance with occupational safety and health standards but rather to understand the underlying cause(s) for the fatality. However, strategies to reduce hazards include developing suggested legislation, regulations, contract language or policy as well as education/training and engineering design, and FACE data are valuable for prioritizing these strategies as well.

D.1.b. Specific Aims/Methods/Results/Discussion/Conclusion

There were four components to the project, each project had its own specific aims

D.1.b.1. Accomplishments of the Basic component of the Michigan occupational health surveillance program:

Specific Goal #1: Compile and Disseminate Data on Magnitude and Trends in Occupational Illnesses and Injuries in Michigan using Occupational Health Indicators.

Specific Goal #2: Conduct Multisource, Case-based Surveillance for Selected Work-Related Injuries.

Specific Goal #3: Conduct Laboratory Based Surveillance for Elevated Blood Lead.

Specific Goal #4: Support the NIOSH Vision of a Comprehensive Nationwide Occupational Health Surveillance System.

D.1.b.1.a. Occupational Health Indicators: Michigan OHI data for all CSTE OHIs have been submitted annually to CSTE, according to the established schedule. The first year of data was summarized initially in a print document (CSTE, 2005) and then subsequent years of data were made available on-line at the CSTE OHI website. Michigan data are available on the CSTE site from 2000 through 2016 (CSTE, undated). Submission of the 2017 OHI data for Michigan was completed as requested in November 2020.

An update of a report detailing Michigan data on Employment Demographics and the first 13 OHIs is currently in development. The original report was published in 2006 and was previously updated in 2013 (Largo et al., 2013). The new version will include data from 2010-2016 for OHIs #1 - #13 and include an analysis of trend for each OHI with at least three years of available data. We will point out for the OHIs based on ICD-CM codes how the change in coding from the 9th to the 10th ICD code that took place on 10/1/2015 may have affected the trend. Preliminary findings include the following:

- Among the thirteen OHI indicator categories, Michigan demonstrated a downward trend in 86.5% of rate indicators. The rates that increased from 2010-2016 were the total pneumoconioses crude mortality rate, the asbestosis crude and age-adjusted mortality rate, the prevalence rate of blood lead levels ≥ 5 µg/dL, and the incidence rate of blood lead levels ≥5 µg/dL. None of the three trends were statistically increased.
- The rate of total work-related injuries and illness per 100,000 FTEs in Michigan decreased by an average of 146.4 events/100,000 each year. Comparatively, the national rate of total work-related injuries and illness per 100,000 FTE's decreased by an average of only 100/100,000 events each year.
- The national work-related fatality rate per 100,000 FTEs age 16 years or older decreased from 2010 to 2015 before increasing in 2016. The Michigan work-related fatality rate per 100,000 FTEs ≥16 years decreased from 2010 until experiencing an uptick in 2014. Although the overall trend of the work-related fatality rate for the period of 2010-2016 decreased, the rate in Michigan was consistently higher than the national rate in all years, except for 2015.
- Deaths from or with asbestosis accounted for between 80% and 89% percent of deaths from pneumoconiosis from 2010 - 2016.

We have provided leadership in the multi-state CSTE/NIOSH OHI workgroup since its inception. This has included participation in numerous conference calls, email exchanges, and discussions at the annual CSTE meeting. Specific outputs have included:

- **Quality Assurance:** From 2007 to 2010, Michigan and Massachusetts staff conducted quality assurance (QA) reviews of all states' data submissions to CSTE and worked with CSTE and state

staff to address errors and inconsistencies, before the data were posted on the CSTE website. In 2011, this function was transferred to NIOSH.

- **Updating the OHI "How-To Guide":** Annually, Michigan staff have updated the guide with instructions for "Employment Demographics and Indicators #10 and #12".
- **Trend analysis:** Michigan staff participated in an OHI subgroup to develop guidance on how to do temporal analyses of OHIs and assisted in writing a draft of the new "Occupational Health Indicator Trend Analysis Guidance."
- **New Indicators:** Michigan pilot tested the lower back injury indicator and work-related asthma indicator during their development, OHI #20 and OHI# 21, respectively.
- **Presentations:** Michigan has made presentations at the CSTE Annual Conferences regarding OHIs: 2006 (Anaheim) – results of MI multi-year OHI data; 2007 (Atlantic City) – challenges associated with in-depth analyses of OHI data; 2009 (Buffalo) – utilizing multi-year OHI data.
- **Publications:** Dr. Rosenman was a co-author on two OHI publications. (Thomsen et al., 2007; Simms et al., 2013).

D.1.b.1.b. Adult blood lead: Since 1997, Michigan has been conducting case-based surveillance for elevated blood lead. All blood lead tests in individuals ≥ 16 years of age are required to be reported by laboratories and are reviewed and de-duplicated to determine the number of individuals. Source of exposure to lead in each individual was determined via review of the laboratory report, interview of the individual, or contact with the health care provider who ordered the blood lead test. From 1998 through 2020, 306,792 adults had blood lead tests, including 13,222 with blood lead levels (BLL) ≥10-24 µg/dL and 3,109 with BLL ≥25 µg/dL. From 1998 through 2020 there were an average of 693 individuals per year with BLL ≥10 µg/dL. In 2020, there were 602 reports on 355 individuals with BLL ≥10 µg/dL.

There were 229 MIOSHA inspections with 1,185 violations and $458,888 in monetary penalties that resulted from identification of worksites of individuals with BLL ≥25 µg/dL. In the current project period (7/1/14- 6/30/21), MIOSHA inspected 20 worksites of individuals with blood leads ≥ 25 µg/dl. MIOSHA cited 16 of the 20 workplaces and issued 115 violations of MIOSHA standards with 68.7% being lead-related violations and $116,900 in monetary penalties with 95.8% being lead-related fines.

Reports summarizing the lead data and MIOSHA inspections have been published and disseminated in annual reports for 1998 through 2019 (https://oem.msu.edu/index.php/annual-reports) and annual data summary fact sheets (https://oem.msu.edu/images/Data_Fact_Sheets/2020/SummaryTrackingABLES_7_14_2021.pdf) and three brochures (Working Safely with Lead, Lead Hazards from Hobby Casting and Reloading, Lead Safety with Firearms: Lead Hazards at Indoor Firing Ranges). Two peer reviewed publications were published (Rosenman et al, 2001; Rosenman et al 2003). A joint MSU - MDHHS report with results of expanded surveillance of lead in adults living in Flint related to the Flint Water Crisis in late 2015 was posted on our website (Rosenman and Stanbury, 2020). Data have been submitted annually to the NIOSH ABLES program as part of multi-state publications in MMWR. Adult lead data from 1997 through 2018 has been posted on the interactive MiTracking website (https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_78428---,00.html). In 2018, MIOSHA updated Michigan's lead standards for industry and construction to lower the blood lead level for removal, becoming the first and at this time only state to require medical removal from the workplace at a BLL of 30 µg/dL (https://www.michigan.gov/leo/0,5863,7-336-94422_11407_30453_30456-485429--,00.html).

Dr. Rosenman was on the MIOSHA standards advisory committee to lower the allowable BLL. Joanna Kica, MSU's lead surveillance coordinator, is an appointed member of the Governor's Michigan Child Lead Exposure Elimination Commission (CLEEC), which provided important support for this policy change.

D.1.b.1.c. Case based surveillance for arsenic, cadmium and mercury: Since 2006, Michigan has been conducting case-based surveillance for elevated blood or urine levels of arsenic, cadmium and mercury. Source of exposure to the metal was determined via review of the laboratory report, interview of the individual or contact with the health care provider who ordered the laboratory test. From 2006 to 6/30/2021, 377 individuals with elevated arsenic, 243 individuals with elevated cadmium and 379 individuals with elevated mercury have been identified. The source of exposure was occupational in 12.9% of the individuals. MIOSHA inspected six worksites. MIOSHA issued nine violations of MIOSHA standards with $8,025 in monetary penalties. Reports summarizing the surveillance data on the three metals and MIOSHA inspections have been published and disseminated in annual reports for 2006 through 2020 (https://oem.msu.edu/index.php/annual-reports), and an annual data fact sheet (https://oem.msu.edu/images/Data_Fact_Sheets/2021/SummaryTrackingHeavyMetals_7_7_2021.pdf).

D.1.b.1.d. Case based surveillance for work-related amputations, burns, crushing injuries, hospitalized injuries, and skull fractures: Michigan promulgated reporting regulations that allow case-based surveillance for <u>all</u> workplace injuries. As a result, thousands of individuals have been reported under condition-specific protocols for case identification, and over 1,400 enforcement inspections have been conducted by MIOSHA to investigate the workplaces where these injuries occurred. In addition to providing information necessary for worksite interventions, Michigan's case-based systems have demonstrated the significant undercounts of selected conditions when relying on either workers' compensation data or the BLS employer based survey (Kica and Rosenman, 2012; Kica and Rosenman, 2014; Largo and Rosenman, 2014 Largo and Rosenman, 2015; Kica and Rosenman, 2018).

