Final Progress Report

Enhanced Program in Occupational Injury and Illness Surveillance

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Michigan State University

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A. List of Terms and Abbreviations

AAPCC – American Association of Poison Control Centers

ABLES - Adult Blood Lead Epidemiology and Surveillance

BRFSS - Behavioral Risk Factor Surveillance System

BLS - Bureau of Labor Statistics

CFOI - Census of Fatal Occupational Injuries

CET - MIOSHA Consultation, Education and Training

CJIC - Michigan State Police Criminal Justice Information Center

CSTE - Council of State and Territorial Epidemiologists

DRDS - Division of Respiratory Disease Surveillance

EPA - Environmental Protection Agency

FARS - Michigan State Police Fatality Analysis Reporting System

FRA - Federal Railroad Agency

IOM - Institute of Medicine

IPM - integrated pest management

LARA – Licensing and Regulatory Affairs

MDA - Michigan Department of Agriculture

MDCH - Michigan Department of Community Health

MDELEG - Michigan Department of Energy, Labor and Economic Growth

MDHHS – Michigan Department of Health and Human Services

MDOT - Michigan Department of Transportation

MIFACE – Michigan Fatality Assessment and Control Evaluation

MIOSHA – Michigan Occupational Safety and Health Administration

MPCA - Michigan Primary Care Association

MSU - Michigan State University

MSHA - Mine Safety and Health Administration

NEDSS - National Electronic Disease Surveillance System

NIOSH - National Institute for Occupational Safety and Health

NTSB - National Transportation Safety Board

NAICS - North American Industry Classification System

OD – Occupational Disease

OHIs - occupational health indicators

OLD – Occupational Lung Diseases

PAC – Pesticide Advisory Council PEL

- permissible exposure limit

PCC - Poison Control Center

PPPM – MDA Pesticide and Plant Pest Management Division

RADS – Reactive Airways Dysfunction Syndrome

REL - recommended exposure level

SENSOR - Sentinel Event Notification System for Occupational Risks

SIC - Standard Industrial Classification

SPIDER - SENSOR Pesticide Incident Data Entry and Reporting

WNV - West Nile Virus illness

WRA - work-related asthma

B. Abstract

Michigan State University in conjunction with the Michigan Department of Health and Human Services (MDHHS), formerly the Michigan Department of Community Health (MDCH) and the Michigan Department of Licensing and Regulatory Affairs conducted state-based occupational injury and illness surveillance to generate the occupational indicators and surveillance programs for four specific conditions: (1) work-related asthma; (2) acute pesticide illness; (3) silicosis and other lung diseases; and (4) work-related acute traumatic fatalities. The state also initiated surveillance for work-related amputations, work-related burns, work-related crushing injuries, work-related skull fractures, and elevated heavy metals. The state has had Sentinel Event Notification System for Occupational Risks (SENSOR) funded projects in work-related asthma from 1988 to date, pesticides from 2001 to date, silicosis from 1988-1992 and 2002 to date, other lung diseases from 2010 to date, and acute traumatic fatalities from 2002 to date. Since initiation of surveillance 3,351 cases of work-related asthma (448 in the last five years), 691 cases of acute pesticide poisoning (420 in the last five years), 1,163 cases of silicosis (72 in the last five years), 1,626 cases of other occupational lung diseases (988 in the last five years) and 1,944 acute traumatic fatalities (675 in the last five years) have been confirmed. In the last 5 years, there were 3,153 work-related amputations, 7,522 work-related burns, 2,080 work-related crushing injuries and 1,159 work-related skull fractures. There were 458 worksite follow-back industrial hygiene inspections conducted for all conditions in the last five years. There were 10,234 fellow workers interviewed (487 in the last five years) during the WRA inspections. There has been 100% reporting from the 136 acute care hospitals in the state. A quarterly newsletter (total 150 different newsletters; 22 in the last five years) and 147 annual reports (41 in the last five years) have been written and mailed out to 3,200 targeted physicians and health care professionals. Special projects were initiated for swimming pool exposures, isocyanates, and engineered stone countertop exposures. Evaluation of the effectiveness of our effort to improve working conditions was conducted. Forty-two papers and book chapters for the peer-reviewed literature and nine abstracts were written. Forty-nine presentations at medical conferences on conditions under surveillance and 105 educational presentations to worker groups were made. 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 with silicosis. We have collaborated with other states to highlight the risk of asthma at swimming facilities and by gender differences. 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. We have used our data to complement known deficiencies in the existing national systems based on employer reporting in the Bureau of Labor Statistics Annual Survey.

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 Michigan State University (MSU); the Michigan Occupational Safety and Health Administration (MIOSHA) in the Michigan Department of Licensing and Regulatory Affairs (LARA); and the Michigan Department of Health and Human Services (MDHHS). The project consisted of both population and case-based surveillance and included: production of occupational health indicators (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 448 cases of work-related asthma (WRA), 675 deaths from acute traumatic work-related injuries; 72 cases of silicosis; 988 cases of other occupational lung diseases; 420 cases of acute pesticide illnesses; 3,153 work-related amputations, 7,522 work-related burns, 2,080 work-related crushing injuries and 1,159 work-related skull fractures in the last five years.

C.2.Translation of Findings: Our surveillance project was modeled after the original National Institute for Occupational Safety and Health (NIOSH), Sentinel Event Notification System for Occupational Risks (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 the Michigan Department of Licensing and Regulatory Affairs (LARA), 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 LARA 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 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 could be a model for other states.

C.3. Outcomes/Impact

C.3.a. Potential Outcomes: Michigan OSHA, using State and Federal OSHA funds, has conducted 458 industrial hygiene (IH) inspections; seven for silica and other occupational lung diseases, 46 WRA, 56 amputations, 248 for burns, 67 for crushing injuries and 34 for skull fractures in the last five years. Another 42 on-site investigations for acute traumatic fatalities were conducted by MSU. As part of the MIOSHA WRA inspections, MSU has interviewed 487 co-workers of the index cases. The Michigan Department of Agriculture has completed 21 inspections to follow up confirmed pesticide illness cases and 71 cases, which meet the criteria for regulatory concerns were reported to the EPA.

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 at swimming facilities and by gender differences. 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 Bureau of Labor Statistics Annual Survey.

We compiled the surveillance data each year and issued 41 condition-specific annual reports. NIOSH has repeatedly used Michigan surveillance data and investigations in the NIOSH Chart book, the World Report and NIOSH hazard alerts. We wrote 42 papers and book chapters for the peer-reviewed literature and nine 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 was 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 174 in 2001 to a projected 125 work-related fatalities in 2014; a reduction of 28%. The number of agricultural fatalities has fallen from a high of 31 in 2003 to a projected 14 in 2015 (notifications of work-related deaths are continuing); a decrease of 55%. This was written up as a success story on the CSTE website (http://www.cste2.org/docs/MISuccess.pdf). 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. Work-Related Asthma

D.1.a.1. Specific Aims

The overall goal of this surveillance project is to reduce the occurrence and burden of work-related asthma. The following specific aims reflect the planned activities of this proposed project:

- To continue surveillance for work-related asthma.
- To prioritize and expand ongoing compliance and consultative industrial hygiene and education activity for occupational allergens in the State of Michigan.
- To continue and expand on occupational health surveillance collaborative activities within Michigan, among states and with the National Institute for Occupational Safety and Health (NIOSH).

D.1.a.2. Background and Significance of Work-Related Asthma

There is ongoing interest in the recognition and management of occupational lung disease, such as work-related asthma (WRA) (Tarlo and Lemiere 2014). Approximately 300 substances are documented to cause work-related asthma (Rosenman and Beckett, 2015). OSHA permissible exposure limits for many of these substances are not protective to prevent the development of new onset asthma or triggering of symptoms for individuals who have pre-existing asthma. The 2003 American Thoracic Society (ATS) consensus statement estimated for asthma that 15% of cases are attributable to work exposures (ATS, 2003). In 2011, a second ATS consensus statement estimated that 21.5% of adults with asthma have work-aggravated asthma (Henneberger et al., 2011). The combined estimates from these consensus statements would indicate that 36.5% of all adult asthma is work-related. Data collected in Michigan and two other states in the Behavioral Risk Factor Surveillance System (BRFSS), a random sample of adults in the general population, found that 54% of adults in Michigan with asthma reported their asthma was caused or made worse by work, and among these respondents reporting WRA, only 22-25% reported ever telling or being told by a health professional that their asthma was work-related (Lutzker et al., 2010). There are an estimated 803,000 adults in Michigan with asthma (Fussman, 2013). Fifteen to 54% of 803,000 translates into 120,450-433,620 cases of WRA attributable to work in Michigan.

National data showed that individuals with WRA had a higher mean number of days with asthma symptoms. Individuals with more days of symptoms were more likely to not be able to work or perform usual activities (Knoeller et al., 2012). Data from the United Kingdom estimated that when medical care and lost time are factored in, the work-related asthma costs were 100 million dollars per year with 49% of the cost borne by the patient, 48% by the State and only 3% by the employer (Ayres et al., 2011). A consensus statement by the American College of Chest Physicians (ACCP) published in September 2008 provides useful and comprehensive guidance on the diagnosis and management of WRA (Tarlo et al, 2008).

D.1.a.3. Methods

Aim #1: To continue surveillance for work-related asthma

Case reports for work-related asthma came from a variety of sources: mandatory reporting by health care providers, clinics, and employers; hospital discharge data; death certificates; and Poison Control Center reports. We worked with the Workers' Compensation Agency staff, part of LARA, to obtain data on work-related asthma on individuals who file Workers' Compensation claims. An additional reporting source, added in 2012, has been laboratory reporting of positive specific IgE testing for chemicals as well as latex. On a pilot basis, we began to explore the usefulness of self-reporting by individual workers with subsequent review of their medical records.

Michigan state law requires clinics, employers, health professionals and hospitals to report all known or suspected occupational illnesses. There is a $50 fine and it is a misdemeanor to fail to report. More importantly, the law assures the health care provider is not violating confidentiality laws by reporting, and reporting falls under the public health exemptions to the Federal HIPAA rules. The law allows the state to collect additional information as needed, and allows the state to conduct active surveillance (e.g., requesting hospitals or clinics to review medical records and submit reportable conditions) without obtaining patient consent. This was the legal basis for the surveillance proposed in this project.

Inspections of occupational health clinics were conducted to enforce the reporting law. Like disease reporting laws for communicable disease, no attempt had ever been made to penalize a health care provider for non-compliance with the OD Reporting Law prior to 2009. In preparation for enforcement of the OD Reporting Law, a mailing was sent in the summer of 2009 to all the occupational health clinics in the state to remind them of the reporting law and to let them know the state planned to enforce the law. After a three month period to allow clinics to comply, chart reviews were conducted for selected clinics from which no reports were received. The results of the investigations and any fines were publicized in the Michigan occupational health community. Biennial audits of occupational health clinics were conducted by MIOSHA since 2009. There have been 25 occupational health clinics audited for compliance with the OD reporting law since 2009. This is the first time we are aware that any state agency has conducted audits to enforce a public health disease reporting law.

There is a standard OD reporting form. These reports were received via the mail, electronically, by fax and over the telephone. Web-based reporting was accepted at www.oem.msu.edu. For the convenience of reporters we had a toll free 800 number to answer questions and/or receive OD reports. For the sake of efficiency we encouraged electronic reporting but also continued to encourage providers to report in whatever way was most convenient for them.

In addition to receiving OD reports, we actively solicited reports from all of the Michigan hospitals. On a quarterly basis, we requested the 136 acute care hospitals in the state (including the four VA hospitals) to send us the face sheet, discharge summary and pulmonary function tests on all patients discharged with ICD-9 506 (acute inhalation exposure). The hospitals were required by Michigan's occupational disease reporting law to supply this information. Follow-up calls were made to non-reporting hospitals.

There was 100% compliance by the hospitals with this law. A year later, when the preceding complete year of hospital discharge data had been cleaned and compiled, the Michigan Health and Hospital Association provided us a database of all hospital discharges with these ICD-9 codes and ICD-9 493 (asthma) where Workers' Compensation was the primary payer. This file that included ICD-9 code 506 was compared to the OD report file, and any hospital that overlooked a case was required to provide the medical records and report the patient. In addition, hospital discharge records were requested for ICD-9 code 493 where Workers' Compensation was the expected payer and the associated discharge diagnoses were respiratory-related.

Follow-up calls were made until the report was received. Medical records were requested and reviewed and in conjunction with the patient interview used to determine which cases were due to occupational exposure.

Because we received the database of all hospital discharges we were able to confirm that we received reports of all hospitalized patients. Approximately half of the hospitals provided us emergency department records. We were unable to confirm the completeness of the emergency department reports because there was no computerized record compiled for all emergency department visits as there was for hospitalized patients.

Workers' Compensation claims: Most respiratory claims only mention irritation/chemical pneumonitis. Workers' Compensation shared with us on a quarterly basis a computerized listing of all individuals who filed a Workers' Compensation claim for a respiratory problem.

Death certificates: Death certificates were requested annually from the Michigan Department of Health and Human Services' Vital Registration unit for all individuals where the underlying COD was Respiratory conditions due to chemical fumes or vapors (ICD-10 code J68).

The two Michigan poison control centers consolidated into one center in 2010; that sole center electronically reported all occupational poisoning calls on a quarterly basis. The major difficulty with poison control center records was finding the patient or even their medical records since names and addresses are often missing in the poison control center records, and personal identifiers such as birth dates, social security number or medical record number are not collected by the poison control centers.

Clinical laboratories for specific IgE testing: Since 2012, laboratories reported adults with elevated IgE antibody test results to amylase, anhydrides, ethylene oxide, formaldehyde, latex and isocyanates. This newest reporting source was added in relation to interpretation of an existing reporting rule for laboratories, promulgated through the MDHHS.

Employee Unions as a Medium for Self-Reporting of WRA: in February of 2015, the AFL-CIO emailed its 25,460 Michigan members for whom an email address was available. Union members were asked to contact the MSU Surveillance Center if they had asthma that was caused or aggravated by work exposures. A total of 3,822 members opened the email, and three members contacted the MSU Surveillance Center to report their asthma. An additional member who had relocated to another state contacted MSU to ask for materials to share with the union members at her new workplace.