D.1.b.1.e. Amputations: Since 2006, Michigan has been conducting case-based work-related amputations surveillance using hospital medical records and workers' compensation claim data. Quarterly, inpatient and emergency department medical records were provided by Michigan's 134 acute care hospitals, including four VA hospitals. Annually, the Michigan WDCA provided access to all paid wage replacement workers' compensation claims for the previous year. The two data bases were matched, and a combined de-duplicated count of amputations was determined. Michigan's multisource system identified 2,557 work-related amputations in adults (age 16 and older) from 2006-2009, 2,453 cases in the previous project period (7/1/2010 - 6/30/2014) and 2,365 in the current project period (7/1/14- 6/30/20). In comparison, BLS reported 2,030 amputations from 2009 through 2018; only 38.2% of the 4,996 amputations identified in Michigan's multi source system from 2009 to 2018. Three hundred and eight worksites have been inspected by MIOSHA leading to 1,941 violations of MIOSHA standards and $1,065,235 in monetary penalties**,** with 89 inspections occurring in the current project period from 7/1/2014 - 6/30/2020 ($436,940 in monetary penalties and 166 violations). Eighty-nine percent of the companies inspected as a result of our referral system received citations. Most (85.7%) of these citations were for the absence of guards on machines or other safety issues directly related to the injury. Excluding the years 2013-2016, when

the date was missing on when the hazard abatement occurred, 69.1% of these safety hazards were not corrected between the time of the injury and the time of the inspection. Reports summarizing the amputation data and MIOSHA inspections have been published and disseminated in annual reports for 2006 through 2017 (https://oem.msu.edu/index.php/annual-reports), an annual data fact sheet (https://oem.msu.edu/images/Data_Fact_Sheets/2019/Amputations_Fact_Sheet_2020.pdf), and three hazard alerts (Work-Related Amputations and Deaths Due To Power Presses in Michigan, Work-Related Amputations Due to Power Saws, Work-Related Amputations in the Food Service Industry) and one NIOSH blog (Rosenman, 2013). Three peer-reviewed papers have been published (Stanbury, Reilly, Rosenman, 2003; Largo and Rosenman, 2013; Largo and Rosenman, 2015).

NIOSH contracted for the RAND Corporation to conduct an evaluation of the Michigan amputation surveillance system. Key findings of the RAND report included: "Inspections from the surveillance program found 2.60 times as many violations as other inspections and assessed approximately 2.45 times the amount of a typical inspection in monetary penalties. The Michigan program substantially influenced other state programs such as the one in Massachusetts. The program also provided better information on the extent of amputations in Michigan and in which industries and firms amputations had occurred that were not reported in other sources…our preliminary analysis suggests that these NIOSH-supported surveillance programs are likely have positive benefits to society" (Miller et al. 2020).

D.1.b.1.f. Burns: Since 2009, Michigan has been conducting case-based work-related burns surveillance. Quarterly, inpatient and emergency department medical records are provided by Michigan's 134 acute care hospitals, including four VA hospitals. Annually, the Michigan WDCA provided access to all paid wage replacement workers' compensation claims for the previous year. Quarterly, the Michigan Poison Center provided reports with personal identifiers of work-related chemical burns. The MIFACE program provided death certificates of individuals who died from work-related burns. The four data sets were matched, and a combined de-duplicated count of burns was determined. Michigan's multisource system identified 18,641 work-related burns in adults (age 16 and older in 2009 and 2010, and age 14 and older since 2011) since 2009, including 7,141 cases in the previous project period (7/1/2010 - 6/30/2014) and 9,085 in the current project period (7/1/14-6/30/20). In comparison, BLS reported 6,900 burns from 2009 through 2018; only 39.6% of the 17,407 burns identified in Michigan's multi-source system from 2009 to 2018. Three hundred twenty-one worksites have been inspected by MIOSHA leading to 745 violations of MIOSHA standards and $1,505,120 in monetary penalties**,** with 96 inspections occurring in the 7/1/2014 - 6/30/2020 project period ($332,055 in monetary penalties and 181 violations). Ninety-six percent of the companies inspected received citations. Most (71.7%) of these citations were for safety issues directly related to the injury and 98.3% of these safety hazards were not corrected at the time of the inspection. Reports summarizing the burns data and MIOSHA inspections have been published and disseminated in annual reports for 2009 through 2017 (https://oem.msu.edu/index.php/annual-reports), an annual data fact sheet (https://oem.msu.edu/images/Data_Fact_Sheets/2019/Burns_Fact_Sheet_2020.pdf), and three hazard alerts (Food Service Work-Related Burn Injuries in Michigan, Prevent Burns from Hydrofluoric Acid in the Workplace, Work-Related Burns Caused by Cleaning Products). One peer-reviewed paper was published (Kica and Rosenman 2012).

D.1.b.1.g. Crushing injuries: Since 2013, Michigan has been conducting case-based work-related crushing injury surveillance. Quarterly, inpatient and emergency department

medical records were provided by Michigan's 134 acute care hospitals, including four VA hospitals. Annually, the Michigan WDCA provided access to all paid wage replacement workers' compensation claims for the previous year. The MIFACE program provided death certificates of individuals who died from a work-related crushing injury. The three databases were matched, and a combined de-duplicated count of crushing injuries was determined. From 2013 to 6/30/2021, Michigan's multisource system identified 8,916 work-related crushing injuries in adults (age 16 and older). In comparison, BLS reported 2,290 crushing injuries from 2013 through 2019; only 36.6% of the 7,765 crushing injuries identified in Michigan's multi source system from 2013 to 2019. One hundred and sixty-four work sites were inspected by MIOSHA leading to 380 violations and $694,175 in monetary penalties. Eighty percent of the companies inspected received citations. Most (88.3%) of these citations were for safety issues directly related to the injury and 86.3% of these safety hazards were not corrected at the time of the inspection. Reports summarizing the crushing injury data and MIOSHA inspections have been published and disseminated in annual reports for 2013 through 2018 (https://oem.msu.edu/index.php/annual-reports), an annual data fact sheet (https://oem.msu.edu/images/Data_Fact_Sheets/2020/SummaryTrackingCrushingInjuries_2_3_2021.pdf), and one hazard alert (Work-Related Crushing Injuries Due to Presses). One peer-reviewed paper was published (Kica and Rosenman 2018).

D.1.b.1.h. Hospitalized injuries: Since 2014, Michigan has been conducting case-based surveillance for work-related injury hospitalizations. Quarterly, inpatient and emergency department medical records are provided by Michigan's 134 acute care hospitals, including four VA hospitals, for hospitalizations with acute work-related injuries where workers' compensation is the payer. Since 2015, there were 4,348 hospitalized injury reports received. One hundred forty-seven work sites have been inspected by MIOSHA leading to 283 violations and $321,100 in monetary penalties.

D.1.b.1.i. Skull fractures: Since 2010, Michigan has been conducting case-based surveillance for work-related skull fractures. Quarterly, inpatient and emergency department medical records are provided by Michigan's 134 acute care hospitals, including four VA hospitals. Annually, the Michigan WDCA provided access to all paid wage replacement workers' compensation claims for the previous year. The MIFACE program provided death certificates of individuals who died from a work-related skull fracture. The three data bases were matched and a combined de duplicated count of skull fractures was determined. Michigan's multisource system identified 3,954 work-related skull fractures in adults (age 16 and older) since 2010 and 845 work-related skull fractures in the previous project period (7/1/2010 – 6/30/2014) and 3,109 in the current project period (7/1/14- 6/30/21). In comparison, BLS reported 890 skull fractures from 2010 through 2019; only 25.4% of the 3,507 skull fractures identified in Michigan's multi source system from 2010 to 2019. Seventy-three work sites have been inspected by MIOSHA leading to 155 violations and $282,000 in monetary penalties, with 45 of the inspections with 89 violations and $203,950 in monetary penalties occurring in the current project period (7/1/2014 - 6/30/2021). Sixty-eight percent of the companies inspected received citations. Most (98%) of these citations were for safety issues directly related to the injury, and 88% of these safety hazards were not corrected at the time of the inspection. Reports summarizing the skull fracture data and MIOSHA inspections have been published and disseminated in annual reports for 2010 through 2017 (https://oem.msu.edu/index.php/annual-

reports), an annual data fact sheet (https://oem.msu.edu/images/Data_Fact_Sheets/2020/SummaryTrackingSkullFractures_2_3_2021.pdf), and one hazard alert (Work-Related Crushing Injuries Due to Presses). One peer-reviewed paper was published (Kica and Rosenman, 2014).

D.1.b.1.j. Data Sources for Case-Based Occupational Injury and Illness Surveillance: Data sources used for our multi-source surveillance system and their salient features are listed in Table 1. They include access to personal identifiers for case follow-back except where indicated.

Table 1: Data sources, their uses, and data access methods

Data source	Data owner	Summary	Conditions for which data source is used	Methods for data access/transmission
OD Reports	MIOSHA	Individual case reports by providers, hospitals, employers and clinics	All known or suspected occupational diseases	Fax, phone, on-line reporting form, mail.
Hospital Discharge data	(1) Michigan Hospitals (2) Michigan Health & Hospital Association	All hospital discharges from inpatient and hospital emergency departments	Selected ICD10-CM codes or payor is workers' compensation	(1)Quarterly request to hospitals for medical records of patients with selected ICD codes and where workers' compensation was the primary payor; records provided by direct on-line access to a secure portal set up by the hospital or mailed CDs or paper copies. (2) Annually: spreadsheet of all hospital discharges for same criteria, used to cross check with hospital reports for completeness.
Mortality data	MDHHS	All deaths	Selected ICD10 codes or where the "injury at work" is checked, MIFACE	Bi-annually. Paper copies of death certificates. Direct requests for MIFACE cases as needed.
"ToxSentry" (poison control information system)	MiPC	Electronic records of all calls to the MiPC	Lung disease, burns, farm-related injuries, pesticide-related, or heavy-metal related.	Weekly - Direct access to ToxSentry system using the ToxSentry Query Builder. ToxSentry is accessed online through a secure server.
Blood Lead laboratory reports	MDHHS	All reports of individuals tested for lead in blood	ABLES	Labs submit HL7 reports to MDHHS via the MiHIN/data hub; Weekly, adult lab reports are downloaded from MDHHS

				electronic database of all blood lead laboratory reports to Excel spreadsheet and made available to MSU via secure FTP site
Lab reports for arsenic, cadmium, mercury, blood and urine; specific IgE testing	MDHHS	All reports of individuals tested for cadmium, mercury, arsenic in blood/urine, selected specific IgE	Other heavy metals, asthma	Labs submit HL7 reports to MDHHS via MiHIN/data hub. Bi-monthly, metals reports are downloaded from MDHHS electronic database of laboratory reports to Excel spreadsheet and made available via FTP site.
MiEMSIS	MDHHS	An electronic data system for tracking all EMS runs	Asthma, COVID-19, injuries	Direct access to MiEMSIS in a secure web site.
MIOSHA fatality/injury hotlines	MIOSHA	Mandatory employer verbal report of work-related fatalities, injury hospitalizations, amputation, or loss of eye to MIOSHA	FACE, amputations, hospitalized injuries	Fatalities: direct report via email to MSU of the call to MIOSHA. Hospitalizations, amputations, loss of eye: Monthly password protected spreadsheet.
Workers' Compensation claims	Michigan WDCA	Database of all paid wage-replacement claims	Work-related injuries and illnesses	Quarterly where the condition is listed as "respiratory", or the body part code is coded as "lungs" on a spreadsheet via FTP site; annually for <u>all</u> work-related injuries and illnesses downloaded from FTP site.
Records of cases of asbestos disease.	Michigan 3rd Judicial Court	The 3rd Judicial Court handles the majority of asbestos-related cases in Michigan.	Lung disease	Annually: provided spreadsheet of all asbestos cases, settled or otherwise disposed from prior calendar year.
Law enforcement reports	Michigan State Police, county Sheriff's Offices, local police departments	Individual reports regarding law enforcement investigations	MIFACE	Direct requests from offices/departments for each case
Medical examiner reports	Medical examiner offices	Individual reports from medical examiner investigations	MIFACE	Direct requests from offices for each case.

		and/or autopsies		
Newspaper clippings	Public	All Michigan newspapers	FACE, critical injuries	Use advanced search feature of google to identify work-related fatalities and critical injuries
UD10 and UD10e crash reports	Michigan State Police	Database of all fatal and non-fatal work-related vehicular-related injuries	FACE	Annually; Excel files
National aviation accident database	NTSB	The database includes aviation, highway, maritime, and railway related fatalities	FACE	Annually run query https://data.ntsb.gov/carol-main-public/keyword-search
Metal and nonmetal mine fatality database	MSHA	The searchable database of reports of mine fatality investigations, with name of deceased.	FACE	Monthly run query at https://www.msha.gov/data-reports/fatality-reports/search
FRA accident /incident database	FRA	Searchable data base of all reports of injuries involving trains	FACE	Monthly run query at https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/query/query.aspx
IRR	Coast guard	All marine casualties	FACE	Monthly run query at https://cgmix.uscg.mil/IIR/IIRSearch.aspx
Cooperative extension	MSU County Extension directors and agents	Extension staff learn about farm related fatalities through word of mouth	FACE	Verbal reporting of farm-related deaths as they occur.
Police, Firefighter, and EMT On-line Memorial Pages	Public on-line sites	Obituaries of police, firefighters and EMS fatally injured on the job.	FACE	Monthly search: memorial pages for police officers, firefighters and EMTs (www.odmp.org), (www.usfa.fema.gov/fatalities/), (http://nemsms.org/notices.htm).

D.1.b.1.k. Innovation: The Michigan occupational injury and illness surveillance program has developed and led numerous innovations in the surveillance of work-related conditions over its 32 years, starting at the beginning, when we developed the prototype procedures and infrastructure to realize the SENSOR concept (Baker, 1989), which are still in use today in Michigan and other states. One key innovation was the development of procedures with MIOSHA so that follow-up worksite inspections could be undertaken while protecting the confidentiality of reported cases. Federal OSHA and some other state OSHA plan states have

subsequently developed Memoranda of Understanding with public health partners to implement this same approach. Another key innovation was the development of regulations requiring reporting of injuries, chemical poisonings, lead and other metals tests with identifiers, mirroring state public health practice for reporting and public health follow-up of infectious diseases. Our surveillance approach and data have led to important policy changes in Michigan and nationwide, including lowering of the acceptable blood lead level in Michigan's lead standards for construction and industry in 2018 and implementation of an EPA ban on consumer paint stripping products containing methylene chloride. Another impact of Michigan surveillance data on policy was in their use to help develop the recommendations in "A Smarter National Surveillance System for Occupational Safety and Health in the 21st Century" (National Academies of Sciences, Engineering, and Medicine, 2018). Dr. Rosenman was on the National Academies Committee that developed the report. This report led the development of NIOSH's implementation plan for occupational health surveillance (NIOSH, 2019).

D.1.b.2. Case based surveillance for work-related lung disease

Specific Goal #1: Continue surveillance for occupational lung disease (OLD) through the collection, analysis and dissemination of data on occupational lung disease in Michigan.

Specific Goal #2: Prioritize and expand ongoing compliance and consultative industrial hygiene activity for occupational allergens and respiratory hazards to prevent additional OLD in Michigan.

Specific Goal #3: Continue to develop and disseminate informational and educational materials on occupational disease reporting and occupational lung disease.

Specific Goal #4: Continue and expand on occupational health surveillance collaborative activities within Michigan, among surveillance states, and with NIOSH.

D.1.b.2.a. SILICOSIS:

D.1.b.2.a.1.The Burden of Silicosis in Michigan: 1988-2016: Since 1988, Michigan has been identifying individuals who develop silicosis with the goal of targeting prevention actions. Michigan's system is both the longest running and only comprehensive surveillance system for silicosis in the United States. Furthermore, Michigan is the only state where the surveillance program is part of a regulatory program to conduct enforcement inspections at the workplaces of the individuals identified with silicosis. Our recent article in the Annals of the American Thoracic Society (Reilly MJ et al., 2018) reported on the 1,048 cases of silicosis identified over 29 years in Michigan. The journal published an accompanying editorial that emphasized the importance of the article, especially in light of the recent adoption of the new silica standard (Deslauriers and Redlich, 2018). We wrote a NIOSH blog and participated in an American Thoracic Society podcast about the article. Key findings:

- Classically, silicosis was considered a disease that caused fibrosis and restriction on pulmonary function testing. Our data show that a high percentage of individuals with silicosis have obstructive lung disease (30% in never smokers and 44% in ever smokers) as well as restrictive lung disease (42% in never smokers and 32% in ever smokers). Only 25% of the

individuals with silicosis had normal spirometry. Workers with silicosis who also smoked cigarettes had more lung impairment than those who never smoked. Doctors, who often are not familiar with the effects of silica, may not recognize when silica contributed to their patients having COPD or may miss the diagnosis of silicosis. It also underscores the importance of smoking cessation programs to reduce morbidity among workers exposed to silica.

- The incidence of TB in individuals with silicosis was 1000-fold greater than in the Michigan general population, which emphasizes the importance of screening workers with silicosis for TB.
- The sources of silica exposure in Michigan causing silicosis have changed over time, decreasing among foundry workers and increasing in construction. Newer sources of exposures are in the granite and synthetic stone countertop industry and extraction of natural gas and oil by hydraulic fracturing (fracking). The continued use of silica in abrasive blasting operations is an ongoing source of exposure.
- Respiratory diseases were the underlying cause of death on the death certificate in 45% of individuals with silicosis in Michigan (COPD 14%, lung cancer 11%, unspecified interstitial fibrosis or respiratory failure 10%, pneumonia 6%, asbestosis or non-specified pneumoconiosis 3%, tuberculosis 0.5%, and sarcoidosis 0.5%). These percentages illustrate not only the respiratory morbidity of silicosis, but also that the doctors completing cause of death on the death certificate are often not aware of the decedent's work and/or medical history (i.e., only 11% of individuals identified in our surveillance system with the advanced form of silicosis, progressive massive fibrosis, had silicosis listed on the death certificate).
- Medicare paid for most of the medical costs associated with silicosis. The percentage of workers with silicosis applying for workers' compensation (WC) dropped from 42% in 1988-1997 to 16% in 2008-2016.
- Thirty-four (62%) of the 55 inspections where silica was sampled were above the NIOSH REL of 50 ug/m3, which is the newly adopted OSHA PEL. Even though inspections have decreased over time, the percent of those above the OSHA and NIOSH limits has remained unchanged.
- Michigan OSHA evaluated medical surveillance for 70 of 78 inspections. Only eight (11%) facilities provided medical testing specifically for silicosis, including a periodic chest x-ray classified by a B reader.
- Individuals with silicosis or silica exposure are at increased risk of developing connective tissue disease, primarily rheumatoid arthritis (Makol et al., 2011), and increased risk of developing chronic renal disease, especially ANCA positive disease (Millerick-May et al., 2015).
- Michigan has a unique comprehensive state-based surveillance program for silicosis. It is important to the rest of the country because it identifies contemporary industries and occupations that are still at risk.
- Despite improvement in workplace controls for silica, with the new MIOSHA medical screening requirement and emerging industries using silica we expect to see an increase in individuals diagnosed with silicosis.