Outreach activity to maintain and improve reporting consisted of the following:

1) Four page quarterly respiratory disease newsletter-"Project SENSOR News"
2) Annual report and 2-page Data Fact Sheet for work-related asthma
3) Presentations at Grand Rounds and medical conferences
4) Display booths at medical conferences
5) Information on the OD Reporting Law shared with newly licensed physicians
6) Updating of the Surveillance Center website and linkages to other important sites
7) Posting educational materials including case reports on the MDHHS and MIOSHA websites, as appropriate
8) Advisory Committee
9) Provision of software for electronic medical record reporting system
10) Creation and maintenance of Face Book and Twitter accounts to highlight work-related asthma, maintained by the MSU Surveillance Center
11) Development and distribution of scientific journal articles to raise awareness of and increase reporting of occupational diseases including WRA
12) Study to address under-reporting

We maintained an updated mailing list of physicians from the following groups: Michigan Allergy Society; Michigan Thoracic Society; Michigan Chapter of the American College of Physicians; Michigan Occupational and Environmental Medical Association; Michigan Chapter of the American College of Chest Physicians; Occupational Health Clinics in the Michigan yellow pages; any Michigan physician who ever submitted an occupational disease report; Internists in the Department of Medicine at Michigan State University, University of Michigan and Wayne State University; and family practitioners in the Departments of Family Practice at Michigan State University, University of Michigan and Wayne State University. We also maintained an updated list of non-physician health care providers: nurses who are members of the Michigan Association of Occupational Health Nurses; and nurses in Michigan who are certified by the American Board of Occupational Health Nurses. The mailing list for occupational respiratory disease consists of approximately 3,200 health care professionals.

We wrote and sent or emailed a four page quarterly newsletter on occupational respiratory disease to these 3,200 health care providers. From calls, letters and surveys, we know that physicians and other health care professionals read the newsletter. An average of 30-50 health care professionals would contact us when an announcement was included in the newsletter about material that was available. Dr. Rosenman received 2-3 calls per week from healthcare providers with occupational medicine questions about their patients. Typically, the health care providers indicated they enjoyed receiving the newsletter and that is how they knew to contact Dr. Rosenman with their questions.

We compiled an annual report and 2-page Data Fact Sheet on tracking work-related asthma. The Data Fact Sheet was a distillation of the annual report. The report and associated Data Fact Sheet summarized the data collected and lessons learned through case identification, interviews, and MIOSHA enforcement inspections at the workplaces where the index cases developed their asthma. The report and Data Fact

Sheet were posted on the MSU Surveillance Center's web site: www.oem.msu.edu and uploaded to the NIOSH Clearinghouse. The Data Fact Sheet was also distributed at medical conferences.

Dr. Rosenman gave talks at medical conferences and grand rounds across the state.

We routinely exhibited a display booth at major medical conferences around the state. At the booth, we distributed newsletters, annual reports, condition-specific data fact sheets, brochures, copies of the reporting law, and a resource sheet of useful contact numbers. We had a signup sheet for health care providers to put their name to be placed on the mailing list. We routinely did this at the annual Michigan State Medical Society (MSMS) meeting, annual Michigan Thoracic Society meeting, annual joint meeting of the Michigan Occupational Physicians and Nurses Association, University of Michigan Annual Pulmonary meeting and the annual Michigan Safety Conference meeting. We expanded the exhibit booth to other medical groups including: Michigan Association of Physician Assistants, MSU Osteopathic Medicine meeting, Michigan Certified Nurse Practitioner Annual Conference, MSMS House of Delegates, and the MSMS Annual Spring Scientific Sessions.

The OD Reporting Law is available as a link on LARA's Health Professional Licensing Division Page, along with links to other MI requirements such as the Communicable Disease Reporting Law. The OD Reporting Law link replaced the mailing that newly licensed physicians in the state previously received. Most of the licensing process is now conducted electronically; this shift from mailed information to an electronic link followed suit with the state's change to the use of electronic forms submittal for medical licensing.

The MSU Surveillance Center web site (www.oem.msu.edu) contained: annual reports; data fact sheets (2-page condition-specific summaries of the annual reports), quarterly newsletters, resource materials on medical screening for work-related asthma; brochures on reporting occupational diseases, when to suspect asthma is work-related, and information on asthma and cleaning agents; a training course on abrasive blasting; the Michigan occupational disease reporting form; resources for temporary employment agencies; and a mechanism to report occupational diseases online. Regular reporters on our website reporting system were assigned a personal identity number. This made it easier for them to report, since we had their contact information on file and ensured that the report was truly submitted by the indicated healthcare provider. There were links to this site from both the MDHHS and the MIOSHA web sites.

We also posted case histories of work-related asthma and lung disease cases where MIOSHA enforcement inspections were conducted on the LARA Air Contaminants Initiative page at: http://www.michigan.gov/lara/0,4601,7-154-11407-318422--,00.html.

We continued to maintain an advisory committee for the respiratory diseases. The advisory board members represented the organizations of the targeted physicians, including the Michigan Occupational and Environmental Medicine Association, the Michigan Allergy and Asthma Society, and the Michigan Thoracic Society. The committee provided a mechanism for us to receive feedback from the targeted physicians. Additionally, the involvement of leaders and prominent members of these organizations encouraged their members to become active in Michigan's occupational disease surveillance efforts.

Dr. Rosenman and Ms. Reilly were members of the Michigan Asthma Advisory Committee (MAAC) and Steering Committee. The committees provided guidance for the Asthma Initiative of Michigan (AIM). The www.getasthmahelp.org website was the direct result of the efforts of the Asthma Initiative of Michigan. As part of their involvement, the MSU Surveillance Center developed materials on WRA for the state's website on asthma in general. The state's asthma website, www.getasthmahelp.org maintained by the MDHHS, continued to be updated with information on WRA, provided by the MSU Surveillance Center. The website was part of the state's strategic plan for asthma. Sections on this website included: General information about WRA; Myths about WRA; Types of WRA; Substances at work that can cause asthma; When to suspect asthma is work-related; What to do if diagnosed with WRA; Prevention of WRA; Recommended medical screening program for people exposed to work-related allergens; and links to other websites. The site was intended for health care professionals, clinicians and public health personnel, patients and family members.

The automated occupational disease reporting system that was developed for the electronic medical record used by the family practitioners and internists at Michigan State University was updated when new software was introduced to the MSU clinics. Three categories of disease were used to help MSU physicians determine when they should report a patient: Category I (such as silicosis) was automatically reported unless the provider did not allow a report to be submitted; Category II (such as asthma) prompted the provider with a reminder that "for a significant percentage of patients this condition may be caused or aggravated by work"; and Category III (such as rheumatoid arthritis) allowed the provider to report the patient but there was no prompt with a reminder. This EMR was used in the MSU internal medicine clinics where there were 50 providers.

The MSU Surveillance Center created a Face Book (FB) page (Michigan State University Occupational and Environmental Medicine) and a Twitter account (@MSUOEM) during the most recent funding cycle. Through these newer social media outlets, we had 92 posts on FB and 138 tweets/retweets since creation of these accounts in 2010.

Forty two publications based on the surveillance system and data were completed during the most recent five years of surveillance for occupational diseases, including WRA. Publications include: Occupational Diseases in Individuals Exposed to Metal Working Fluids (Rosenman, 2015), Occupational Health Disparities: A State Public Health–Based Approach (Stanbury M and Rosenman KD, 2013), Cleaning and Disinfecting Environmental Surfaces in Healthcare: Towards an Integrated Framework for Infection and Occupational Illness Prevention (Quinn et al., 2015), Web-Based Listing of Agents Associated with New-Onset Work-Related Asthma (Rosenman KD and Beckett WS, 2015), and A Study of Characteristics of Michigan Workers with Work-Related Asthma from Exposure to Welding Fume (Banga et al., 2011).

One theme that repeats itself when we examine the surveillance data that we have collected over the past 26 years is that there is more work-related illness in the state than what is actually reported (Biddle et al., 1998; Henneberger et al., 1999; Rosenman et al., 2000a; Rosenman et al., 2003b; Rosenman et al., 2006). During the most recent funding cycle, we conducted a survey of the MI Allergy Society, MI Thoracic Society and MI Occupational and Environmental Medicine Association (MOEMA) members about barriers

to reporting. Two-thirds of the allergy physicians, half of the thoracic physicians and almost all (98%) of the MOEMA physicians were aware of the OD Reporting Law. About 60% of the allergy physicians, half of the thoracic physicians, and 80% of the MOEMA physicians who were aware of the law reported at least one patient. The top barrier to reporting was unfamiliarity with the mechanism to report. Other barriers included not being confident in diagnosing a patient with an OD, concerns about confidentiality, forgetting and time constraints. We sent the results to the society members with a copy of the OD reporting form and a brochure about the ways to report occupational diseases via the web, email and fax.

We followed our standard procedure for following up on occupational asthma reports that have been used for the previous funding periods. We first wrote the patient a letter telling him/her why we wanted to interview him/her about what caused their illness. The patient was then contacted by telephone and administered an interview, with consent. We were unable to contact only 7% of the occupational asthma patients reported, and approximately 5% refused to be interviewed. When we were unable to contact the individual or they refused to be interviewed, we were able to obtain sufficient information from records to confirm the case as work-related or not for 73% of those cases. Our questionnaire included demographics, history of onset of symptoms, medication history, health care usage, smoking history, respiratory symptoms, work history and work exposures. We added new questions to the WRA questionnaire about temporary employment history/status. All interviewed cases were sent a thank you letter and educational information about occupational asthma.

Medical records and pulmonary function tests were requested from the treating physicians identified by the patient in the questionnaire or in the hospital record.

Dr. Rosenman reviewed the patient questionnaire, medical records, pulmonary function tests, and results from work site industrial hygiene evaluations, if conducted, to determine if the patient met the criteria for confirmed occupational asthma. There usually was sufficient information in the OD report and medical records to supply necessary information for the surveillance data system, even when patients could not be located or did not agree to be interviewed. Cases were assigned a case classification according to NIOSH criteria (Jajosky et al, 1999).

Questionnaire responses were computerized for data analysis. A computer tracking system was used to manage the day-to-day follow-up of the cases, including the results of work site interventions and case confirmation. Quality control procedures were routinely conducted, running frequencies and reviewing outliers. Data were kept on a password protected computer site accessible only by authorized staff.

An annual report with statistical data, progress reports, and highlights of interesting new findings was prepared and disseminated for work-related asthma. The Annual Report was posted on the Surveillance Center web site and provided during medical conferences where our OEM educational booth was displayed. A 2-page data fact sheet was produced; this was based on the annual reports. The data fact sheet was available on-line at www.oem.msu.edu as well as at our educational display booth exhibited during medical conferences across the state.

Work-related asthma record-specific data was submitted to the Division of Respiratory Disease Surveillance (DRDS), NIOSH, in the format specified by NIOSH without identifiers, and summary data was submitted to NIOSH for publication in the Worker Chart Book.

Aim#2: To prioritize and expand ongoing compliance and consultative industrial hygiene and education activity for occupational allergens in Michigan.

The Surveillance Center provided LARA with the name and address of the company where a patient with confirmed disease was exposed. Industrial hygiene inspections were routinely conducted to follow-up confirmed case reports of illness caused by possible occupational allergens. Special care was taken to protect the anonymity of the case, particularly in small companies. No individual lost their job because of the inspections.

All worksites of new onset, not aggravated asthma, where the interview indicated there was ongoing exposure at the facility, were inspected. During these inspections air sampling was performed; ventilation, work practices and protective equipment were assessed; the OSHA 300 log was examined for additional cases of occupational asthma; and a questionnaire was administered to fellow workers from the same department or exposure zone where the occupational asthma index case worked. We added questions about temporary employment status to the co-worker questionnaire. If the plant was small (<50 employees) everyone was interviewed. Any fellow workers who reported daily or weekly wheezing, chest tightness or shortness of breath, or who indicated they developed asthma since starting to work at the facility were sent a letter from the MSU Surveillance Center recommending follow up with their doctor. The MIOSHA inspector completed a 2-page form on work practices and exposures based on their findings during the inspections. We added questions to this MIOSHA Inspection check list on health and safety practices for temporary employees.

The employer received the industrial hygiene report and, when appropriate, recommendations for medical surveillance, which we developed. In unionized facilities the Union president received a copy of the industrial hygiene report. The report was prominently posted in an accessible area in both unionized and non-unionized facilities. The reporting physician received a letter from Dr. Rosenman along with a copy of the industrial hygiene report.

Information about the inspections were collected in the computerized case data tracking system and included information about any exposure measurements taken and results, the number of potentially exposed workers, and whether the company was cited for violations.

We implemented the following new projects:

- Needs assessment for temporary employment agencies
- Re-survey a sample of companies inspected for WRA
- Develop listings of companies by counties using select asthma-causing agents
- Develop case histories linking index cases of WRA with MIOSHA inspections
- Isocyanate National Emphasis Program (NEP)

Needs assessment for temporary employment agencies: Nationwide and in Michigan there has been a doubling in the number of temporary employees since 1990 (Luo et al., 2010). There are 107,600 temporary employees in MI, 2.6% of the workforce of 4,107,200, up from 2.2%, five years ago. There were 53 work-related acute traumatic fatalities of temporary workers in MI from 2001-2012. The number of temp employees with OLD has not been uniformly collected. We are aware of eight temp workers with WRA.

During the most recent funding cycle, we conducted an occupational safety and health needs assessment of the MI temporary staffing agencies. The survey results indicated the need for information on who was responsible for: health and safety training prior to job assignments; providing medical surveillance for early recognition of work-related illness; complying with reporting requirements when temporary employees develop work-related illness; workers' compensation insurance coverage; making reassignments; and determining ability to work. We developed and distributed three educational documents to the 311 temporary staffing agencies in MI: 1) Temporary Workers Hazard Alert; 2) Guidance Sheet on Safety and Health Responsibilities of Host Employers and Temporary Staffing Agencies; and 3) Safety and Health Resources for Temporary Staffing Agencies. Some of this material was used by OSHA/NIOSH in their new Recommended Practices for Protecting Temporary Workers document (http://www.cdc.gov/niosh/docs/2014-139). All three documents are also available on the MSU OEM web site at: www.oem.msu.edu.

Re-survey a sample of companies inspected for WRA: We mailed out letters to 60 companies formerly inspected for WRA from 2008-2012. The letters were in 2 formats: those to companies where the MIOSHA inspector made recommendations related to the exposure being investigated (n=28 letters) and to those companies where no recommendations were made (n=32 letters). The objective was to determine whether companies make changes in their respiratory-related program after a WRA MIOSHA inspection, and if the recommendations were followed. Follow up phone calls to non-responding companies were made. Of the 32 companies where no recommendations were made, 5 were out of business, one was closing within the year and for two companies we were unable to obtain a response. Of the 24 remaining companies where no recommendations were made, approximately half reported making some adjustments after the inspection, to health and safety protocols, in work practices, and equipment changes. Of the 28 companies where there was at least one recommendation, one was out of business and for one company we were unable to obtain a response. Of the 26 remaining companies where recommendations had been made, nearly all reported having made some change as a result of the inspection, including the addition of ventilation, hiring an occupational clinic to monitor employee respiratory health, adjusting preventative maintenance duties, adding PPE (Personal Protective Equipment) and making ergonomic changes.

Companies using select asthma-causing agents: Resources for Clinicians- MI Workforce with Potential Exposure to Acrylic Acid, Chromium, Diethanolamine, Ethylene Oxide, Isocyanates, Maleic Anhydride and Methyl Methacrylate. A resource document was produced that listed the companies in Michigan where known asthma-causing agents were used. This resource was posted on the MSU Surveillance Center's website, posted to its Face Book and Twitter accounts, and uploaded to the NIOSH Clearinghouse.