D.1.b.2.a.2. Abrasive Blasting Survey 1995 – 2016: In 1995, we surveyed Michigan companies that performed abrasive blasting, documented the extent of silica use in abrasive blasting activities, and offered a training manual on identifying alternative media, safe work

procedures, and the health effects of exposure to crystalline silica. The survey was updated in 1999, 2005, 2011 and 2016. At the completion of each survey, literature was distributed to the facilities using silica, with information on the hazards associated with the use of silica as well as information on alternative media.
We updated the training manual in 2018, after the new Federal silica standard was adopted by MIOSHA (MSU, 2018). **2016 Survey:** Of 139 companies that performed abrasive blasting, 49 (35%) used silica. The 139 companies employed 2,986 workers, ranging from one (the owner/operator) to 500, with an average of 22 employees per company. A total of 140 employees used silica sand for abrasive blasting, with an average of 3 employees per company (range 1-50). **Past Surveys:** In prior surveys, we found 40% used silica as an abrasive in 2011, 55% in 2005, 72% in 1999 and 89% in 1995.

D.1.b.2.a.3. New MIOSHA Silica Standard: In February 2017, Michigan adopted the new Federal comprehensive standard for silica. Twenty-nine publications on silica from the Michigan surveillance project were entered into the Federal OSHA record to justify the need and individual requirements of the new standard. Michigan data showed that the decrease in mortality from silicosis was not a reliable marker of its burden. Of the 786 individuals with silicosis in the Michigan surveillance system who died, only 14% had silicosis listed anywhere on the death certificate, although 50-60% had died from respiratory disease. Common respiratory conditions listed as the cause of death were lung cancer, COPD, pneumonia, unspecified interstitial fibrosis or respiratory failure. The decrease in silicosis reported in Michigan could primarily be attributed to a decrease in the number of workers at risk rather than the adoption of the original OSHA silica standard in 1971. The number of employees in Michigan foundries peaked in 1973 and decreased 75% by 1991; this paralleled the 83% decrease in new silicosis cases from 1993 to 2011 (factoring in a 20-year latency for silicosis development).

D.1.b.2.a.4. Michigan miners with potential silica exposure: In a related project funded by the Alpha Foundation, we are contacting the 3,957 mine workers at the 424 mines owned by 243 mine operators in Michigan (MSHA, Mine Data Retrieval System). We directly contacted the worker. We paid for a chest radiograph and spirometry for any miner with ≥15 years of work in a mine. MSHA regulations require that mine workers receive an 8-hour yearly health and safety refresher training. We have attended 145 sessions conducted around the state by MSHA trainers from Michigan Technological University. We used a half hour per session to discuss respiratory issues and solicit participation. Among the 2,155 miners we have spoken with, 416 meet the 15-year minimum work criteria for medical testing. Further outreach to the mining community and performance of the medical testing is underway.

D.1.b.2.b. WRA:

D.1.b.2.b.1. The Burden of Work-related Asthma in Michigan, 1988-2018: Since 1988, Michigan has identified individuals who develop WRA to target prevention actions. Michigan has the longest running surveillance system for WRA in the United States and is the only state where the surveillance program is part of a regulatory program to conduct workplace enforcement inspections of the individuals identified with WRA. Our recent article in the Annals of the American Thoracic Society **(**Reilly MJ et al., 2020) reported on the 3,634 confirmed cases of WRA identified over 31 years in Michigan. The journal published an accompanying editorial

that emphasized the importance of the article, including the need for greater attention to prevention of WRA and work-aggravated asthma from cleaning products and disinfectants (Tarlo SM, 2020). We also wrote a NIOSH blog. Key findings:

- Overall, cases of WRA in Michigan have decreased over the 31 years. The cumulative incidence rate of WRA decreased from 3.5 during 1988-1997 to 2.0 cases/100,000 MI workers during 2008-2018.
- There were decreases in cases from specific exposures to well-known causes of WRA such as isocyanates and metal working fluids and in the cumulative incidence rate in manufacturing (11.6 to 5.6 cases/100,000 workers). These decreases were consistent with improved workplace engineering and controls such as enclosure of work processes, product substitution and use of personal protective gear.
- Cleaning products, some of which contain asthma causing ingredients and which are used in all industries increased over time from 5% to 20%.
- Sixty-six percent of WRA cases had an emergency department visit; 35% were hospitalized at least once.
- Despite the high morbidity and cost of WRA, only 49% had applied for WC.
- Nine cases died from a workplace exposure asthma attack. Five worked in manufacturing; one each worked in construction, agriculture, food services, and automotive repair. Four were exposed to isocyanates, and one each was exposed to secondhand cigarette smoke, cleaning agents, construction chemicals, mold release spray, and welding fume.
- WRA cases were useful for targeting workplace enforcement inspections. MIOSHA inspected 806 of the 2,601 facilities where WRA cases worked. During the inspections, 10,493 co-workers of the index cases completed a confidential respiratory questionnaire; 1,622 (15%) reported being bothered at work by daily or weekly chest tightness, shortness of breath or wheezing, or having new-onset asthma since beginning to work at the facility. Symptomatic co-workers decreased over time from 18% to 12%.

D.1.b.2.b.2. Other Recent Peer-Reviewed Publications and Other Outreach on WRA:

D.1.b.2.b.2.a. Cobalt: Al-Abcha A, Wang L, Reilly MJ, Rosenman KD. Work-related Asthma in Cobalt-exposed Workers. J Asthma 2020 May 2:1-10. We described the 35 cases of WRA that occurred in Michigan from exposure to cobalt from 1988 to 2017. MIOSHA initiated 26 workplace investigations to follow up these cases. Six workplaces were cited for cobalt air levels above the PEL. The inspections resulted in $29,380 in penalties.

D.1.b.2.b.2.b. Cleaning Products: Rosenman K, Reilly MJ, et al. Cleaning Products and Work-Related Asthma, 10 Year Update. J Occup Environ Med 2020; 62:130-137. This was a collaborative effort led by Michigan among the NIOSH-funded states that conduct WRA surveillance, to describe WRA and characteristics of individuals with exposure to cleaning products from 1998 to 2012, compared to our previous publication of reports from 1993 to 1997 (Rosenman et. al., 2003).

D.1.b.2.b.2.c. Hazard Alerts: During the most recent funding we developed six hazard alerts for WRA: cobalt exposure resulting in WRA and hard metal lung disease; isocyanate exposure during foam-in-place operations; isocyanate exposure during spray polyurethane foam applications for insulation in construction; styrene exposures and WRA; WRA from welding

fume, and WRA in the transportation manufacturing industry. These Hazard Alerts provide case studies, data from our surveillance, and recommendations for employers and employees. All 51 hazard alerts, including the six for OLD.

D.1.b.2.b.2.d. Social Media Campaign for WRA: We completed a campaign to encourage workers who may have WRA to review our surveillance website for more information. The campaign, which ran from mid-June to mid-September 2019 on Facebook (FB) and Twitter, targeted approximately 3.3 million adults working within a 75-mile radius of Lansing, MI. We served four display ads 693,510 times, resulting in 1,231 clicks to a special WRA landing page on our website for more information and generated 2,101 new users to our website. The campaign was highly successful, with the ads performing three times better than the click through rate of a normal display ad. The four ads that we posted on FB and Twitter and led back to our special WRA landing page on our website (https://oem.msu.edu/index.php/work-related-injuries/asthma/what-should-know-wra) covered four main topics: 1) What is Work-Related Asthma; 2) What Makes a Lung Friendly Workplace; 3) Discuss Work-Related Asthma with a Doctor; and 4) What Can Worsen Asthma at Work.

D.1.b.2.c. Other Occupational Lung Diseases:

D.1.b.2.c.1. The Burden of OLD: Since 2011, we expanded our surveillance to other OLDs. OLD cases follow the same protocol as silicosis and WRA with case identification, confirmation and workplace intervention with MIOSHA enforcement inspections. We expanded surveillance because, through the course of silicosis and WRA surveillance, we were identifying a significant number of other work-related lung disease that warranted follow up, some chronic and some that were acute. Hard metal lung disease, HP, metal fume fever, chemical pneumonitis and others were being reported. Since 2011, we have identified 2,187 cases of other OLD, collected medical records, completed medical questionnaires and conducted 49 workplace enforcement inspections.

D.1.b.2.c.2. Pilot study of DPLD: We conducted a pilot study of 44 patients discharged from the hospital with non-specific codes for the interstitial pneumonias (ICD-10 J84.1, J84.89 and J84.9). Medical records were obtained and, where possible, patients were interviewed using a standardized medical questionnaire and their chest radiograph reviewed. This pilot study showed misuse of the three nonspecific codes for the interstitial pneumonias; more specific ICD codes were identified in 28 of the 41 (68.3%) charts where sufficient medical records were obtained. Seven patients did not have interstitial fibrosis, and for 21 patients specific ICD codes should have been used. Some of the miscoding was due to the lack of an exposure history. Eleven individuals should have been classified as asbestosis and one as silicosis based either on radiographic findings and/or a history of extensive mineral dust exposure obtained from an interview of the patient or next of kin. Work/exposure histories were only found in seven of the medical charts. Inclusion of work histories as part of the diagnostic work up could have resulted in better classification of the individuals' illnesses.