Develop case histories linking index cases of WRA with MIOSHA inspections: As per their request for assistance, we submitted case histories to MIOSHA for their FY 2014-2018 Initiative to link work-related lung disease to overexposures in the work place. MIOSHA included the case histories on their website for stakeholders about important health and safety topics. Three case studies (#1, #3 and #4) were developed on WRA and other occupational lung disease cases where a MIOSHA enforcement inspection occurred. They were posted on the MIOSHA web site: http://www.michigan.gov/lara/0,4601,7-154-61256_11407-318422--,00.html#publications#case Case Study #1 MIG Welding, Case Study #3 MIG and Stick Welding and Isocyanate Exposure, and Case Study #4 Cobalt Exposures from Grinding on Tungsten Carbide.

Case Study #1 – Welding Fume Exposure and Respiratory Illness: A man in his 30's who had smoked a pack of cigarettes a day since his mid-teens was working as a MIG (metal-inert gas) welder through a temporary staffing agency at a company fabricating steel racks for auto parts. He developed symptoms of wheezing, coughing, chest tightness and shortness of breath at work a few months after beginning the job. These symptoms became worse during the workday and through the work week. He was treated multiple times at an emergency room for acute shortness of breath.

The Michigan Occupational Safety & Health Administration (MIOSHA) initiated an inspection after the hospital diagnosed and submitted an occupational disease report regarding his work-related lung condition. It was determined that there was no local exhaust ventilation in the welding area, although general supply and exhaust ventilation were operational. Air sampling was performed and it was determined that three of the four samples exceeded the eight-hour time-weighted average limit of 5 mg/m^3 for total welding fume particulate. The company was cited for overexposure to welding fumes and the lack of a respiratory protection program.

Additionally, 12 welders at the facility completed a confidential medical questionnaire during the inspection and three were bothered at work by daily or weekly breathing symptoms. In addition to the citations, the MIOSHA report recommended that local exhaust ventilation be installed and that welders be provided periodic medical testing.

Case Study #3 - Occupational Disease Asthma Report: MIG and Stick Welding and Isocyanate Exposures Investigated: A man in his 50's who had smoked a half pack of cigarettes a day for 28 years developed wheezing, cough, chest tightness and shortness of breath while welding at work. He began welding in his late 20's, doing MIG and stick welding. He had welded at five different companies for 21 years before developing breathing symptoms. He continued to work for another four years until he was laid off and went on Social Security disability because of the severity of his lung disease. Medical testing indicated he had asthma; he did not have the smoking-related condition, chronic obstructive pulmonary disease (emphysema). He had been hospitalized six times for his lung disease prior to being laid off and had not been hospitalized since. At the last facility he worked, when he was diagnosed with asthma, he worked near the painting area. He had blood tests that showed past exposure to isocyanates, which like welding fumes, are a well-known cause of work-related asthma.

The Michigan Occupational Safety and Health Administration (MIOSHA) initiated an inspection after a physician submitted an occupational disease report. During the inspection, three welders had air sampling with time weighted averages for welding fumes and two were above the MIOSHA standard of 5 mg/m^3. The company was cited for overexposure. There was no local exhaust in the welding area where up to 20 welders worked. The company was also cited for not having a respiratory protection program. During the inspection, another welder with breathing problems related to work was identified. At the time of the inspection, isocyanate-containing paints were not identified.

Case Study #4 - Work-Related Asthma from Cobalt Exposures While Grinding on Tungsten Carbide: A man in his 30's who had smoked a quarter pack of cigarettes a day for 20 years became short of breath a few months after beginning to grind tungsten carbide. He had previously worked 10 years for the same company grinding steel. He was diagnosed with work-related asthma from exposure to cobalt found in tungsten carbide. He received workers' compensation for his asthma. He was able to continue to work with medical restrictions that he not be exposed to cobalt.

The Michigan Occupational Safety and Health Administration (MIOSHA) initiated an inspection after being notified by Workers' Compensation about the lung condition. The company received two citations related to cobalt exposure: 1) Four employees had a time weighted average above the .05 mg/m^3 PEL; 2) An inadequate respiratory protection program because the written protection program was inadequate, there was no medical evaluation or fitness evaluation prior to wearing a respirator, and no fit testing. The company was also cited for not having a hearing conservation program, improper labeling of containers and improper completion of the OSHA log. Three other workers were identified during the inspection as having work-related breathing problems. A periodic medical surveillance program was recommended for workers with potential exposure to cobalt.

Isocyanates and the NEP: Two inspections were performed as part of the isocyanate NEP. At the first inspection, 73 employees over two shifts were interviewed; at the second inspection four questionnaires were completed. No individuals reported any asthma-related symptoms from these two inspections. At a third inspection at an isocyanate-using company not under the NEP, 11 questionnaires were completed, per MIOSHA's request to assist and administer co-worker questionnaires. No individuals reported any asthma-related symptoms at this third facility.

Aim #3: To continue and expand on occupational health surveillance collaborative activities within Michigan, among states and with NIOSH.

Ms. Reilly was appointed to the Advisory Board for the State's Michigan Tracking Network, a 3-year project to develop an interactive public web portal to provide access to health and environmental data for Michigan. The role of the MSU Surveillance Center is to ensure that the Work Place, as an environment, is included in this developing project.

Surveillance data was provided to NIOSH according to NIOSH specifications.

All existing educational products developed through the Michigan Surveillance Center were uploaded to the CDC's NIOSH Clearinghouse. As new products such as data fact sheets and annual reports were produced, they were also uploaded to the NIOSH Clearinghouse.

Michigan actively participated in preparing joint publications among the SENSOR states, including taking the lead on Swimming Facilities and Work-Related Asthma (Rosenman et al, 2015), and other projects including Isocyanates and Work-Related Asthma: Findings from California, Massachusetts, Michigan and New Jersey; 1993-2008 (Lefkowitz et al., in review); and Gender Differences in Work-Related Asthma: Surveillance Data from California, Massachusetts, Michigan and New Jersey (White et al, 2014).

Dr. Rosenman was active in CSTE and participated in planning for the annual CSTE/Occupational Health meetings. He was the Co- Lead for the CSTE Occupational Health Work Group. We developed an Occupational Health Story on WRA and isocyanates for the CSTE website where state success stories are shared. The document can be found at: http://c.ymcdn.com/sites/cste.site-ym.com/resource/resmgr/Occupational_Health_Success_Stories/OHSuccessStoryMichigan1final.pdf Dr. Rosenman and other staff participated in the Consortium of Occupational Health States (COSS) meetings and related joint activities.

D.1.a.4. Results, Discussion and Conclusions

The Surveillance Center has received 4,686 reports and confirmed 3,408 individuals with work-related asthma who worked at 2,455 different facilities. On average, 187 reports were processed annually. Table 1 shows the leading causes of work-related asthma in the Michigan surveillance system.

Since 1988, MIOSHA conducted 774 follow up investigations of the confirmed work-related asthma cases in 663 facilities. Multiple investigations were performed at some of the larger facilities where asthma cases were received from different departments. Every company investigated received a report of the findings. Air sampling for potential allergens was conducted during 547 of the investigations: 66 (12.1%) of the 547 facilities had sampling results above the National Institute for Occupational Safety and Health recommended exposure level (REL) and 27 (4.9%) were above the enforceable Michigan OSHA permissible exposure limit (PEL) (Table 2).

Table 1. Leading Agents Associated with Work-Related Asthma Identified by the Michigan Surveillance System: 1988-2015		
Agent	**Number**	**Percent**
Isocyanates	403	11.8
Cleaning Solutions	385	11.3
Metal-Working Fluids	319	9.4
Exhaust/Smoke/Fumes	162	4.8
Welding Fume	145	4.3
Solvents	112	3.3
Paint Fumes	81	2.4
Epoxies	71	2.1
Fungus	69	2.0
Formaldehyde	66	1.9
Acids	64	1.9
Latex/Rubber	61	1.8
All Others	1,470	43.1
TOTAL	3,408	100.1

Table 2. Results of 774 Industrial Hygiene Inspections in 663 Facilities Where Patients with Confirmed Work-Related Asthma were Exposed to Allergens: 1988-2015		
Inspection Results	**Number**	**Percent**
Air Sampling – NIOSH Standard		
Above NIOSH Standard	66	8.5
Below NIOSH Standard	459	59.3
No NIOSH Standard	27	3.5
Unknown (no report yet)	11	1.4
Did Not Sample for an Allergen	27	3.5
Did Not Sample	184	23.8
TOTAL	774	100.0
Air Sampling – MIOSHA Standard		
Above MIOSHA Standard	27	3.5
Below MIOSHA Standard	517	66.8
No MIOSHA Standard	7	0.9
Unknown (no report yet)	11	1.4
Did Not Sample for an Allergen	28	3.6
Did Not Sample	184	23.8
TOTAL	774	100.0

We interviewed 10,729 fellow workers at 644 facilities during these investigations. A total of 1,644 fellow workers who were bothered at work with daily or weekly respiratory symptoms received a letter referring them for medical follow up. The grouped results of the respiratory symptoms, in conjunction with the walkthroughs and air sampling, were used in reaching conclusions in the reports written for each investigation.

The 774 inspections resulted in a total of $644,767 in initial penalty costs (final penalties assessed amounted to $331,982) at 217 companies inspected. There were a total of 1,025 citations issued at 396 of the WRA inspections (333 Serious, 10 Willful, 46 Repeat and 636 Other than Serious).

Despite the absence of specific standards for many workplace allergens, these investigations produced a similar number of citations and monetary penalties as other Michigan OSHA inspections. Among the first 50 company inspections generated to follow-up an asthma index case, 20 (40%) were cited for violation of a Michigan OSHA standard. These companies received an average of 3.2 citations per company with an average penalty of $425. We randomly selected 75 companies with the same 4 digit standardized industrial classification (SIC) code as the asthma companies but which had been inspected to follow-up an employee complaint. Among these 75 companies, 41 (55%) received a citation for violation of a Michigan OSHA standard. There was an average of 2.7 citations per company cited with an average fine of $183 per company (Rosenman and Watt 1991). We also compared the results of the 545 Michigan OSHA inspections performed from 1989-2002 to follow up reports of occupational asthma with Non-SENSOR Michigan OSHA inspections performed during the same time period. Two control groups of inspections were used; inspections matched by 5 year time periods and industry type (same 2-digit SIC code, n=1,635) and all inspections from 1989-2002 (n=12,268). SENSOR asthma inspections were more likely to be conducted in larger, unionized employers. Although the likelihood of citations (~50%), type of citation, and penalties (~30%) were no different between SENSOR and non-SENSOR inspections, the number of citations and amount of penalties were less in SENSOR inspections (Reed et al., 2007).

Work-related asthma deaths: Michigan was the only state that conducted surveillance for work-related asthma that has been able to identify work-related asthma deaths. In the prior 5-year funding period, we described 8 deaths we identified through three sources: 1) The work-related asthma surveillance program, which was the focus of this proposal; 2) The work-related traumatic fatality surveillance project (FACE); and 3) The Michigan asthma mortality project, which ended in 2012. This last project, was done cooperatively between MSU and MDHHS, was funded by the Center for Environmental Health at CDC. Michigan was the only state funded to do this activity. Fortunately, a very small percent (0.01-0.02%) of asthma patients die from asthma. Since 2003, the Michigan Surveillance Center has identified nine work-related asthma deaths: six of those deaths occurred at work, the other three individuals died at home after long term complications of their asthma, which they had developed while working.

The most recent WRA death, in 2013, was of an individual first identified through our surveillance system in 1999. She died at the age of 67 in 2013. The underlying cause of death on her death certificate was occupational asthma. She had first been diagnosed with occupational asthma at the age of 54. She had developed shortness of breath in association with exposures at work at the age of 53. Prior to developing shortness of breath she had worked for 12 years operating a molding machine at a company that made rubber products. There was no family or personal history of allergies. Prior to working at the rubber manufacturer, she had worked as a waitress, a nurse's aide and in a dry cleaner. Two months after leaving work her pre bronchodilator results were a FVC of 2.39 liters (87% of predicted), a FEV_1 of 1.33

liters (59% of predicted) and a FEV_1/FVC ratio of 56%. Post bronchodilator her FEV_1 increased 30% to 76% of predicted. Her alpha-1 antitrypsin level was normal.

Four months after not working, she felt better. She was using an inhaled steroid and long acting bronchodilator and only used albuterol once a week. Three months later, still not working, she developed increased respiratory symptoms that she attributed to humidity. She was prescribed a six day course of oral steroids. A month later she returned to work on a trial basis. Her respiratory symptoms increased. She would work one day then miss the next day because of symptoms. Albuterol use increased to four to five times per day. She was hospitalized for three days; ipratropium was added to her medication. On return to work she was given a medical restriction and was given an office job at the rubber manufacturer. Repeat spirometry showed her FEV_1 was still reduced at 57% of predicted. She developed increased shortness of breath at the office job and left work. She applied and was accepted for Social Security Disability and was awarded workers' compensation. She last worked at the age of 54

Her respiratory symptoms persisted after leaving work. She was bothered by perfumes, heat and humidity. She continued to smoke a pack of cigarettes a day from the age of 16 until she died. She had 25 emergency department visits and six hospitalizations for respiratory problems after leaving work.

D.1.a.5. References Work-Related Asthma

Ayres JG, Boyd R, Cowie H, Hurley JF: [2011] Costs of Occupational Asthma in the UK. Thorax 66:128-133.

Balmes J, Becklake M, Blanc P, Henneberger P, Kreiss K, Mapp C, Schwartz D, Toren K, Viegi G: [2003] American Thoracic Society Statement: Occupational Contribution to the Burden of Airway Disease. Am J Respir Crit Care Med 167:787-797.

Banga A, Reilly MJ, Rosenman KD: [2011] A Study of Characteristics of Michigan Workers with Work-Related Asthma from Exposure to Welding Fumes. J Occup Environ Med 53:415-419.

Blanc PD, Toren K: [1999] How Much Asthma Can Be Attributed to Occupational Factors? Am J Med 107:580-587.

Flattery J, Davis L, Rosenman KD, Harrison R, Lyon-Callo S, Filios M: [2006] The Proportion of Self-Reported Asthma Associated with Work in Three States-California, Massachusetts and Michigan, 2001. J Asthma 43:213-218.

Henneberger PK, Redlich CA, Callahan DB, Harber P, Lemiere C, Martin J, Tarlo SM, Vandenplas O: [2011] An Official American Thoracic Society Statement: Work-Exacerbated Asthma. Am J Resp Crit Care Med 184:368-378.

Knoeller GE, Mazurek JM, Moorman JE: [2013] Asthma Symptoms among Adults with Work-Related Asthma. J Asthma 50:166-173.

Leigh JP, Romano PS, Schenker MB, Kreiss K: [2002] Costs of Occupational COPD and Asthma. Chest 121: 264-272.

Lutzker LA, Rafferty AP, Bruner WM, Walters JK, Wasilevich EA, Green MK, Rosenman KD: [2010] Estimates of the Prevalence of Work- Related Asthma in Michigan, Minnesota and Oregon. J of Asthma47:156-161.

Quinn M, Henneberger PK, Braun B, Delclos GL, Fagan K, Huang V, Knaack JL, Kusek L, Lee SJ, LeMoual N, Maher KA, McCrone SH, Hogan Mitchell A, Pechter E, Rosenman KD, Sehulster L, Stephens AC, Wilburn S, Zock JP: [2015] Cleaning and Disinfecting Environmental Surfaces in Healthcare: Towards an Integrated Framework for Infection and Occupational Illness Prevention. Am J Infect Control 43:424-434.

Rosenman KD and Watt F: [1991] Workplace Follow-up of Occupational Disease Reports. Presented at the National Conference on State-Based Occupational Health and Safety Activities. Cincinnati, Ohio: NIOSH, September 3-6, 1991.

Reed PL, Rosenman KD, Gardiner J, Reeved M, Reilly MJ: [2007] Evaluating the Michigan SENSOR Surveillance Program for Work-Related Asthma. Am J Ind Med 50:646-656.

Rosenman KD, Beckett WS: [2015] Web Based Listing of Agents Associated with Work-Related Asthma. Respiratory Medicine 109:625-631.

Rosenman KD, Millerick-May M, Reilly MJ, Flattery J, Weinberg J, Harrison RJ, Lumia ME, Stephens AC, Borjan M: [2014] Swimming Facilities and Work-Related Asthma. J Asthma 52:52-58.

Rosenman KD: [2015] Occupational Diseases in Individuals Exposed to Metal Working Fluids. Current Opinion in Allergy and Clinical Immunology 2:131-136.

Tarlo SM, Lemiere C: [2014] Occupational Asthma. N Eng J Med 370: 640-649.

Tarlo SM, Balmes J, Balkissoon R, Beach J, Beckett W, Bernstein D, Blanc PD, Brooks SM, Cowl CT, Daroowalla F, Harber P, Lemiere C, Liss GM, Pacheco KA, Redlich CA, Rowe B, Heitzer J: [2008] Diagnosis and Management of Work-Related Asthma: American College of Chest Physicians Consensus Statement. Chest 134:1S-41S.

White GE, Seaman C, Filios MS, Mazurek JM, Flattery J, Harrison RJ, Reilly MJ, Rosenman KD, Lumia ME, Stephens AC, Pechter E, Fitzsimmons K, Davis LK: [2014] Gender Differences in Work-Related Asthma: Surveillance Data from California, Massachusetts, Michigan , and New Jersey. J Asthma 51:691-702.

Vollmer WM, Heumann MA, Breen VR, Henneberger PK, O'Connor EA, Villave JM, Frazier EA, Buist AS: [2005] Incidence of work-related asthma in members of a health maintenance organization. J Occup Environ Med 47:1292-1297.

D.1.b. Work-Related Traumatic Deaths

D.1.b.1. Specific Aims

The overall goal of this surveillance project is to reduce the occurrence and burden of work-related traumatic death. The following specific aims reflect the planned activities of this proposed project:

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

- To continue to identify the underlying causes of work-related fatal injuries in Michigan.
- To continue to formulate and disseminate prevention strategies to reduce work-related fatal injuries.
- To continue collaborative activities among the states with funded FACE programs and with NIOSH.

D.1.b.2. Background and Significance of Work-Related Traumatic Deaths

Work-related fatal injuries are a significant problem both in Michigan and the United States. The U. S. Bureau of Labor Statistics 2013 work-related fatality data identified 4,585 individuals who died at work. In Michigan in 2013, 134 individuals died due to a work-related injury. On average, 135 work-related fatalities have occurred each of the last 5 years in Michigan. In 2010 there were 144 deaths (88 deaths occurred between 7/1/2010-12/31/2010), in 2011 there were 141 deaths, in 2012 there were 134 deaths, in 2013 there were 134 deaths, in 2014 there were 137 deaths and in the first six months of 2015, 41 work-related deaths have so far been identified. Work-related fatal injuries are preventable. The MIFACE program goals continue to be the prevention of future fatalities by the assessment of the factors causing these deaths and effective dissemination of the information to parties who could initiate health and safety changes in similar type workplaces. Surveillance findings in Michigan highlighted hazards in construction, transportation, manufacturing, and agriculture as a priority for prevention efforts. In contrast to national 2013 statistics, although the percentage of construction work-related injuries were similar (828 of 4,585 (18.1% nationally and 25 of 134 (18.6%) in Michigan), the hours-based (full-time equivalent (FTE) incident rate in Michigan was nearly double the national rate (18.9 compared to 9.7 nationally).

An economic analysis by J. Paul Leigh of UC Davis Medical School indicated that the 5,607 traumatic occupational deaths in 2007 cost the nation $6 billion annually, including direct medical costs and indirect costs such as lost wages and productivity (Leigh JP [2011]). In Michigan, for 2007, there were 121 work-related deaths identified with a lifetime cost of $129,481,006. Reducing the number of work-related deaths not only reduces the economic burden to Michigan and the nation, but also the emotional and personal burdens faced by family members.

MIFACE surveillance findings also underscored the limitations of relying on OSHA to investigate work-related deaths. Two-thirds of Michigan's work-related fatal injuries were either not under the legal jurisdiction or considered not program-related fatalities by the Michigan Occupational Safety and Health Administration (MIOSHA) and did not receive an enforcement inspection. Examples of these fatalities were self-employed workers, family farms, work-related homicides and suicides, and on-the-road motor vehicle deaths.

We have also noted the limitation of relying on death certificates to ascertain if the injury was work-related. Medical examiners complete the individual's death certificate's Injury at Work information. During the past four years (2010-2013), the Injury at Work information was not correct (the Injury at Work box was completed with NO when the death was work-related) 30-45% of the time (2010 (29.7%), 2011 (30.7%), 2012 (44.8%), and 2013(37.4%)).

D.1.b.3. Methods

Aim #1: To Continue to Identify Work Situations in Michigan at Increased Risk for Work-Related Fatal Injuries

A comprehensive surveillance system for work-related fatal injuries was maintained. Information collected in this surveillance system identified types of industries and work situations which were at increased risk of fatalities. We continued to work closely with multiple groups to identify and obtain information about all work-related fatal injuries as they occurred. Multiple data sources continued to be used to identify and verify work-related deaths.

- Michigan OSHA Hotline: By Michigan law, an employer must report orally, any work-related fatality or hospitalization of 3 or more employees within 8 hours of occurrence to MIOSHA. Upon notification of a work-related death, MIOSHA distributed an e-mail notification to appropriate MIOSHA and MSU staff. MSU contacted the compliance officer assigned to investigate the fatality to gather information about the fatality.

- Coordination with the Census for Fatal Occupational Injuries (CFOI). Working within the BLS confidentiality limits, CFOI and MIFACE coordinated their activity to eliminate duplicate requests to other agencies. Each year the numbers have differed by one or two deaths because of differences in interpretation of "work-related".

- Newspaper Articles from Internet Notification: We established a "Google Alert" to receive e-mail updates on Michigan work-related deaths on a daily basis. We identified multiple keyword terms and as Google searches the Internet, when it finds a newspaper article, radio or TV broadcast using these search terms, Google notifies MIFACE by sending an email message.

- MDHHS Vital Statistics: MDHHS and MSU have a signed agreement that allows CFOI to share with us death certificates they identify as work-related.

- Michigan State Police Fatality Analysis Reporting System (FARS): The Michigan State Police Criminal Justice Information Center (CJIC) and the Office of Highway Safety Planning on an annual basis searched this database for work-related fatal crashes and forwarded the reports to MSU.

- Workers' Compensation Records: MSU received copies of workers' compensation claim forms for all fatal work-related injuries where a dependent files for workers' compensation.

- Medical Examiners: Each of Michigan's 83 counties has an assigned medical examiner. Upon notification of a work-related death, MSU contacted the Medical Examiner for the county of death and requested a copy of the Death Scene Investigation, the Medical Examiner Report, and toxicology results.

- Coast Guard: Michigan is located in the 9th Coast Guard District. On a monthly basis, MSU accessed the 9th District's Public information website (http://www.uscgnews.com/go/doctype/4007/117443/) to review all press releases from the Coast Guard and daily operational summaries.

- National Transportation Safety Board (NTSB): On a monthly basis, MSU reviewed the summaries from the NTSB aviation accident database online (http://www.ntsb.gov/_layouts/ntsb.aviation/index.aspx) to identify possible aviation work-related fatalities that occurred in Michigan and the database to determine if reports had been issued for previously identified aviation work-related fatalities.

- Mine Safety and Health Administration (MSHA): MSU reviewed the Metal and Nonmetal Mine Fatality section's Fatal Alert Bulletins and Fatal grams on the webpage (http://www.msha.gov/fatals/) to

determine if there was a work-related death in Michigan. If a death occurred, MIFACE obtained the "Fatal gram" narrative summary. On a monthly basis, MSU reviewed the site for past fatality reports.

- Federal Railroad Agency (FRA): On a monthly basis, MSU reviewed Federal Railroad Administration Office of Safety Analysis website (http://safetydata.fra.dot.gov/officeofsafety/ to identify fatal work-related deaths.

- MSU Cooperative Extension Agents: Extension agents reported to MIFACE when a work-related death occurred in their county. MIFACE contacted Extension when gathering information about the fatality.

- Police, Firefighter, EMS and Security Guard Memorial Pages: On a monthly basis, MSU accessed the on-line memorial page for police officers (www.odmp.org) and the on-line page for firefighters (http://apps.usfa.fema.gov/firefighter-fatalities/) , EMS personnel (http://www.ems1.com/lodd-line-of-duty-deaths/) and security guards (http://www.privateofficer.com/OfficerDown.html).

The key elements of the surveillance system that provided the greatest number of deaths were the Google Alert internet notifications, MIOSHA hotline, death certificates and the State Police. Many existing data sources, e.g. workers' compensation reports and death certificates, while useful sources of information, were not available until months after the date of death, which was too late to initiate timely on-site investigations.

Outreach to maintain and improve reporting consisted of the following:

1. Work-related Fatality Investigation Reports
2. Annual reports and 2-page Data Fact Sheet for work-related traumatic deaths
3. Hazard Alerts
4. Presentations at Michigan Safety conferences, trade and professional safety and health conferences
5. Display booths at Michigan Safety conferences
6. Updating of the Surveillance Center website and linkages to other important sites
7. Posting educational materials including case reports and a summary of each work-related death on the Surveillance Center website
8. Creation and maintenance of Face Book and Twitter accounts to highlight work-related deaths, maintained by the MSU Surveillance Center
9. Development and distribution of scientific journal articles to raise awareness of and increase reporting of occupational work-related deaths
10. Updated the MSU Surveillance Center and MIFACE website
11. Press Release on Worker Memorial Day
12. Advisory Committee

We maintained an updated mailing list of stakeholders, such as medical examiners, police departments, fire departments, safety and health professionals, individual companies, trade groups, unions, etc.

Both Dr. Rosenman and Debra Chester, MIFACE project coordinator and field investigator gave talks at the Michigan Safety Conference. Ms. Chester also presented at trade group conventions.

We routinely exhibited display booths at major safety conferences around the state. At the booth, we distributed investigation reports, annual reports, and hazard alerts, website information, and a resource sheet of useful contact numbers.

The MSU Surveillance Center web site (www.oem.msu.edu) was updated to provide links to the various surveillance programs located at MSU Occupational and Environmental Medicine. Additionally, the MIFACE website (www.oem.msu.edu/MIFACE_program.aspx) was updated to provide easier access for visitors to find and search fatality investigation reports, summaries of MIOSHA investigations, hazard alerts by industry and/or cause of death, and annual MIFACE fatality summaries.

Each year for Workers' Memorial Day we issued a press release about work-related fatal injuries in Michigan. On the average, we had three radio interviews each year in response to the press release.

We continued to maintain an advisory committee. The advisory board members represented the construction, manufacturing and agricultural industries, manufacturing and construction trade unions, MIOSHA, and insurance representatives. The committee provided a mechanism for us to receive feedback from the targeted groups. Additionally, the involvement of leaders and prominent members of these organizations was an encouragement to their members to become active in Michigan's work-related fatality surveillance efforts.

We followed our standard procedure for following up on work-related traumatic deaths that have been used for the previous funding periods. We wrote letters to the medical examiner and responding public agency (Michigan State Police, City Police Department, County Sheriff, and Township Police) for a copy of their report for all work-related deaths. Additionally, when it was unclear as to whether the death was work-related, request letters to these entities were also written. When needed, letters requesting information were sent to a fire department, EMS agency, or hospital where treatment may have taken place. Follow-up phone calls were made when a response from these agencies was not forthcoming in a timely manner. MIOSHA compliance officer contact was initiated after a MIOSHA program-related fatality notification was received. MIFACE interviewed the assigned MIOSHA compliance officer to complete the appropriate data collection forms. If a work-related death occurred at a privately owned company or public entity (such as a township), a high-ranking individual employed at the company/entity was contacted by letter introducing the MIFACE program and asking for their voluntary participation in the program. If the work-related death occurred to a farm owner or self-employed worker, family members were contacted and asked for their voluntary participation. No MIFACE company/entity follow-up occurred when an individual died as a result of a homicide, suicide, or on-the-road death. When participation was granted, the MIFACE investigator traveled to the location agreed upon, visited the incident site (if applicable) and completed the data collection forms.

Data collection form responses were computerized for data analysis. A computer tracking system was used to manage the day-to-day follow-up of the cases. Quality control procedures were routinely conducted. Data were kept in password protected computer sites accessible only by authorized staff.

An annual report with statistical data, progress reports, and highlights of interesting new findings was prepared and disseminated. MIFACE maintained and continually updated a mailing list of interested stakeholders, such as industry and union groups, public health professionals, and others with an interest

in occupational health. This mailing list was used to distribute the Annual Reports. The Annual Report was also placed on the Surveillance Center web site.

Aim #2: To Continue to Identify the Underlying Causes of Michigan Work-Related Fatal Injuries

The information collected on the data collection forms and through interviews continued to follow the NIOSH FACE model of on-site, in-depth investigations and included collection of: size of company; content of company safety program; victim's age, gender, personal habits and occupation; tasks the victim was performing; tools or equipment the victim was using; the working environment; the energy exchange resulting in the fatality; and the role of management in controlling how these factors interact. The investigations continued to focus upon the underlying causes of the fatalities rather than compliance with MIOSHA standards. On-site investigations at the location of the fatal injury were performed by the project coordinator. A farm safety specialist continued to assist for farm-related fatalities. We continued to follow the protocol developed by NIOSH to conduct the investigations and collect the information.