D.1.b.2.c.3. COVID-19: Since the pandemic, we have identified work-related cases of COVID-19 across all reporting sources. We have compiled data from March to June, for COVID-19 deaths, published in our Fall 2020 newsletter

(https://oem.msu.edu/index.php/newsletters). Further, Dr. Rosenman was requested and presented the work-related COVID-19 data at the Governor's Task Force in September 2020. We published results of calls to the Michigan Poison Center regarding the use of cleaners and disinfectants in relation to COVID-19 in an article in *Public Health Reports*: "Calls to a State Poison Center Concerning Cleaners and Disinfectants From the Onset of the COVID-19 Pandemic Through April 2020" published on October 15, 2020 (Rosenman et al., 2020), and in our Summer 2020 newsletter (https://oem.msu.edu/index.php/newsletters). MIOSHA has conducted 29 COVID-19 related enforcement inspections.

D.1.b.2.d. MIOSHA Enforcement Inspections: Since 1988, we have conducted 960 workplace inspections: 819 for WRA, 92 for silicosis and 49 for other work-related lung disease.

D.1.b.2.d.1. WRA Inspections: A total of 819 workplace inspections have been conducted since 1988; 123 facilities were inspected more than once. During inspections, air monitoring for any suspected agent is conducted. The company's health and safety program and its MIOSHA I&I Log are reviewed. After the investigation, a report of the air sampling results and any recommendations are sent to the company, made available to the workers, and also sent to the reporting physician. Air sampling was conducted during 585 inspections; 30 (5.2%) of the 578 facilities with a MIOSHA standard for the presumed causal agent were above the PEL, including eight for welding fume (measured as total particulate), six for cobalt, four for styrene, three for glutaraldehyde, two each for wood dust and flour dust, and one each for formaldehyde, MWF, chromic acid, phthalic anhydride, and total dust while grinding on fiberglass. During most inspections, the company was provided the Recommended Medical Screening Protocol for Workers Exposed to Occupational Allergens or Welding Fumes, as appropriate. (https://oem.msu.edu/images/resources/AsthmaProtocolUpdate3_7_2016OSHAfactsheetforworkers.pdf
(https://oem.msu.edu/images/resources/Weldingfumesprotocolupdated3_10_2016.pdf).

D.1.b.2.d.2. Co-worker Interviews during Workplace Inspections: During MIOSHA WRA workplace inspections, co-workers of the index case complete a confidential medical questionnaire. Individuals who reported daily or weekly shortness of breath, chest tightness or wheezing, or who developed new-onset asthma since working at the facility are sent a letter recommending, they seek medical care to evaluate their breathing. Since 1988, we have administered this questionnaire to 10,558 workers during 623 MIOSHA inspections for WRA. One thousand, six hundred thirty-five workers had daily or weekly breathing symptoms associated with work, or new onset asthma since beginning to work at 403 of the 623 (65%) companies. The average percent of co-workers with symptoms in these 403 companies was 20.4%. None of the 1,701 co-workers from the remaining 220 companies reported breathing symptoms associated with work. Overall, 1,635 of the 10,558 (15.5%) co-workers interviewed had symptoms consistent with WRA. Over time, the percent of co-workers with breathing problems was 17.9% from 1988-1997, 11.9% from 1998-2007 and 12.2% from 2008-2019. Only 10 workers identified in the interviews with symptoms were also listed on the MIOSHA I&I Log, emphasizing the importance of direct contact with workers to identify individuals with asthma or respiratory symptoms. All symptomatic workers received a letter from Dr. Rosenman recommending medical follow up and contact information if they had questions/concerns.

D.1.b.2.d.3. Silicosis Inspections: Since 1988, 92 (18.2%) of 506 workplaces where cases were exposed to silica were inspected. Chest x-rays were reviewed by Dr. Rosenman if the company performed periodic chest x-ray surveillance. Air monitoring for silica was conducted. The company's health and safety program and its I&I Log were reviewed. After the investigation, a report of air sampling results, violations and recommendations was sent to the company, made available to workers, and sent to the reporting physician. There was air sampling for silica in 65 facilities. Thirty-nine (60%) of the 65 facilities were above the NIOSH REL of 50 ug/m3, which since June 23, 2018 became the OSHA PEL, that was formerly 100 ug/m3. Only eight of the 73 (11.0%) facilities where the medical surveillance program was evaluated provided medical screening for silicosis that included a periodic chest x-ray interpreted by a certified B-reader. Three (4.1%) companies provided periodic chest x-rays that were not interpreted by a certified B-reader. Twenty-two (30.1%) only performed pre-placement testing, 28 (38.4%) provided no medical surveillance, and 18 (24.7%) performed annual or biennial pulmonary function testing without chest x-rays. All companies were provided the Recommended Medical Screening Protocol for Workers Exposed to Silica (https://oem.msu.edu/images/abrasive_blasting/Silica_Screen_Protocol.pdf).

D.1.b.2.d.4. Other Occupational Lung Disease Inspections: A total of 49 MIOSHA inspections were conducted for other OLD, including hard metal lung disease, beryllium lung disease, chemical pneumonitis, other pneumoconioses and HP. Air monitoring was conducted at 33 of the 49 facilities. Overexposures to occupational agents were found during sampling at 6 of the 33 inspections. Co-workers were interviewed during 34 inspections; workers had daily or weekly breathing symptoms associated with work at 19 (56%) companies. The average percent of co-workers with symptoms in the 19 companies was 14.5%. All 84 co-workers from the remaining 15 companies reported no daily or weekly breathing symptoms associated with work. All symptomatic workers received a letter from Dr. Rosenman, recommending medical follow up and contact information for questions.

D.1.b.2.e. Doctor Survey on Barriers to Reporting: Each funding period, we conduct a survey of the occupational medicine physicians, pulmonologists and allergists in the state to gauge their understanding of Michigan's occupational disease (OD) reporting requirements, and barriers to reporting. During this most recent funding cycle we surveyed the 185 physicians and health professionals in the MOEMA, the 465 pulmonologists in the MTS and the 90 allergists in the MAAS. These groups are the target of the survey since they are most likely to see patients with OD. After the survey results were compiled, each group received a letter from Dr. Rosenman outlining the findings for each group, a brochure on the OD reporting law and ways to report, and a Q&A Sheet addressing the major concerns.

D.1.b.2.f. Communication Plan: Educational outreach to medical and safety and health community – newsletter, talks, and educational display booths at medical conferences: An essential element of our surveillance protocol involves educational outreach to stakeholders. Sharing current trends and useful data findings along with recommendations to allow companies and their employees and other stakeholders such as healthcare providers, unions and safety and health professionals to take actions to improve the safety and health in the workforce has always been a priority. Each year we exhibit our educational display booth at three to six conferences, produce quarterly newsletters that reach 3,300 health care and health and safety professionals,

and give five to 10 presentations at hospital grand rounds, to MIOSHA enforcement staff, and during medical conferences. We have found that repeated messages to stakeholders help keep awareness of occupational safety and health in the forefront. We typically receive 50-100 requests annually for more information from our stakeholders, ranging from second opinions from physicians to assistance requests for data and the current literature from industrial hygienists, to individuals contacting us about their work-related injury or illness to ask for guidance. Our expanded social media platforms have helped us to reach a greater audience to share our findings, especially as evidenced by comparing the large increase in the average number of monthly unique visitors to our website from the prior two funding periods, from 400-500 to 5,700.

D.1.b.2.g. MiEMSIS: We added a new source to identify OLD. Since July 2020, we have accessed the MiEMSIS on a monthly basis. MiEMSIS is a database of the approximately 1,000,000 ambulance runs that occur each year in Michigan. We developed data queries to identify work-related ambulance runs for respiratory emergencies. Each month we review 100-150 cases of OLD generated from our algorithms among the approximately 83,000 monthly ambulance runs. We are working on the best algorithms to identify OLD without yielding an overwhelming number of records to review.

D.1.b.2.h. Vulnerable Populations:

D.1.b.2.h.1. Temporary Employees: We conducted an occupational safety and health needs assessment of the Michigan temporary staffing agencies. We developed and distributed three educational documents to the 311 Michigan temporary agencies (https://oem.msu.edu/index.php/resources#Temporary_Worker_Safety). Our material was used by OSHA/NIOSH in their Recommended Practices for Protecting Temporary Workers document (http://www.cdc.gov/niosh/docs/2014-139), and also by the MIOSHA CET program.

During the last funding period, we changed our case ascertainment to be able to identify temporary workers, and we identified 50 temporary workers with WRA or another OLD. MIOSHA conducted enforcement inspections at seven of the host employer workplaces.

D.1.b.2.h.2. Working Youth: We compiled Michigan occupational injury and illness surveillance data of individuals 14-17 years old for 2014-2017 using hospital data, OD reports, poison control data, and WC data. There were a total of 1,501 injuries and illnesses, including OLD. A special report was generated, with case studies, demographics and analyses of the industries, jobs, and exposures common to this group, and posted on our website and the NIOSH clearinghouse, and shared via social media (https://oem.msu.edu/images/resources/GeneralResources/working_youth_2014_to_2017.pdf).

D.1.b.3. Case based surveillance for work-related pesticides illness/injury:

Specific Goal #1: Collect, analyze and disseminate data on acute, work-related pesticide illnesses and injuries in Michigan.

Specific Goal #2: Prioritize and expand ongoing compliance, consultative, and educational activities to prevent and reduce work-related pesticide exposure in Michigan, in collaboration with partner agencies and stakeholders.