We conducted in-depth investigations of fatal incidents that were targeted nationally by NIOSH or were of special significance to Michigan industry. Agriculture and Transportation incidents that did not occur on the road were two priorities since both Agriculture and Transportation had high fatal incidence rates. We utilized root cause analysis to identify both "root cause" and to determine causal factors. A root cause would be a factor, which if removed, would prevent the death from occurring. A causal factor is one that affects an event's outcome and can be beneficial if addressed, but does not prevent a death. The MIFACE participant received the fatality investigation report. If the company had employees represented by a union and union representation was present during the site visit, MIFACE sent a copy of the report to the union representative. Information about the site visit was collected and entered into the computerized case data tracking system.

Aim #3: To Continue to Formulate and Disseminate Prevention Strategies to Reduce Work-Related Fatal Injuries

The purpose of the surveillance system and identification of the underlying causes of Michigan's work-related fatal injuries continued to be the prevention of additional fatalities. An essential function of the activity was the dissemination of the information collected and identification of specific strategies to effect changes in engineering and/or work practices. These strategies included education/training, engineering design, and/or changes in legislation, contract language, or policy.

Reports of on-site investigations continued to include recommendations that identified prevention strategies. We developed numerous contacts, some of whom were on our advisory committee, to provide feedback and assistance to enhance our technical skills in developing innovative yet feasible recommendations.

Information dissemination activities aimed at reducing the number of fatalities were both workplace-specific and industry-wide in scope. On-site reports were routinely disseminated, via a dissemination plan that was developed for each report, to those involved in the incident (employers, worker representatives etc.). Additional outreach activity specific to the fatality was identified for each death investigated that resulted in dissemination to trade associations, employers and unions as appropriate. To facilitate broad-based dissemination to those at risk and those who could effect change, we developed mailing databases for specific types of industries identified through the surveillance system to be at high

risk for work-related fatalities. We continued to publish several on-site investigation reports in trade association journals.

We continued to develop short, user friendly materials to be posted in workplaces (Hazard Alerts). We continued to review the MIOSHA enforcement inspections that did not have a MIFACE on-site investigation. We summarized the MIOSHA inspection (a description of the events involved in the death) and the citations issued by MIOSHA at the conclusion of the investigation. This summary was posted on the MIFACE website. The members of our Advisory Board and individuals at events MIFACE has attended indicated that these summaries were used in employee training and tailgate talks.

We developed a dissemination plan to distribute NIOSH/OSHA publications, such as Youth in Agriculture brochures, Fall Prevention and Heat Stress through our email database and industry-based meetings.

We also disseminated information through speaking engagements with industry, labor, and academic groups, and developed case studies based on on-site investigations for use in teaching.

We continued to use our web page at Michigan State University (www.oem.msu.edu) as another way to disseminate information. With each report sent to the employer, a report evaluation postcard was included. Most returned evaluation postcards indicated that overall impression of the report was Excellent/Good, and that the report was useful during a change in work practice.

The Surveillance Center webpage had a tracking system that counted the number of times each specific webpage was accessed. MIFACE information (investigation reports, MIOSHA summaries and hazard alerts) were accessed by visitors to the site more than 100 times per month.

All materials posted to the MSU MIFACE page were also uploaded to the NIOSH Clearinghouse.

Aim #4*:* To Continue Collaborative Activities among States with Funded FACE Programs and With the National Institute for Occupational Safety and Health

In conjunction with NIOSH and other states funded to conduct surveillance for work-related fatal injuries, Michigan prioritized investigations and data collection for special populations, industries and types of fatalities agreed to by the group.

Publications: Michigan actively participated in preparing a joint publication in the Morbidity and Mortality Weekly Review (*Fatal Exposure to Methylene Chloride in Bathtub Refinishers – Nine States, 2000-2011,* February 24, 2010/61(07); 119-122).

Meetings: Michigan has participated in the yearly FACE meetings. The MIFACE project coordinator has served as the State Coordinating Chair for the past 2 years.

D.1.b.4. Results, Discussion and Conclusions

We have confirmed 1,944 work-related fatal injuries in Michigan for the years 2001-2015; 675 deaths have occurred in the past five years. We contacted 826 companies, and have conducted 189 (23.0%) on-site investigations of which 177 have been released. Two fatality inspections determined that the death was not work-related. For two inspections when MIFACE arrived for the site visit, the individual meeting with MIFACE wanted to consult with an attorney; one individual subsequently refused to participate (Accommodation & Food Service), and for one individual (Retail Trade), MIFACE is still awaiting a final

answer. Ten reports are currently being written or are under review. All investigation reports contained a description of the events preceding the death, identified root cause and causal factors and made recommendations for the prevention of similar fatalities in the future. Of the 826 employers contacted for work-related fatalities, 607 (73.5%) companies declined to participate in the MIFACE program. MIFACE recruitment letters were sent to five families; for four families, we asked them to contact us as we could not locate phone numbers and for three families, phone numbers were located but the numbers had been disconnected. MIFACE did not initiate contact with 1,071 (55.1%) employers. Due to the recentness of the fatality or lack of contact information, MIFACE has not contacted 47 employers.

Table 1 shows the industries of the 177 on-site investigations where reports have been released which have occurred since 2001.

Table 1. MIFACE On-site Investigations and Investigation Reports Released by Industry: 2001-2015

Industry	Number of MIFACE On-Site Investigations	Number of MIFACE On-Site Investigation Reports Released
Agriculture	54	51
Mining	2	2
Utilities	5	5
Construction	57	56
Manufacturing	17	17
Retail Trade	1	
Wholesale Trade	1	1
Transportation & Warehousing	13	11
Real Estate & Rental & Leasing	1	1
Administrative & Support & Waste Management & Remediation Services	11	10
Education	1	1
Arts, Entertainment & Recreation	7	7
Accommodation & Food Services	4	2
Other Services	10	8
Public Administration	5	5
Total	189	177

Nineteen one-page hazard alerts have been developed to highlight the death and potential lifesaving interventions, nine in the last five years. These hazard alerts have been distributed for posting in workplace(s) and for wide spread dissemination (e.g., members of a trade association such as arborists).

The titles of the 19 hazard alerts are:

Farmer Died as Result of Starting a Tractor on Ground	Look For Mobile Equipment Blind Spots
Electrocuted While Welding	CA Storage: Respiration Halted for Fruit and People
Slippery Clutch Pedal	Look Up For Overhead Lines
Pyro technician Struck in Head by Firework	Methylene Chloride Causes Death of Three MI Bathtub Refinishers
Arborists: Look up, Stay Clear and Stay Secured	Falls From Scaffolds Can Be Prevented
Fatal Asthma Attack While Cleaning Bulk Milk Tank	Stop Fatal Falls in Construction
Why Bother With A ROPS Retrofit?	Temporary Worker Safety – A Shared Responsibility
Trench Cave-Ins Kill	STOP Work-Related Homicides
Injury Prevention Strategies for Older Drivers	Don't Get Nailed by a Nail Gun
Carbon Monoxide	

Annual reports on Work-Related Fatal Injuries have been prepared for 2001-2013. The annual reports contain statistics on all the fatal injuries from that year and short paragraphs describing each death.

In addition to the in-depth reports we prepared for on-site investigations, we developed, at the request of health and safety representatives from industry, 359 summaries of fatalities investigated by MIOSHA, but not by MSU; 134 were written in the last five years. A typical MIOSHA report of a fatality investigation contained information about the citations issued but no description of the circumstances of the death. The summaries developed include a description of the death and the citations, and were placed on our website so as to be readily available. The summaries we prepared continue to be used in training programs by MIOSHA, industry, and insurance providers, in "tailgate talks" on the worksite, and by the MIOSHA Consultation, Education and Training (CET) division as a basis for Safety Alerts.

A total of 227 presentations were made by MIFACE personnel using MIFACE data, findings and recommendations, 105 done in the last five years. Presentations were made to agricultural employers/farm families, health and safety specialists, MSU Extension personnel, labor unions, trade associations, occupational health specialists, and at the Michigan Safety Conference. Additionally, MIFACE data has been utilized by CET in their annual meeting for applicants for CET grant awards. In addition, we have set up a display booth at multiple health and safety conferences.

Each year for Workers' Memorial Day we issued a press release about work-related fatal injuries in Michigan. In four of the past five years, Dr. Rosenman or Ms. Chester was a featured speaker in the annual Worker Remembrance Day held in Lansing. In addition to newspaper articles, we had on the average three radio interviews each year in response to the press release.

All the material we have prepared is at the minimum posted on our website, handed out at display booths at conferences, at our presentations, and uploaded to the NIOSH Clearinghouse.

Controlled Atmosphere Storage: In 2009, MIFACE conducted an on-site investigation regarding the 2008 death of a worker in an apple controlled-atmosphere storage facility. While gathering safety and health

information regarding controlled atmosphere storage from MSU Extension personnel, MIFACE learned that the MSU Extension classes and manual regarding controlled atmosphere storage concentrated on maintaining the product and minimal safety and health information which had not been updated since the 1990s. In 2010, MIFACE developed a new Health and Safety section in the Controlled Atmosphere Storage manual which discussed both health issues and safety issues, such as lockout-tagout and personnel entry into an in-use controlled atmosphere storage room.

National Truckers' Association Collaboration: Following the 2011 distribution of MIFACE Investigation Report, #09MI085: Truck Driver Struck by Semi-Tractor When Walking in Parking Lot, a representative from the National Truckers Association (NTA) initiated correspondence with MIFACE which led to collaboration with FACE States and NIOSH to establish a "Safety Issues" page on the NTA webpage (http://www.nationaltruckers.com/blog). This page highlights State FACE and NIOSH transportation-related investigation reports and data. The NTA also sends the information to its 43,000 members. NTA began posting the State FACE and NIOSH transportation-related reports on the Safety Issues webpage in January 2015. To date, two of the eight State FACE and NIOSH documents highlighted on the Safety Issues page are Michigan FACE reports.

Methylene Chloride and Bathtub Refinishers: In 2010, a bathtub refinisher died when using methylene chloride to strip an apartment bathtub. This was the third methylene chloride/bathtub refinishing death in Michigan since 2006. MIFACE notified NIOSH of these three deaths, who in turn notified OSHA. The three agencies then collaborated on safety and health outreach materials to bathtub refinishers as well as a MMWR article to alert physicians, nurses, public health practitioners, epidemiologists and other scientists, researchers, educators and other stakeholders about this emerging public health issue. Additionally, MIFACE spoke with the decedent's spouse and developed a digital video telling his "story"- his life, his work, and how to prevent a future fatality. The digital story, Methylene Chloride and Bathtubs: A Dangerous Combination was placed on YouTube and has more than 1,740 views. On March 14, 2014, California's Department of Toxic Substances Control added methylene chloride to its list of hazardous products. As justification for including methylene chloride, California referenced the MMWR methylene chloride article.

MIFACE continued to conduct outreach to construction employers and employees, especially addressing fatal falls. From 2001 to 2015, the Construction industry in Michigan had 382 of the 1,944 (19.7%) work related death; falls accounted for 137 (35.9%) of these deaths. All fatal falls in construction occurred among males and, when the fall distance is known, 49.6% of these falls occurred at heights of less than 20 feet. Roofers experienced the highest number of fatal falls (29 falls) compared to other construction occupations. Agriculture had both the youngest worker (age 13 years) and the oldest worker (age 91 years) who died as a result of a fall. In addition to the development of two Hazard Alerts addressing fatal falls, MIFACE promoted the OSHA Fall Prevention Campaign by highlighting industry-specific fall hazards and the Fall Prevention Campaign resources during presentations, and sending several emails to the MIFACE email list regarding the Fall Prevention Campaign.

D.1.b.5. References Work-Related Traumatic Deaths

Leigh JP: [2011] Economic Burden of Occupational Injury and Illness in the United States. Milbank Quarterly 89(4):728-772.

MMWR: [2010] Methylene Chloride in Bathtub Refinishers – Nine States, 2000-2011 61(07); 119-122.

D.1.c. Fundamental Program

D.1.c.1. Specific Aims

The overall goal of this Fundamental Program is to continue the surveillance of occupational injuries, illnesses, and hazards in Michigan, so that the data can be used to reduce the occurrence and burden of work-related injuries and diseases.

The specific aims of this project are to:

1. Annually collect and analyze data on magnitude and trends in occupational illnesses and injuries in Michigan, including data for the CSTE Occupational Health Indicators (OHIs) (CSTE, 2015), work-related amputations, and other state-specific data.

2. Disseminate significant surveillance findings through publications in peer-reviewed journals, web postings, and social networking tools such as Twitter and Facebook.

3. Maintain and enforce the surveillance reporting infrastructure and data systems for mandatory reports of occupational disease and injury submitted under the Michigan Public Health Code and ensure their use in expanded surveillance programs.

4. Maintain and promote infrastructure for occupational health across Michigan's public health, academic, and occupational health regulatory system, in partnership with stakeholders and the concerned public to obtain input on priority conditions, disseminate findings, and provide the public with information about occupational safety and health.

5. Continue and expand on occupational health surveillance collaborative activities among states and with the National Institute for Occupational Safety and Health (NIOSH).

D.1.c.2. Background and Significance

Concepts and history of state-based occupational health surveillance: Surveillance in occupational health is defined as the systematic collection and analysis of information concerning hazards, disease or injury for the purpose of prevention of occupational disease or injury. The Institute of Medicine (IOM) published a report in 1987, which concluded that occupational disease and injury surveillance systems were inaccurate and not useful for prevention (NAS, 1987). One year later the same institution made broad recommendations for public health, including "...that every public health agency regularly and systematically collect, assemble, analyze, and make available information on the health of the community..." (NAS, 1988). This public health function - collection, analysis, and dissemination of health data - was identified by the IOM report as the first of the three core public health functions of assessment, policy development, and assurance.

In the intervening years, the National Institute for Occupational Safety and Health (NIOSH), the Bureau of Labor Statistics (BLS), the Occupational Safety and Health Administration (OSHA), Mine Safety and Health Administration (MSHA), and many states have promoted, established, and improved occupational illness, injury, and hazard surveillance systems. The development of these systems has been explicitly integrated into larger systems of intervention and prevention, as evidenced by the scope of activities funded by

NIOSH at the state level, beginning in 1988, under its Sentinel Event Notification System for Occupational Risks (SENSOR), Adult Blood Lead Epidemiology and Surveillance (ABLES), Fatality Assessment and Control Evaluation (FACE), capacity building, Core and Enhanced Occupational Health Surveillance, and Fundamental and Expanded Occupational Safety and Health programs. NIOSH's surveillance strategic plan recognizes the importance of state-based, public health surveillance (NIOSH, 2001).

Minimum and comprehensive guidelines for state occupational health programs, including surveillance, which were described in a report published by NIOSH (Stanbury et al, 1995) and updated in 2008 (Stanbury et al, 2008), provided the model for this program.

Core activities include the routine access and analysis of data from existing datasets; production of the CSTE OHIs; regular dissemination of occupational health data; development of stakeholder infrastructure, development of capacity for case follow-up for selected high priority conditions; and establishment of systems to link surveillance to prevention activities.

The Occupational Health Surveillance Workgroup of the CSTE, co-chaired by Dr. Rosenman, the Principal Investigator of this proposal, identified and defined a list of priority conditions for surveillance in its report to the NIOSH Surveillance Coordinating Group (NIOSH-CSTE, 2001). The Workgroup then went on to define a set of 19 occupational health indicators – OHIs (Thomsen et al 2007), develop a methodology for collecting the data (original publication was in 2002; current update: CSTE 2015), obtain one year of data on the 19 OHIs from 13 states, and publish a report (CSTE, 2005). Subsequently CSTE posted the 2000 OHI data on their website and has been adding years of states' OHI data since then, as well as adding two more OHISs. This multi-year OHI data, now from 21 states, is at http://www.cste.org/?OHIndicators. One of Michigan's NIOSH-funded epidemiologists, Mr. Largo, co-led quality control of OHI data submitted to CSTE by the states until that function was transitioned to NIOSH in 2011, and provided leadership in a number of other aspects of the OHI project

The concepts and implementation strategies that have evolved from these state-federal collaborations described above were the foundation of the Fundamental program for Michigan. Michigan was particularly well-positioned to maintain and enhance its Fundamental program because of its leadership in the CSTE OHI project, its well-developed occupational health infrastructure, and its highly developed occupational health surveillance system.

Occupational disease and injury in Michigan: Michigan is a diverse state demographically and geographically. With a population of 9.9 million, it is the nation's tenth most populous state. It has a large manufacturing base, being home to three major automotive companies, hundreds of automotive parts manufacturers and several large chemical companies, among others. Its second largest industry is agriculture. More than 4.7 million individuals work in the state, and some risk of illness or injury attends virtually every job held. Work-related injuries and illnesses cost 1.4 billion dollars in 2012 in workers' compensation claims in Michigan (National Academy of Social Insurance, 2014). The indirect costs of these conditions may be as much as five times greater (Leigh et al. 1997). Occupational disease and injury data show that working in Michigan has health risks. For example:

- On average, one worker dies on the job every three days in Michigan.
- There were 117,400 recordable injuries in 2013 in Michigan according to the BLS Annual survey, for a rate of 3.8 per 100 workers.

- Between 7,000 and 20,000 reports of occupational disease are submitted annually to the State of Michigan under the mandatory occupational disease reporting law.

- In 2014, 23,306 claims were paid for lost work time and 171,887 for medical claims only for work-related injuries and illnesses.

D.1.c.3. Methods and Results by Specific Aim

Aim #1. Annually collect and analyze data on magnitude and trends in occupational illnesses and injuries in Michigan, including data for the CSTE Occupational Health Indicators (OHIs) (CSTE, 2015), work-related amputations, and other state-specific data.

Occupational Diseases

All occupational diseases are required to be reported by health care providers, institutions, and employers under Michigan's Public Health Code. Reports of priority condition diseases are incorporated into condition-specific surveillance systems, and all disease reports are summarized in annual reports, which were initiated in 1997.

Occupational Health Indicators (OHIs)

The Principal Investigator was the co-chair of the CSTE state partners Workgroup that developed the OHIs and prepared the first CSTE OHI data report in 2002. Staff at MDHHS have participated in the Workgroup since its inception and have had major responsibility for carrying this project to completion.

Tom Largo, MDHHS, participated in refining and updating the descriptions of the OHIs, developing and annually updating the "How To" guide for generating three indicators, suggesting to CSTE revisions to the "How To" guide for other OHI's, pilot-testing guidelines for generating proposed new OHI's, collaborating with NIOSH and staff from other state programs to develop recommendations for states to analyze multi-year OHI data, and serving on the Quality Assurance committee reviewing all the states' submissions to CSTE, prior to their publication on the CSTE website. He then trained NIOSH while that function was transitioning to NIOSH in 2011. Using the "How-To" guide developed by the CSTE Workgroup, Michigan OHI data for all indicators (currently 21) and Employment Demographics were generated and submitted to CSTE annually according to CSTE deadlines.

Work-Related Amputations

Since 2007, Michigan has been conducting case-based surveillance on work-related amputations. Quarterly, inpatient and emergency department medical records are submitted by Michigan's 136 acute care hospitals. In addition, the Michigan Workers' Compensation Agency provides data on claims for wage replacement for all conditions. Cases of work-related amputations identified from medical records are linked to the workers' compensation claims database. The total estimate of work-related amputations is cases that are identified in these two sources; cases found in both data bases are only counted once.

Work-Related 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 136 acute care hospitals, including four Veteran's Administration hospitals. Annually, the Michigan Workers'

Compensation Agency provided access to all paid wage replacement workers' compensation claims for the previous year. Quarterly, the Michigan Poison Control provided reports with personal identifiers of work-related chemical burns. Michigan Fatality Assessment and Control Evaluation (MIFACE) program provided death certificates of individuals who died from a work-related burn. The four data sets were matched and a combined de-duplicated count of burns was determined.

Work-Related 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 136 acute care hospitals, including four Veteran's Administration hospitals. Annually, the Michigan Workers' Compensation Agency provided access to all paid wage replacement workers' compensation claims for the previous year. Michigan Fatality Assessment and Control Evaluation (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.

Work-Related Crushing Injuries

Since 2013, Michigan has been conducting case-based work-related crush injury surveillance. Quarterly, inpatient and emergency department medical records are provided by Michigan's 136 acute care hospitals, including four Veteran's Administration hospitals. Annually, the Michigan Workers' Compensation Agency 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 crush injuries was determined.

Heavy Metals

In September 2005, the Michigan Department of Community Health (MDCH) promulgated rules requiring clinical laboratories to report all test results of arsenic, cadmium, and mercury in blood and urine. All blood and urine heavy metals tests in individuals ≥ 16 years of age were reviewed and de-duplicated to determine the number of individuals exposed to heavy metals. Starting in 2013, only elevated test results were downloaded and reviewed.

Aim #2: Disseminate significant surveillance findings through publications, web postings, presentations, and social networking tools such as Twitter and Facebook.

Reports and publications:

Reports that summarized data from reports submitted under the OD reporting law as well as condition-specific surveillance systems were published annually and posted on the web. These reports used a standardized format for data summarization and included information on worksite interventions and other preventive actions taken in response to the data. They were distributed via email notifications through MSU's occupational health stakeholder's mailing list, to Michigan's 45 Local Health Departments, and to other interested parties (e.g. other states with occupational health surveillance programs). The list of Annual Reports published in this project period is in Section D.2 below.

A special study addressed data on work-related teen injuries in Michigan: MI occupational disease surveillance data of workers 14-17 years of age were accessed and summarized. Multiple reporting

sources were reviewed, including the 2006 to 2012 Michigan Health and Hospital Association (MHA) datasets of hospitalizations where workers' compensation was the expected payer; the 2008-2013 Michigan Poison Control Center data of youth workers with a work-related health issue; and the 2008-2013 Michigan Workers' Compensation Agency paid claims data. Results were presented in several venues, and the summary report is available on the MSU website (http://oem.msu.edu/userfiles/file/WorkingYouthOccTeenInjFinal.pdf).

Social media: Twitter and Facebook were used to disseminate materials and post advisories on occupational health issues. For example, the OSHA twitter feed on risks to outdoor workers of illness from excessive heat was "re-tweeted" during the June 2012 extreme heat wave.

Specific Aim #3: Maintain and enforce the surveillance reporting infrastructure and data systems for mandatory reports of occupational disease and injury submitted under the Michigan Public Health Code and ensure their use in expanded surveillance programs.

To promote awareness and compliance by health care providers with the OD reporting law, MSU maintained the web based OD reporting system on the MSU web site (see www.oem.msu.edu), and MDHHS and MIOSHA maintained links to the site from their web sites. MSU continued to remind health care providers of the reporting requirement through the quarterly mailing of the MSU "Project SENSOR News," a newsletter which has been prepared and mailed four times a year for twenty years and currently goes to a mailing list of 3,200 of which approximately 75% are physicians, and by presenting at meetings of medical professional organizations and other venues attended by health care providers.

Finally, the OD Reporting Law is available as a link on LARA's Health Professional Licensing Division Page, along with links to other MI requirements such as the Communicable Disease Reporting Law. The OD Reporting Law link replaced the mailing that newly licensed physicians in the state previously received. Most of the licensing process is now conducted electronically; this shift from mailed information to an electronic link followed suit with the state's change to the use of electronic forms submittal for medical licensing.

Compliance by other reporting sources with the reporting requirement included: mailed reminders annually to all Michigan acute care hospitals of the requirement for reporting, and follow-up telephone calls to ensure complete reporting; receipt of electronic reports from the Michigan Poison Control Center (PCC) of occupationally related calls with reported adverse health effects, receipt of laboratory results of lead tests in adults from the MDHHS Childhood Lead Program, and receipt of laboratory reports of other heavy metals from the MDHHS Environmental Health Division.

In order to maintain the OD reporting data system and ensure that case reports of targeted conditions were used as designated by condition-specific protocols, MSU coded and data entered all incoming OD reports according to written protocols. Some reports were submitted electronically by completing the form at the MSU website, and some were submitted in hard copy to MSU or to MIOSHA and forwarded to MSU. All data was entered into an Access database from the OD reports including: 1) employee name, age, sex, race, zip code and optional partial social security number; 2) employer name, worksite address, city, zip code, number of persons employed at the facility and an assigned North American Industry Classification System (NAICS) code; 3) details of the illness, diagnosis date, suspected causative agent(s), vital status, and an assigned ICD-9 code; and 4) information about the individual who submitted the

report, including whether the reporter is employed by the company, an outside medical department contracted by the company, or a private practice health professional. MSU conducted case-based follow-up activities, including interviews and MIOSHA referrals, and provided cases of pesticide toxicity to MDHHS.

The calendar year 2014 hospital discharge data request was expanded to include overnight stays for any condition with an expected payer of Workers' Compensation, to parallel the proposed changes in Federal OSHA reporting requirements requiring employer reporting to OSHA of at least one employee with an injury requiring an overnight hospital stay (reduced from five employees).

MIOSHA conduced enforcement activities by auditing selected occupational medicine clinics biennially. Like disease reporting laws for communicable disease, prior to this initiative no attempt had ever been made to penalize a health care provider for non-compliance. It is a misdemeanor and $50 fine for each case not reported. The results of the investigations were publicized in the Michigan occupational health community.

One theme that repeated itself when we examined the SENSOR data that we have collected over the 20 years of the project was that there was more work-related illness in the State than what was actually reported (Biddle et al, 1998; Henneberger et al, 1999; Rosenman et al, 2003). To address this issue why practitioners were not reporting, we used a one page questionnaire that was mailed to: Michigan Thoracic Society, Michigan Allergy Society and the Michigan Occupational and Environmental Medicine Association. Questions asked were: Are you aware that Michigan law requires the reporting of known or suspected occupational disease? Have you ever reported an occupational disease? Why haven't you reported? Unaware of law? Concerned about confidentiality? Never see work-related disease? Don't know how to report? Don't see the benefit of reporting?

MSU maintained an automated occupational disease reporting system which was developed for the electronic medical record used by the family practitioners and internists at MSU. The electronic medical record was modified by categorizing diseases as category I diagnoses (such as silicosis) which were automatically reported unless the provider did not allow a report to be submitted and category II diagnoses (such as asthma) where the health care provider received a reminder that "for a significant percentage of patients this condition may be caused or aggravated by work." The report was then transmitted to the MSU Surveillance Center.

Specific Aim #4: Maintain and promote infrastructure for occupational health across Michigan's public health, academic, and occupational health regulatory system, in partnership with stakeholders and the concerned public to obtain input on priority conditions, disseminate findings, and provide the public with information about occupational safety and health.

The primary mode for delivering information and surveillance products (e.g., annual reports, Project SENSOR News) has been via-mail. MSU and MDHHS performed regular updates of their stakeholder mailing lists, including updated lists of physicians from the following medical professional organizations: Michigan Occupational and Environmental Medicine Association, Michigan Allergy Society and Michigan Thoracic Society were also incorporated into e-mail distribution lists.

In addition to health care provider stakeholders groups, local health departments were targeted for outreach to improve awareness of occupational health issues in local communities and resources for prevention. MDHHS maintained e-mail group lists of local health department Health Officers, Medical Directors, and Environmental Health Directors, in collaboration with the Michigan Association of Local Public Health. These e-mail groups received notification of the annual reports and other materials as they were published or updated. Dr. Rosenman also met with the Local Health Department Environmental Health Directors in late 2014 to present our occupational health surveillance work and obtain input and support.

In addition to on-going activities discussed above, Dr. Rosenman continued to speak at medical professional organization meetings and/or a display booth with surveillance materials was set up.

Finally, a number of special projects were initiated to achieve this aim:

- With the assistance of a CDC Public Health Associate we conducted an analysis of the frequency of completed information about occupation and industry in the MDHHS's communicable disease database for selected infectious diseases with a potential for occupational causation or transmission, as the first step in requesting that occupational information be entered routinely into each infectious disease case report.

- Meetings were held with administrators of the Workers' Compensation Agency's Claims Processing Division to discuss continued access and the long-term partnership between MSU and the WCA. Efforts are underway to allow MSU access to WCA claims data beyond what the general public will see when the new WCA electronic system goes live in 2015, to be used for occupational health surveillance.

- We conducted an occupational safety and health on-line needs assessment of the MI temporary staffing agencies. The survey results indicated the need for information on who was responsible for: health and safety training prior to job assignments; providing medical surveillance for early recognition of work-related illness; complying with reporting requirements when temporary employees develop work-related illness; workers' compensation insurance coverage; making reassignments; and determining ability to work. As a result we developed and distributed three educational documents to the 311 Temporary Staffing Agencies in MI. A report was finalized and the results presented at a NIOSH meeting in Cincinnati on 4/30/2015.

Specific aim #5: Continue and expand on occupational health surveillance collaborative activities among states and with the National Institute for Occupational Safety and Health (NIOSH).

Dr. Rosenman, Ms. Stanbury, and Mr. Largo have had key leadership roles at CSTE in promoting occupational health surveillance and applied epidemiology.

- Dr. Rosenman co-led the CSTE Occupational Health Surveillance Workgroup.

- Ms. Stanbury served on the CSTE Executive Board, overseeing the Occupational/Environmental/Injury Steering Committee, from 2007-2012, which included oversight of the CSTE Occupational Health Surveillance Workgroup. Among other activities, she facilitated passage of a CSTE Position Statement recommending inclusion of occupation and industry as core

variables in the electronic health record, submission of a set of letters to the Office of the National Coordinator on the same issue, and completion of a CSTE publication with occupational health success stories in state health departments.

- Ms. Stanbury continued to co-chair a workgroup after she was on the Board to continue the occupational health "success stories" project including posting new "stories" for the CSTE website, (see https://cste.site-ym.com/?SuccessStories).

- Ms. Stanbury spearheaded a process, through CSTE, to have non-infectious, nationally notifiable diseases (including lead, silicosis and pesticides) published in the annual MMWR surveillance summaries. CDC agreed to do this, she provided editorial support to the CDC authors, and at this point the 2015 annual report is scheduled for a November 2015 MMWR publication, and the 2016 summary is underway.