Specific Goal #3 Support the NIOSH vision of a comprehensive nationwide occupational health surveillance system by integration of acute, work-related pesticide illness and injury surveillance and prevention into occupational health surveillance within Michigan, among states, and with NIOSH.

Pesticide case reports have been collected under the authority of Michigan's Public Health Code since 2003. Ms. Schwartz from MDHHS has coordinated this program until 6/30/20 when she stepped down from her fulltime position in preparation of retiring in 2021. Ms. TenHarmsel at MSU is transitioning into becoming the new coordinator of the pesticide project. The pesticide data has been managed using procedures and systems developed in the NIOSH-supported data management system, SPIDER and assigned case confirmation/case classification status using the published case definition (NIOSH, 2000). In 2006, we initiated data collection for non-occupational pesticide cases. This allowed us to examine cross-cutting exposures among workers and the general population (e.g., swimming pools, drift from farm fields). Over the years, several notable changes to the surveillance system have occurred: (1) In 2012, the search algorithm for case finding in the MiPC database was changed, resulting in a large increase in the number of non-occupational pesticide cases being reported. (2) Under authority of the Michigan Public Health Code's laboratory reporting requirements, laboratories were required to report cholinesterase results and an algorithm was developed to electronically flag reports indicating a 20% or greater change between two reports on the same individual or a value below the lower limit of normal. Individuals flagged were interviewed to assess their exposure to cholinesterase-inhibiting pesticides and occurrence of symptoms. The system identified companies that conducted screening of potentially exposed employees, but no cases meeting NIOSH's case definition of work-related poisoning were identified.

Table 1 shows data on occupational and non-occupational cases by confirmation/classification status and counts in these categories for the subset of cases from the previous funding period - 7/1/15-6/30/2019.

Table 1: Case Confirmation and Classification Status of Pesticide Poisoning Cases

Case Classification Status	**Occupational 1/1/01 – 6/30/14**	**Occupational 7/1/14 -6/30/19**	**Non-occupational 1/1/06 –6/30/14**	**Non-occupational 7/1/14 –6/30/19**
Definite	106	25	16	37
Probable	245	76	281	292
Possible	645	251	1493	528
Suspicious	16	4	22	43
Total Confirmed cases	*1012*	*356*	*1812*	*900*

Approximately 80% of cases were identified from reports from the MiPC. Very few reports were provided by health care providers, in spite of our outreach strategies (e.g., reminder mailing each spring to Michigan's 35 clinics serving migrant farmworkers and quarterly mailings of our newsletter to 3,300 health care providers).

Michigan data on acute pesticide injuries and illnesses from 2003 through 2019 have been compiled into 18 annual reports (https://oem.msu.edu/index.php/annual-reports). These reports included summary descriptive data, results of intervention activities, and brief descriptions of all confirmed occupational cases. Annual reports were provided to partners and stakeholders including Local Health Departments, agencies serving migrant farmworkers, data providers, NIOSH and the EPA and MSU Extension, and made publicly available on the websites of MSU (oem.msu.edu) and MDHHS (www.michigan.gov/mdch-toxics).

Data summary reports were provided quarterly to the Michigan PAC. Ms. Schwartz from MDHHS is the state health department representative on the PAC. Dr. Rosenman is the medical representative on the PAC. The PAC includes members from industry, academia, state agencies, and advocacy organizations (e.g., the Michigan Environmental Council). It was established by MDARD to provide advice on all pesticide-related issues. The PAC, with its wide range of representatives, has also been the advisor to the Michigan pesticide surveillance program. Quarterly they receive and discuss Michigan's pesticide surveillance data.

Since the start of pesticide surveillance, 21 exposure events, some of which involved multiple cases, have been reviewed by MDARD for investigation of violations of pesticides regulations. Ten investigations led to violations and for four the results are pending. Disinfectant-related exposure events are reviewed by MIOSHA for potential worksite follow-up. Seven investigations led to citations and for one the result is pending.

Because of the numerous cases of exposure to disinfectants related to swimming pools, a press release, a fact sheet and cover letter about safe use of pool chemicals was developed and disseminated to all 45 local health departments, which are responsible for annual safety inspections at public pools. This occurred annually in conjunction with CDC's national recreational water safety week.

A fact sheet on pesticide use in the home was developed, posted on the MDHHS website, and made available to the MDHHS's Healthy Homes section. Educational materials addressing specific issues such as disinfectant use in barber shops and beauty salons have been collected and sent to employers and employees. A fact sheet for pet owners was posted and letters sent to the Michigan and the American VMA about the potential danger to veterinary staff of inducing dogs to vomit after they have ingested zinc phosphide-containing baits. This resulted in the American VMA putting up a web page with links to our letter and our fact sheet, sending out a national email alert to 20,000 veterinarians and putting it on their twitter feed. A multi-state publication was subsequently developed (Lee et al., 2010).

Forty priority alerts were sent to NIOSH regarding cases with four or more exposed persons, or where an individual was hospitalized, or where there was an acute pesticide poisoning but no violations of the pesticide label. NIOSH forwarded these reports to the EPA personnel who review the registration of pesticides for potential future regulatory action.

Michigan has been actively involved in multi-state publications of pesticide surveillance data, 14 overall of which five have been published in this latest funding period (Calvert et al., 2015; Namuland et al., 2016; Fortenberry et al., 2016; Calvert et al., 2016; Liu et al., 2018). Data from the surveillance system were also included in a publication about occupational health disparities in Michigan (Stanbury and Rosenman, 2014).

Michigan chaired the NIOSH pesticides multi-state Coding Committee, which involved regular conference calls to discuss enhancements to the Standardized Variable Document, the SPIDER database, joint issues of concern in data management, and ideas for collaborative projects. We participated in meetings of the Migrant Health Network of the Michigan Primary

Care Association and provided updates to the MDHHS website on West Nile Virus for safe use of insect repellants. We made various presentations about the program, to groups representing MSU Agriculture Extension, MDARD, and SENSOR-Pesticides.

Dr. Rosenman has provided presentations about farm work and pesticides, including "Work Related Injuries and Illnesses of Farm Workers" to the Michigan Migrant Child Task force and webinars organized by the Michigan Center for Rural Health for rural health care providers titled "Screening, Identifying, Treating and Reporting Environmental and Occupational Health Risks".

Annually, all chemical cases related to recreational water exposures meeting the case definition were reported to the CDC NORS (https://www.cdc.gov/nors/index.html). These cases were included in the CDC annual summary of disease outbreaks associated with recreational water (https://www.cdc.gov/healthywater/surveillance/rec-water-surveillance-reports.html). We recruited individuals with pesticide injuries/illnesses to participate in the NIOSH NPPTL video for safety training (https://www.cdc.gov/niosh/npptl/RespVideos.html).

The Michigan pesticide program was a co-recipient with other pesticide surveillance states and the NIOSH surveillance group of the 2011 Bullard-Sherwood Award. This is an annual award presented by NIOSH "to recognize outstanding efforts by its scientists and their partners in applying occupational safety and health research to prevent work-related injury, illness, and death".

D.1.b.4. Case based surveillance for work-related Traumatic Fatalities:

Specific Goal #1. To continue to identify work situations in Michigan at increased risk for work-related fatal injuries.

Specific Goal #2. To continue to identify the underlying causes of work-related fatal injuries in Michigan.

Specific Goal #3. To continue to formulate and disseminate prevention strategies to reduce work-related fatal injuries.

Specific Goal #4. To continue collaborative activities among the states with funded FACE programs and with NIOSH.

D.1.b.4.a. Identification of Work-Related Deaths: We have confirmed 2,722 WR fatal injuries since 2001, 950 in the years 2014-2019. Data from 2020 are still being processed. Ninety-one percent were men. The WR fatality incidence rate in Michigan in 2019 was 3.7/100,000 workers overall, 5.6/100,000 employed men and 0.6/100,000 employed women. The largest number of deaths (2,283, 84%) occurred among workers 20-64 years old. The percentage of individuals 65 years of age or older (26, 16.0%) who died in 2019 was more than double the percentage of Michigan's employed population in that age bracket (6.7%).

Michigan data for the years 2001-2019 showed that construction-related fatal injuries were the most common, accounting for 19.4% of all deaths, followed by agriculture (13.2%), transportation and warehousing (11.1%), and manufacturing (9.7%). Similar trends are apparent when looking at employment-based fatality rates, with agriculture and construction having the two highest rates each year, though agriculture often had a higher rate than construction owing to the much smaller size of the workforce. Motor vehicle related fatalities were the most common

cause of death (18.3%), followed by struck-by incidents (15.7%), falls (14.9%), homicides and assaults (13.3%), and machine-related incidents (11.6%).

We have published 18 annual reports of WR fatal injuries, 2001-2018, and are currently finalizing the 2019 report. Copies of the 18 previous annual reports are on our website at www.oem.msu.edu. These reports contain overall statistics, examinations of trends within select industries and causes of death, and summaries of each. The data is posted on the MDHHS Michigan Public Health Tracking interactive website in five-year groupings from 2001-2015 (https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_78428---,00.html). Deaths from 2016 through 2020 will be posted when data from 2020 is completely tabulated.

In 2020, we published a peer-reviewed paper that highlighted the importance of a multisource system to maximize the identification of work-related fatalities (Oliveri et al., 2020).