- Ms. Stanbury worked with a CDC multi-state workgroup to collect and publish surveillance data for carbon monoxide poisonings, including those that were work-related. Data analysis was completed and the draft manuscript is in preparation at NCEH-CDC.

- Mr. Largo participated in the OHI workgroup, as noted above, including leadership in the QA process until transitioned to NIOSH.

Multi-state collaborations resulted in a number of peer reviewed publications, including multi-state surveillance for dermatitis and using workers' compensation for surveillance.

D.1.c.4. Results, Discussion and Conclusions

Three organizations were responsible for NIOSH-funded occupational health surveillance in Michigan. The Occupational Health Surveillance Center at MSU, which was the lead agency, was established in 1988 under contract with MIOSHA (currently located in LARA); MDHHS became involved in 2000. These collaborations continued to be strengthened during this five year project.

Occupational Health Indicators:

Michigan OHI data were submitted each year covering the time period 2007-2012 , and were published on the CSTE (http://www.cste.org/?OHIndicators).

In 2005, Michigan and national data were sought for OHIs 1-13 from 1990 to the most recently available year to examine temporal trends and make Michigan-U.S. comparisons. The report "Thirteen Indicators of the Health of Michigan's Workforce", which was published 2006 in both hardcopy and posted on the MSU and MDHHS websites, was updated in 2013 with data through 2009.

http://www.michigan.gov/documents/Michigan_Indicator_Report_revised_41206_156036_7.pdf.

A report has been drafted by Mr. Largo and others titled: "Occupational Health Indicator Trend Analysis Guidance."

Case-based Surveillance:

Protocols for case identification, case follow-up, and referral to MIOSHA for intervention have been successfully developed, thousands of individuals have been interviewed, and hundreds of worksite inspections have been conducted for conditions under "Fundamental and Priority Conditions," including work-related asthma, silicosis and other lung diseases, and work-related fatalities (FACE).

Reports, publications, and outreach

Analysis and dissemination of these surveillance data have taken place regularly over the 26 years in peer-reviewed publications, annual reports, special topic reports, and newsletters.

Twenty-one annual reports under the Fundamental program were published, posted, and disseminated in this grant period (see D.2.a.1).

Twenty-one other reports were also produced (see D.2.a.2). (Note we have included reports about carbon monoxide surveillance. CO surveillance was conducted with another funding source at MSU and then turned over to MDHHS in 2014, but we have included references to these data reports because the surveillance system used our other condition-specific surveillance systems as its model.)

Thirteen papers with surveillance data for conditions under the Fundamental program were published in peer reviewed journals and they are listed in Section D.2.b below. In addition to papers related to specific conditions several notable papers used surveillance data to address cross-cutting topics including work-related health disparities (Stanbury and Rosenman, 2013) and multi-state surveillance using workers' compensation (Bonauto et al, 2010; Rosenman et al, 2013; Davis et al 2013; Simms et al, 2013).

Eighteen presentations were made at professional meetings on "Fundamental" topics.

Summary data and key accomplishments

The following summaries and data tables are for conditions under surveillance in Fundamental.

All Occupational Diseases and Worksite Referral Inspection summary

Occupational Disease Reports: 1987-2013	
Year of Report	**Number of Reports**
1987	301
1988	694
1989	1,471
1990	8,650
1991	9,180
1992	11,254
1993	14,961
1994	19,196
1995	16,913
1996	20254
1997	19,378
1998	20,754
1999	21,538

2000	19,627
2001	18,245
2002	14,938
2003	15,890
2004	15,105
2005	12,885
2006	12,778
2007	11,240
2008	7,477
2009	6,837
2010	7,952
2011	10,701
2012	8.069
2013	9,623

Amputations

Michigan's surveillance system identified 2,637 work-related amputations among state residents during the period 2009-2013. Males had much higher rates than females and rates generally decreased with increasing age. During this five-year period, MIOSHA inspected 56 worksites in response to project referrals (2009: 5, 2010: 0, 2011: 18, 2012: 13, 2013: 20) and identified 141 violations with penalties of $173,095. Three annual reports summarizing data from the system were produced (another one is pending publication) and one article covering the period 2006-2012 was published in a peer-reviewed journal.

2009-2013 MI Resident Work-Related Amputations						
Age Group	**Male**		**Female**		**Total**	
	Avg Ann #	**Avg Ann Rate**	**Avg Ann #**	**Avg Ann Rate**	**Avg Ann #**	**Avg Ann Rate**
16-19	21	24.4	4	5.2	26	14.9
20-24	54	26.1	7	3.2	61	14.6
25-34	103	23.8	12	3.1	115	14.0
35-44	92	18.8	11	2.5	103	11.2
45-54	113	20.5	18	3.6	131	12.4
55-64	66	19.1	8	2.5	74	11.0
65+	12	11.7	3	3.2	15	8.0
Total	464	20.9	63	3.1	527	12.4

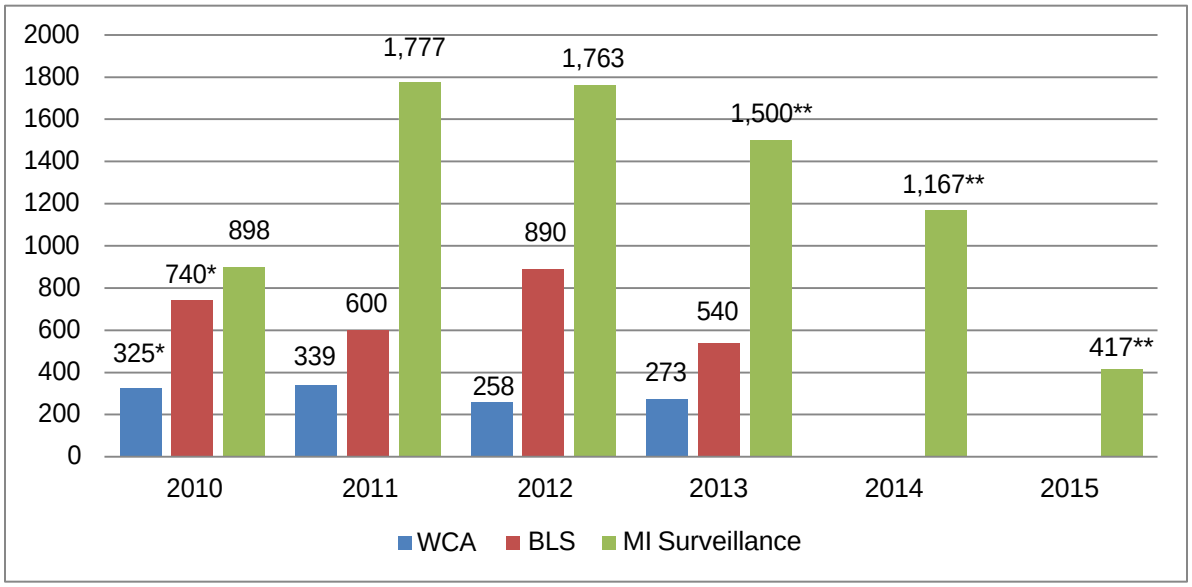
Burns

Michigan's multisource system has led to the identification of 7,522 work-related burns in adults (age 16 and older in 2010, and age 14 and older since 2011) in this project period (7/1/2010- 6/30/2015). Two

hundred and forty-eight burn investigations were completed. One hundred and sixty facilities received 597 citations with $1,321,390 in penalties. The bar graph below shows the number of work-related burns identified in Michigan through its multi-source surveillance system in comparison to the numbers identified in the US Bureau of Labors' employer survey and the number of paid lost time workers' compensation claims.

Data were analyzed and summarized in one publication, three annual reports, a Data Fact Sheet, and a presentation. (See Section D.2).

Work-Related Burns by Year as Identified through Michigan's Multi-Source Surveillance, US Bureau of Labor Statistics and Michigan Workers' Compensation Agency, (7/1/2010 – 6/30/2015*)**



*2010 WCA and 2010 BLS estimates of work-related burns cover the whole calendar year, whereas 2010 MI surveillance estimate of burns is only for the second half of the year, 7/1/2010 through 12/31/2010.
**Data set for number of work-related burns for 2013 and 2014 still being finalized.
*** Incomplete, number of work-related burns received 1/1/-6/30/2015. 2014 and 2015 WCA and BLS estimates of work-related burns are not yet available.

Work-related Skull Fractures

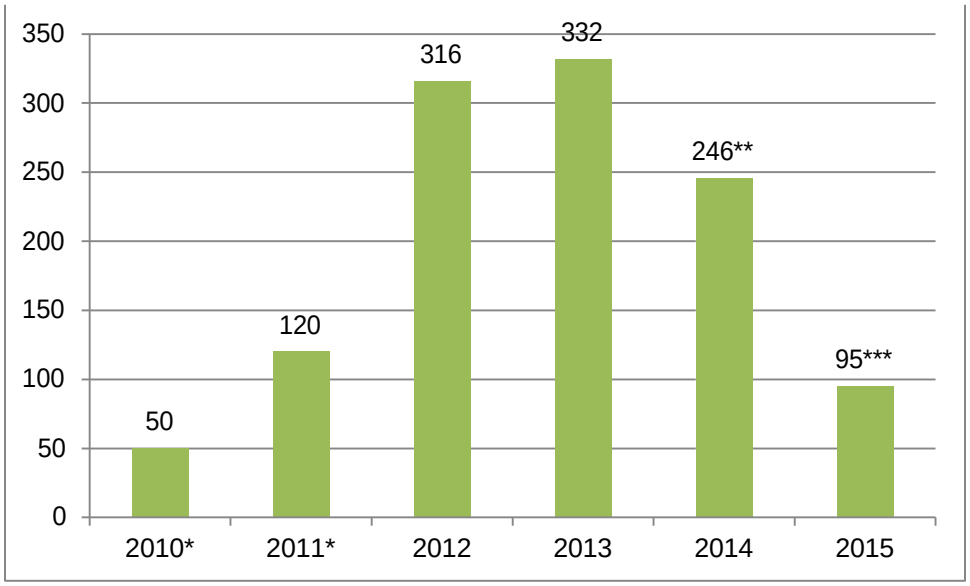
Michigan's multisource system identified 1,159 work-related skull fractures in adults (age 16 and older) in this project period (7/1/2010- 6/30/2015). Thirty-four skull fracture investigations were completed. Nineteen facilities received 74 citations with $86,900 in penalties.

Data were analyzed and summarized in one publication, two annual reports, one "data fact sheet", and two presentations. The number of work-related skull fractures identified by year is shown below.

Skull fractures were also used to develop a Hazard Alert: "Stop Work-Related Assaults in the Health Care

Setting." (http://www.oem.msu.edu/userfiles/file/SKULLfracs/HAZALERTS_skull_4_2015.pdf)

Work-Related Skull Fractures Identified through Michigan's Multi-Source Surveillance System, (7/1/2010 – 6/30/2015)



*2010 and 2011 WCA and MI Surveillance estimates do not include nasal fractures.
** Data set for number of work-related skull fractures for 2014 still being finalized.
*** Incomplete, number of work-related skull fractures received 1/1/-6/30/2015.

Work-related Crushing Injuries

Michigan's multisource system identified 2,080 work-related crush injuries in adults (age 16 and older) in this project period (7/1/2010- 6/30/2015). Crushing injuries investigations were completed at 67 facilities. Forty-seven facilities received 199 citations with $268,225 in penalties. Work-related crushing injuries by industry are shown below.

Data were analyzed and summarized in one presentation (See D.2)

Work-Related Crushing Injuries 2013 – Industry in which Injured			
Industry Classification (NAICS)	**Number**	**Percent**	**Rate**
Primary Metal Manufacturing (33)	209	26.7	34.1
Construction (23)	73	9.3	35.2
Admin. and Support and Waste Management and Remediation Services (56)	60	7.7	36.7
Retail Trade (44)	56	7.1	16.9
Wood Product Manufacturing (32)	52	6.6	41.8

Wholesale Trade (42)	50	6.4	49.6
Health Care and Social Assistance (62)	47	6.0	7.2
Other Services (except Public Administration) (81)	35	4.5	15.9
Agriculture, Forestry, Fishing and Hunting (11)	30	3.8	36.8

Transportation and Warehousing (48)	25	3.2	22.1
Food Manufacturing (31)	21	2.7	36.7
Public Administration (92)	21	2.7	16.0
Accommodation and Food Services (72)	20	2.6	7.0
Sporting Goods, Hobby, Book and Music Stores (45)	16	2.0	12.4
Educational Services (61)	15	1.9	4.2
Professional, Scientific and Technical Services (54)	13	1.7	5.2
General Warehousing and Storage (49)	9	1.1	19.7
Utilities (22)	8	1.0	19.9
Finance and Insurance (52)	6	0.8	3.2
Real Estate and Rental and Leasing (53)	6	0.8	9.0
Information (51)	5	0.6	9.1
Arts, Entertainment, and Recreation (71)	5	0.6	5.0
Mining, Quarrying, and Oil and Gas Extraction (21)	2	0.3	42.3
Total of All Crushing Injuries	920*	100.0	21.3

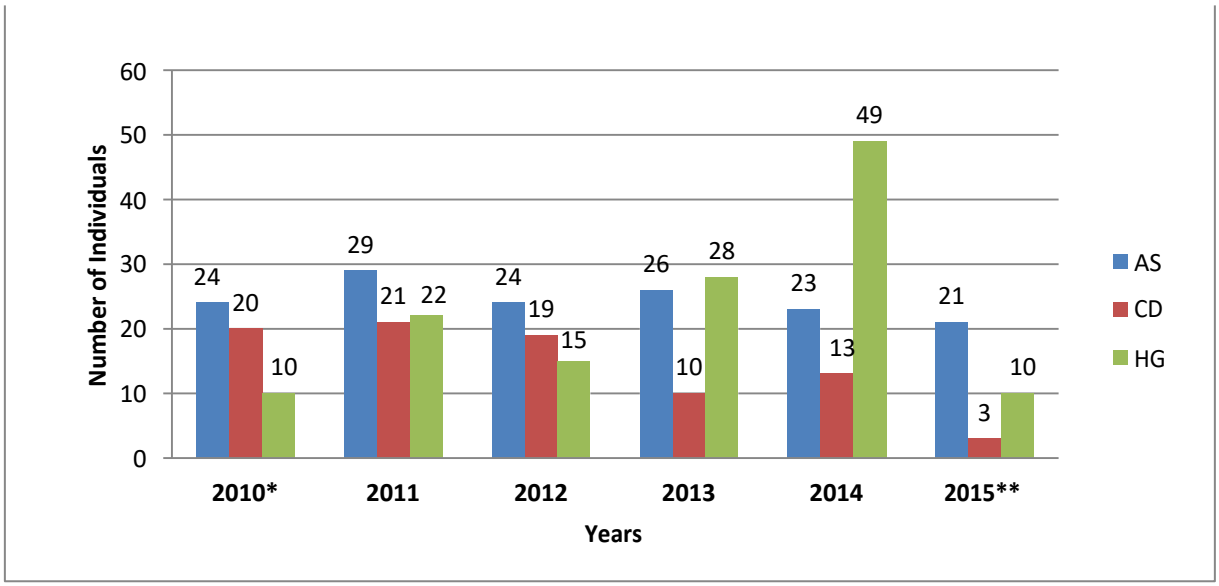
*Sufficient information for industry classification was obtained on 784 (85.2%) individuals.