D.1.b.4.b. Work-Related Fatality Investigations: We have conducted 230 fatality investigations and wrote and posted 220 reports to the MSU (https://oem.msu.edu/index.php/work-related-injuries/work-related-fatalities/miface-investigation-reports) and NIOSH (https://wwwn.cdc.gov/NIOSH-FACE/Default.cshtml?state=ALL&Incident_Year=ALL&Category2=0000&Submit=Submit) websites. In the past five years, 35 investigations have been completed and 43 reports have been posted to the MSU and NIOSH webpages (five reports currently in process). The reports contain a description of the events preceding the death, causal factors and recommendations to prevent similar fatalities in the future. An example of a report for a farmer who was pinned by a tree limb while he was removing limbs and bucking it with a chainsaw is at https://oem.msu.edu/images/MiFACE/InvestigationReport_Agriculture/18MI213_InvestigationReport.pdf. Evaluations of final reports sent to and received back from employers or family members interviewed during the investigation gave uniformly "good" or "excellent" ratings. A comment from one agricultural operation commented that they were confident the report would "help others and prevent another tragic loss." All evaluations also indicated that the employer or family member intended to use the information contained in the report to implement our recommendations, change work practices, and/or use in employee training (with one exception, a family farm member who was interviewed but then retired). All the investigation reports are posted on our website, the NIOSH FACE website, the NIOSH Clearinghouse, handed out at display booths at conferences and at our presentations. Reports are disseminated following a dissemination plan developed specifically for each report.

D.1.b.4.c. Formulation and Dissemination of Prevention Activity: MIFACE investigation reports have been instrumental in addressing both state and national concerns. Materials from MIFACE were cited in four trade association publications and two newspaper articles in the past five years. MIFACE data and investigation reports were also used in two issues of the National Safety Council's monthly Safety and Health Magazine (February 2020, *#17MI007 Truck Driver Dies After Air Release From Tire Failure;* December 2020, *#17MI045 Worker Dies After Falling Through Skylight*).

Thirty-three hazard alerts 1-4 pages in length have been developed to highlight the death and preventive interventions, twenty-five in the last five years These hazard alerts have been distributed to trade associations for use in training and posting in workplaces. All the actual hazard alerts can be found on our web site (https://oem.msu.edu/index.php/work-related-injuries/miface-hazard-alerts), and on the NIOSH Clearinghouse web site.

We have developed, at the request of our advisory committee, 538 summaries of fatalities investigated by MIOSHA; 200 were written in the last five years. A typical MIOSHA report of a fatality investigation contains information about the citations issued but no description of the circumstances of the death. The summaries developed included a description of the workplace and activities occurring prior to the death and the MIOSHA citations issued at the conclusion of the MIOSHA compliance visit. The summaries we prepared, as well as full MIFACE on-site investigation reports, were used in training programs and distributed to employers and employees by MIOSHA.

A total of 212 presentations have been made by MIFACE personnel using MIFACE data, findings and recommendations, including 37 in the last five years. This has included recurring collaborative presentations with trade groups such as the Michigan Farm Bureau (MFB) and Local 324 of the International Union for Operating Engineers (OE324). These collaborative presentations have provided the opportunity to reach hundreds of workers in each of the farming and construction sectors in the past five years. Other presentations were made to health and safety specialists and students, MSU Extension personnel, labor unions, trade associations, and occupational health specialists. We have presented at the Michigan Safety Conference, the NOIRS, and the AIHA annual conference.

In the last five years, we have staffed a display table and distributed educational material at trade, industry, and health and safety conferences including the annual Michigan Safety Conference and the Michigan Nursery and Landscape Expo.

A 2019 incident in which two workers died after being crushed by falling granite slabs at a warehouse led to the development of a hazard alert describing a number of similar WR deaths in Michigan and preventative strategies that was shared with stakeholders across the state and with the national FACE program. MIFACE has also begun preparing a peer-reviewed article examining WR deaths involving stone slabs across the country, which will include data from OSHA compliance inspections as well as deaths investigated by MIFACE and other FACE programs. The article will identify trends and common factors that may be targeted for preventing further similar deaths.

Data from MIFACE on WR deaths among young workers in Michigan was cited by the AIHA in a 2019 letter of support for Michigan House Bill 4282, which was under consideration by the House Committee on Education, that would allow high school students to meet a portion of the health and physical education graduation requirements through the completion of an OSHA 30-hour course. The Committee passed the bill, and it has continued to make its way through the House.

In both 2020 and 2021, Dr. Oliveri was invited by the AIHA Confined Spaces committee to present on multiple confined space fatalities at the annual AIHA conference, which was held virtually both years. The presentation included discussion of common root causes and recommendations for addressing each factor. Over 500 health and safety professionals watched the presentations live and recordings are available to view through AIHA's educational resource library. The presentations received very positive reviews, with an average rating of 4.6/5.

MIFACE data and projects from previous funding cycles have had major impacts. These include the following investigation reports: MIFACE Investigation #01MI047: *Corrections Officer Dies When He Falls Off Ladder While Supervising Prison Work Crew* resulted in the addition of language in community work contracts used by the Michigan Department of Corrections; MIFACE Investigation #03MI018: *Manager of After-Market Truck Bed Liner Store Dies of Asthmatic Attack after Spraying Van with Isocyanate-Based Truck Bed Liner* resulted in

MIOSHA conducting site visits at all the truck bed liner facilities in the state. It was also used by NIOSH in their hazard alert (Preventing Asthma and Death from MDI Exposure During Spray-on Truck Bed Liner and Related Applications (NIOSH, 2006)), by New Jersey, Washington, and Minnesota in their educational outreach efforts, by the Alliance for the Polyurethanes Industry (API) and OSHA regional offices in an alliance to address the hazards, and was published in a peer-reviewed journal (Chester et al, 2005); MIFACE Investigation #04MI223: *Young Waitress Died from an Asthma Attack while Working in Bar,* which linked the waitress's death to second-hand smoke, was cited during the debate in the Michigan legislature to pass legislation to ban smoking in workplaces and published in a peer-reviewed journal (Stanbury et al, 2008); MIFACE Investigation #08MI121: *59-Year-Old Male Worker at a Fruit Storage Facility Died after Entering a Controlled Atmosphere Storage Room,* which was distributed by MSU Extension, presented at a controlled atmosphere storage seminar, and was used to revise the safety sections of the Michigan State University Cooperative Extension's Controlled Atmosphere Storage and Warehousing training manual; and MIFACE Investigation #09MI009: *Construction Worker Pinned under Tire of Articulated Machine,* which was posted by the Office of Fire Fighter Training (OFFT) on the Bureau of Fire Services/State Fire Marshal website, at a Michigan Fire Fighters Training Council meeting and emailed to the Fire Service Coalition. MIFACE Investigation #10MI013: *Tub Refinisher Died Due to Methylene Chloride Overexposure while Stripping a Bathtub* led to the publication in MMWR in conjunction with NIOSH and OSHA on 13 deaths, three in MI, from 2006 to 2010 "Fatal Exposure to Methylene Chloride in Bathtub Refinishers – Nine States, 2000-2011, Published February 24, 2012. This article was picked up by the news media and was covered on more than 48,000 newspaper, radio, TV, blog and websites. MIOSHA, OSHA and NIOSH used the information to develop and disseminate safety and health educational materials to bathtub refinishers. FACE states utilized and distributed educational materials developed by MIFACE to all the bathtub refinishing companies in their states. We produced and posted "Methylene Chloride and Bathtubs: A Dangerous Combination" on You Tube, which has been viewed more than 900 times. This story was also posted on the "Success Stories" website of CSTE (http://c.ymcdn.com/sites/cste.site-ym.com/resource/resmgr/Occupational_Health_Success_Stories/MI_bathtub_refinisher.pdf). The widespread media exposure contributed to the US EPA decision to ban the use of methylene chloride in paint and coating removal consumer products (https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/final-rule-regulation-methylene-chloride-paint-and).

D.1.b.4.d. ***Collaborative Activities among States and with NIOSH:*** Dr. Rosenman and Mr. Largo have been active in CSTE and have participated in planning for the annual CSTE/Occupational Health meetings. Dr. Rosenman is co-lead of the CSTE Occupational Work Group. In 2019, Dr. Oliveri was elected the Coordinating Committee Chair for the FACE state programs and has since served as the liaison between state FACE programs and NIOSH FACE personnel, and assisted in planning and developing the agendas for FACE calls, webinars, and meetings.

We have been responsive to national activity in response to national fall prevention initiatives by OSHA and NIOSH. MIFACE developed and distributed four hazard alerts regarding fatal falls to construction employers and employees, sent emails highlighting the educational materials available from OSHA and the CPWR, and presented the MIFACE data and resources during a CPWR-hosted webinar during the Fall Prevention Stand-Down week.

From 2017-2019, MIFACE led and coordinated a partnership between the state FACE programs and the NTA through which blog posts discussing FACE investigations into WR deaths in the transportation and warehousing industry were produced by the state FACE programs and posted on the NTA website. This partnership continued until the NTA website closed down in 2019.

Development of the interactive electronic datasets accessible to the public for adult lead, Acute Pesticide Illness, Acute traumatic fatalities and workers' compensation claims

Michigan Environmental Public Health Tracking website (https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_78428---,00.html#:~:text=The%20Michigan%20Environmental%20Health%20Tracking,on%).

There are three documents that accompany the data on the MiTracking web site for each of the four conditions: 1) Full Metadata- this is a detailed, technical description of the data; (2) About These Data - is oriented more to the general population; and (3) WC Content- this is the information that will be seen initially when a person wants to look at the work-related injury and illness data queries.

The National Tracking Network is a CDC funded system of integrated health, exposure, and environmental hazard information and data from national, state, and city sources. The Tracking Network provides users with the ability to query data content areas for various indicators and measures, and to create maps, tables, and graphs with the query results. This website portal houses environmental data for the state of Michigan. It has interactive capabilities to search various markers of health and the environment and will continue to expand with additional capabilities as additional data is added.

There is a link to the tracking site from our existing MSU Occupational and Environmental Website (https://oem.msu.edu/index.php/work-related-injuries/workers-compensation-data).

Publications

Peer-reviewed articles (27), book chapters (3), letters (2), blogs (3), abstracts (6)

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Newsletters (22)

	Year	Issue (Vol & #)	Topic
Spring	2021	V32N2	Does SARS CoV-2 Spread Primarily by Droplet or Aerosol Transmission? Why Does It Matter?
Winter	2020 -21	V32N1	COVID-19 and Workers' Compensation
Fall	2020	V31N4	Work, Health Disparities and COVID-19
Summer	2020	V31N3	COVID-19 and the Use of Disinfectants
Spring	2020	V31N2	Occupational Burden of Respiratory Disease

Winter	2019-20	V31N1	The Burden of Work-Related Asthma in Michigan
Fall	2019	V30N4	Vaping and Acute Lung Disease
Summer	2019	V30N3	Diesel Exhaust and Asthma
Spring	2019	V30N2	Twenty–Nine Year Summary of Silicosis in Michigan
Winter	2018-19	V30N1	Work-Related Allergies and Asthma from Exposure to Insects
Fall	2018	V29N4	Mining in Michigan and Respiratory Disease
Summer	2018	V29N3	Fish and Shellfish Allergy
Spring	2018	V29N2	Report on Work-Related Surveillance, National Academies of Sciences, Janu 2018
Winter	2017	V29N1	Construction Work and Respiratory Disease
Fall	2017	V28N4	Update on Cleaning Agents and Asthma
Summer	2017	V28N3	Occupational Asthma and Wood Dust
Spring	2017	V28N2	Prevalence in Michigan of Cigarette Smoking COPD and Asthma by Occupa & Industry
Winter	2016-17	V28N1	Overview of Worker's Compensation: Trends, Issues and Roles of Physician
Fall	2016	V27N4	Work-Related Asthma from Exposure to Cannabis sativa (Marijuana and He
Summer	2016	V27N3	Obliterative Bronchiolitis from Exposures in the Work Environment
Spring	2016	V27N2	Elevated Blood Lead Levels in Flint
Winter	2015-16	V27N1	Use of a Methacholine Challenge Test to Diagnose Work-Related Asthma
Fall	2015	V26N4	Medications and Work-Related Asthma
Summer	2015	V26N3	Lung Cancer Screening for Asbestos Exposed Workers

Annual Reports (Copies of all 48 reports are on our website, oem.msu.edu)

Acute Traumatic Work-Related Fatalities in Michigan, 2015-2018 - 4 annual reports
Blood Lead Levels Among Adults in Michigan, 2015-2019 - 5 annual reports
Heavy Metals Surveillance in Michigan, 2015-2020 – 5 annual reports
Occupational Pesticide Illness and Injury in Michigan, 2015-2019 – 5 annual reports
Silicosis and Other Work-Related Lung Diseases in Michigan, 2015-2019 - 5 annual reports
Summary of Occupational Disease Reports to Michigan OSHA, 2015 -2019, 5 annual reports
Work-Related Amputations in Michigan, 2015-2017 – 3 annual reports
Work-Related Asthma in Michigan, 2015 - 2019 – 5 annual reports
Work-Related Burns in Michigan, 2015 - 2017 – 3 annual reports
Work-Related Crushing Injuries in Michigan, 2015-2018 – 4 annual reports
Work-Related Farm-related Injuries in Michigan, 2015-2019 - 3 annual reports
Work-Related Skull Fractures in Michigan, 2015 -2017 – 3 annual reports

Hazard Alerts (43)

Farmer & Trees: Tasks that Can Kill, 9/23/20
Suicide in the Workplace: Prevention Opportunities, 9/14/20
Roof Safety-Prevent Fatal Fall, 7/29/20
Work-Related Crushing Injuries due to Presses-STOP Work-Related Crushing Injuries, 6/15/20
Work-Related Roadway Collisions: Prevention Strategies for Employers, 4/10/20
Injury Prevention Strategies for Older Drivers, 4/10/20
Look for Mobile Equipment Blind Spot, 4/9/20
Temporary Workers Safety: A Shared Responsibility, 4/6/20
Look Up for Overhead Power lines, 4/3/20
Arborists: Look Up, Stay Clear & Stay Secured, 3/24/20
Why Bother with a ROPS Retrofit, 3/24/20
Don't Get Nailed by a Nail Gun, 3/20/20
Hospitalized Work-Related Fall Injuries in Michigan-STOP Work-Related Fall Injuries, 3/12/20
Stop Work-Related Homicides, 3/12/20
Prevent Work-Related Asthma and Hard Metal Lung Disease from Cobalt Exposure, 1/21/20
Prevent Work-Related Asthma from Styrene Exposure, 1/20/2020
Work-Related Hospitalizations from Ice-Related Fall Injuries in Michigan, 1/16/20
Falling Stone Slabs Can Kill, 10/24/19
Stop Work-Related Assaults in the Health Care Setting, 7/18/19
Trench Cave-Ins Kill, 6/6/19
Stop Fatal Falls in Construction, 5/3/19
Roadside Workers and Traffic Hazards, 4/4/19
Falls from Scaffolds can be Deadly Prevention is Key, 3/13/19
Work-Related Burns Caused by Cleaning Products, 1/14/2019
Work-Related Amputations in the Food Service Industry, 12/10/18
Work related Fatalities While Performing Rim Wheel Servicing, 7/17/2018
Safe Animal Handling, 8/8/17
Farm-Related Machinery Entanglements in Michigan, Rotating Farm Machinery Entanglements, 8/3/17
Prevent Work-Related Asthma from Isocyanate Exposure in SPF-Spray Polyurethane Foam Applications for Insulation in the Construction Industry, 5/2/17
Plan. Provide. Train. Prevent Fall Injuries and Fatalities, 4/17/17
Work-Related Amputations: Power Presses, 3/21/17
Work-Related Injuries and Fatalities from Forklifts, 9/16/16
Work-Related Amputations: Power Saws, 4/27/16
Safe Use of Tractors Will Prevent Work-Related Deaths, 4/27/16
Carbon Monoxide Poisoning in Michigan, 4/13/16
Prevent WRA from Isocyanate Exposure in Foam-in-Place Process, 4/12/2016
Food Service Work-Related Burn Injuries in Michigan, 3/3/16
Work-Related Fatalities & Injuries from Using Ladders in Michigan, 2/29/16
Prevent Burns from the Hydrofluoric Acid in the Workplace, 9/15
Prevent WRA in the Transportation Manufacturing Industry, 9/9/15
Stop Work-Related Fall Injuries, 8/17/15
Prevent WRA from Welding Fume, 8/12/15

Human Subjects/IRB Approval

IRB approval was obtained and renewed annually for all the activity in this award.

D.1.c. References

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E. Inclusion of Children

Children who had an occupational illness or injury were included in the data.

F. Materials available for other investigators

The MSU Occupational and Environmental Website (www.oem.msu.edu) has copies of all our annual reports, data fact sheets, hazard alerts, newsletters and important resources we have compiled. The web site is organized by the condition that we have had under surveillance.

In addition to our regular web site, we have data for four conditions on Michigan's interactive web site; MITracking (https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_78428---,00.html); acute traumatic work-related fatalities, adult lead and workers' compensation data. There are three documents that accompany the data on the MiTracking web site for each of the three conditions: 1) Full Metadata- this is a detailed, technical description of the data; (2) About These Data - is oriented more to the general population; and (3) WC Content- this is the information that will be seen initially when a person wants to look at the work-related injury and illness data queries.

Our resources are also available on the NIOSH Clearing House (https://wwwn.cdc.gov/niosh-statedocs/)

G. Inclusion Enrollment Report

View Burden Statement

PHS Inclusion Enrollment Report

This report format should NOT be used for collecting data from study participants.

OMB Number: 0925-0001 and 0925-0002
Expiration Date: 10/31/2018

***Study Title (must be unique):** Use of Michigan Workers' Compensation Data for Surveillance of Work-Related Injuries and Illnesses

* Delayed Onset Study? ☐ Yes ☒ No

If study is not delayed onset, the following selections are required:

Enrollment Type ☐ Planned ☒ Cumulative (Actual)

Using an Existing Dataset or Resource ☒ Yes ☐ No

Enrollment Location ☒ Domestic ☐ Foreign

Clinical Trial ☐ Yes ☒ No **NIH-Defined Phase III Clinical Trial** ☐ Yes ☒ No

Comments:

Racial Categories	Ethnic Categories									
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			Total
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native	0	0	0	0	0	0	0	0	0	0
Asian	0	0	0	0	0	0	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	0	0	0	0	0
Black or African American	0	0	0	0	0	0	0	0	0	0
White	0	0	0	0	0	0	0	0	0	0
More than One Race	0	0	0	0	0	0	0	0	0	0
Unknown or Not Reported	0	0	0	0	0	0	25,731	44,720	171	70,622
Total	0	0	0	0	0	0	25,731	44,720	171	70,622

Report 1 of 1

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