Heavy Metals

There were 147 elevated arsenic, 86 elevated cadmium and 134 elevated mercury metals reports received on 367 individuals, including 13 children in this project period (7/1/2010- 6/30/2015).

Data were analyzed and summarized in three annual reports and one "data fact sheet" (see D.2). A bar graph of the number of individuals with elevated levels by metal is shown below.

Laboratory Reports of Elevated Heavy Metals, (7/1/2010 – 6/30/2015)



* The reporting period is only half a year: 7/1/2010-12/31/2010.
**The reporting period is only half a year: 1/1/2015-6/30/2015.

D.1.c.5. References - Fundamental

Biddle J, Roberts K, Rosenman KD, Welch EM: [1998] What Percentage of Workers with Work-Related Illnesses Receive Workers' Compensation? Journal of Occupational and Environmental Medicine 40:325-331.

Council of State and Territorial Epidemiologists: [2005] Putting Data To Work: Occupational Health Indicators from Thirteen Pilot States for 2000. http://www.cste.org/pdffiles/newpdffiles/cste_ohi.pdf.

Council of State and Territorial Epidemiologists: [2015] Occupational Health Indicators: A Guide for Tracking Occupational Health Conditions and Their Determinants.
http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PDFs/2015_Ed_of_OHI_Guidance_Manu.pdf

Halperin WE: [1996] The role of surveillance in the hierarchy of prevention. Am J Ind Med 29:321-323

Henneberger PK, Kreiss K, Rosenman KD, Reilly MJ, Chang Y-F, Geidenberger CA: [1999] An Evaluation of the Incidence of Work-Related Asthma in the United States. International Journal of Occupational and Environmental Health 5:1-8.

Largo T, Rosenman K: [2009] Work Related Amputations in Michigan 2006: A joint report of the Michigan Department of Community Health and Michigan State University. Report from the Michigan Department of Community Health, June. http://www.michigan.gov/documents/MDHHS/2006_MI_work-related_amputations_286264_7.pdf.

Largo T, Rosenman K, Reilly M: [2009] "Measuring, Characterizing and Preventing Work-related Amputations in Michigan." Presented at the Michigan Epidemiology Conference (March 31, 2009) and at the 2009 CSTE Annual Meeting, June 10.

Largo T, Stanbury M: [2003] Assessment of Thirteen Data Sources for Occupational Health Surveillance in Michigan. Report from the Michigan Department of Community Health.
www.michigan.gov/documents/MDHHS_OccHealthDataSources_86519_7.pdf.

Largo T, Stanbury M, Rosenman K: [2013] Thirteen Indicators of the Health of Michigan's Workforce. Report from the Michigan Department of Community Health.
http://www.michigan.gov/documents/Michigan_Indicator_Report_revised_41206_156036_7.pdf

Leigh JP, Markowitz SB, Fahs M, Shin C, Landrigan PJ: [1997] Occupational injury and illness in the United States. Estimates of costs, morbidity, and mortality. Arch Intern Med 157(14):1557-68

National Academy of Sciences: [1987] *Counting Injuries and Illnesses in the Workplace: Proposals for a Better System.* National Academy Press. Washington DC.

National Academy of Sciences: [1987] The Future of Public Health. National Academy Press. Washington D.C.

National Academy of Social Insurance: [2014] Workers' Compensation: Benefits, Coverage, and Costs, 2012. https://www.nasi.org/sites/default/files/research/NASI_Work_Comp_Year_2014.pdf

NIOSH: [2001] Tracking Occupational Illnesses, Injuries and Hazards: The NIOSH Surveillance Strategic Plan. DHHS (NIOSH) Publication No 2001.118.

NIOSH-CSTE Surveillance Planning Workgroup: [2001] The Role of the States in a Nationwide, Comprehensive Surveillance System for Work-related Diseases, Injuries, and Hazards. http://www.cste.org/Occupational%20health/NIOSH.pdfNIOSH.

Rosenman KD, Reilly MJ, Henneberger PK: [2003] Estimating the Total Number of Newly-Recognized Silicosis Cases in the United States. American Journal of Industrial Medicine 44:141-147.

Rosenman KD, Kalush A, Reilly MJ: [2007] Variations in Worker Compensation Claims by Company – The Potential for Achieving a Significant Reduction in Claims. American Journal of Industrial Medicine 50:415-420.

Stanbury M, Anderson H, Bonuato D, Davis L, Materna B, Rosenman K: [2008] Guidelines for Minimum and Comprehensive State-based Public Health Activities in Occupational Safety and Health. DHHS(NIOSH) Publication No. 2008-148. http://www.cdc.gov/niosh/docs/2008-148.

Stanbury M, Largo T, Granger J, Cameron L, Rosenman K: [2004] Profiles of Occupational Injuries and Diseases in Michigan. MDHHS Report, June. http://www.michigan.gov/documents/MDHHS_ProfilesReport_94691_7.pdf.

Stanbury M, Reilly MJ, Rosenman KD: [2003] Work-Related Amputations in Michigan, 1997. Am J Ind Med 44:359-67.

Stanbury M, Rosenman KD, Anderson HA: [1995] Guidelines: Minimum and Comprehensive State-Based Activities in Occupational Safety and Health. DHHS (NIOSH) Publication No. 95-107.

Thomsen C, McClain J, Rosenman K, Davis L: [2007] Indicators for Occupational Health Surveillance. MMWR 56:No. RR.1. http://www.cdc.gov/mmwr/PDF/rr/rr5601.pdf.

D.1.d. Pesticides

D.1.d.1. Specific Aims

The overall goal of this surveillance project was to reduce the occurrence and burden of acute, work-related pesticide illness and injury. The following specific aims reflect the activities of this project:

- Continued surveillance of work-related pesticide illness and injury in Michigan.
- Prioritize and expand ongoing compliance and consultative activity to prevent and reduce work-related pesticide exposure.
- Continue and expand on work-related pesticide surveillance collaborative activities within Michigan, among states, and with the National Institute for Occupational Safety and Health (NIOSH).

D.1.d.2. Background and significance of work-related pesticide exposures

Pesticides provide many benefits to society in protecting the food supply and controlling disease vectors. It is also well recognized that pesticides can have adverse effects on the environment and on human health. Those occupationally exposed to pesticides are at especially high risk of adverse health effects. There are approximately 700 registered active ingredients in about 16,000 pesticide products used in the United States. Currently, there are 15,531 different pesticides registered for sale and use in Michigan. Pesticide use is regulated by the Environmental Protection Agency (EPA); in some cases, including Michigan, the EPA delegates its authority to enforce regulations to state agencies.

Surveillance data on adverse health effects of work-related pesticide exposures are important to document the scope of the problem, identify high-risk groups, identify emerging problems, direct prevention and control activities, and provide data for the evaluation of prevention efforts (Calvert and Higgins, 2010). Although there are published case reports of workers with acute pesticide poisonings, including occasional deaths, there is no nationwide system to characterize the full scope and magnitude of this problem across the country. Nationally, the American Association of Poison Control Centers (AAPCC) compiles reports from all poison control centers (PCC) in the United States. The AAPCC system identified 109,495 pesticides/disinfectant calls in 2010 nationally (Roberts and Reigart, 2013), with approximately 2,900 PCC calls meeting the definition of the Council of State and Territorial Epidemiologists (CSTE) for a work-related pesticide illness call (CSTE, undated). However, calls to poison control centers do not capture all cases of work-related pesticide poisonings. The need for an acute pesticide poisonings surveillance system that includes work-related case surveillance was recognized by the Council of State and Territorial Epidemiologists (CSTE), which passed a resolution in 1996 that acute pesticide poisonings should be added to the list of reportable conditions, a Position Statement in 1999 providing a case definition and methods for surveillance and an updated Position Statement in 2009 recommending that pesticides be part of the system of nationally notifiable conditions.

In 1987, NIOSH began providing technical and financial support to state-based work-related pesticide illness and injury surveillance systems under the NIOSH SENSOR program. Currently there are 12 states participating in the SENSOR-Pesticides program, including Michigan, which joined in late 2000. This multi-state program has successfully improved both the quality and quantity of pesticide poisoning data, and has met many of the surveillance goals enumerated above. NIOSH and the workgroup of states have made significant progress over the last 28 years in providing detailed technical advice and coordinating and standardizing data collection procedures, case definitions, data coding, and related materials.

Agriculture is the second largest industry in Michigan based on income generated, yet most agricultural employees are not covered by the Michigan Occupational Safety and Health Administration (MIOSHA) due to their employment status (self-employed or family members) or do not receive routine inspections because they work on farms with fewer than 11 employees. There are over 7,000 privately certified (agricultural) applicators and over 14,000 commercially certified applicators in Michigan. The MIOSHA Program refers most agricultural worker complaints to the Michigan Department of Agriculture and Rural Development (MDARD) for intervention and enforcement activities. MDARD has lead responsibility in the state for oversight of pesticides, including pesticide registration, investigations into misuse, and training and enforcement of the Worker Protection Standard (which protects agricultural workers from adverse health effects of pesticide exposure). An enforcement database documents all enforcement

activities, including those in which human exposure and health impact data are collected. However, prior to the MDHHS pesticide surveillance system, there was no analysis of these data and potentially exposed individuals were referred to their medical care provider with no additional follow up. MDARD inspections in response to complaints about pesticide exposure have limited their involvement to issues of misuse, based on the permissible uses listed on the label, record keeping, and possible violations of the Worker Protection Standard. MDHHS's involvement provides a public health and medical role to complement MDARD's enforcement activities.

D.1.d.3. Methods

Aim #1: Continue case-based surveillance for work-related pesticide illnesses and injuries

Case identification: Case reports for work-related pesticide illnesses and injuries came from a variety of sources and were obtained under the authority of the Occupational Disease reporting law. The law assures that the health care provider is not violating confidentiality laws by reporting. In addition, reporting falls under the public health exemptions to the Federal HIPAA rules. The law allows the state to collect additional information as needed, and allows the state to conduct active surveillance (e.g., requesting hospitals or clinics to provide medical records and report reportable conditions) without obtaining patient consent.

MDHHS received case reports from MSU, which were submitted by health care providers and employers under the reporting law to the MSU Surveillance Center. These reports were received via the mail, electronically, by fax and over the telephone at the MSU Surveillance Center. Web-based reporting was accepted at www.oem.msu.edu. For the convenience of reporters MSU had a toll free number to answer questions and/or receive OD reports. MSU encouraged electronic reporting but supported providers in reporting in whatever ways were most convenient for them.

In addition to receiving OD reports from health care providers and employers, the Surveillance Center actively solicited reports from all of the Michigan hospitals. The procedure for obtaining hospital discharge data was: each quarter MSU requested all the acute care hospitals in the state to send the hospital face sheet and discharge summary of patients with the following pesticide-related ICD codes: E 863.0-9, E866.5, E980.7, 989.2-4. Follow-up calls were made to non-reporting hospitals. A year later, when the preceding complete year of hospital discharge data from all Michigan acute care hospitals had been cleaned and compiled, the Michigan Health and Hospital Association provided a computerized file of all hospital discharges with these ICD-9 codes. This file was compared to the OD report file, and any hospital that had overlooked a case was requested to provide the medical records and report the patient. Follow-up calls were made until the report was received. Pesticide illness and injury case reports were provided by the MSU Surveillance Center to the Pesticide Surveillance Coordinator at MDHHS, under a Memorandum of Understanding Agreement.

MDHHS received access to the data management system, Toxicall©. A query for pesticide cases had been written and DHHS staff reviewed pesticide cases daily and printed out all occupational pesticide exposure cases.

MDHHS also received access to MDARD's electronic files of all pesticide misuse investigations. Pesticide complaints were made to either the MDARD headquarters or to their regional offices and the complaint form included name, address, and telephone number of complainant, a brief narrative of the problem, the

name of the pesticide (when available), and information about possible violations. An electronic file was started for each complaint and included the complaint form, the investigation narrative, and findings. The files may have contained laboratory sampling results, photos, and other information about the investigation. The Pesticide Surveillance Coordinator reviewed files at MDARD quarterly and printed out the complaint forms, the inspection reports, and any MDARD citations and actions.

MDHHS conducted rulemaking to mandate laboratory reporting of cholinesterase tests and the rules went into effect in September 2005. Laboratories were informed of this requirement and electronic systems were established for most of the major reference labs, in conjunction with MDHHS Communicable Disease. A data management system was established, including an algorithm to identify reports meeting certain criteria for follow-up, and follow-up medical records review and interview procedures were implemented. Although we identified companies where cholinesterase screening was a routine part of employee health surveillance, we did not identify any new cases through this mechanism and thus this activity was discontinued in 2013.

Outreach to maintain and improve reporting: Some outreach activities were conducted to improve reporting of all occupational diseases and injuries and these are described in the Fundamental five-year summary. The activities specifically related to pesticides injury/illness reporting included promotion of awareness at clinics likely to see farm workers. This involved: The Pesticide Surveillance Coordinator attended meetings of the Migrant and Seasonal Farm Worker Work Group coordinated by the Michigan Primary Care Association (MPCA). This work group included members of Community Health Centers which provide medical services to migrant and seasonal farm workers; Migrant Health Promotions, a nonprofit organization dedicated to improving the health of farm worker families through peer education and advocacy; representatives of the Michigan Department of Human Services; and representatives of the MDHHS. Most years, in the late spring the Pesticide Surveillance Coordinator mailed these health centers reminders of pesticide poisoning and reporting requirements. One year over 550 letters were sent to migrant camp owners reminding them of the legal requirement to report any known or suspected pesticide poisonings. Finally, MDHHS had a table each year at the Conference for Michigan's Farm Worker, Service Providers, and Growers, with about 150 attendees annually. Information about pesticide safety was presented at one of the breakout sessions at the 2014 conference.

SOPs for conducting case follow-up were contained in electronic files and in a three-ringed binder, including letter templates, interview forms, coding lists, data dictionaries etc. The following activities were carried out by the MDHHS Pesticide Surveillance Coordinator as per the SOP.

- MDHHS entered data from the initial case report into the SPIDER* database and the pesticide surveillance administrative tracking spreadsheet. The name of the reported individual was compared to the SPIDER database to determine if the person was already included in SPIDER. If yes, then the report was given the same case ID#. Follow-up information was used to determine if the report referred to the same exposure event or to a new exposure event. New exposure information was linked to the same case if the individual had more than one exposure event. If the person had not been previously entered, it was a new case. SPIDER was filled out as completely as possible with information from the case report and a paper file was started.

*SENSOR Pesticide Incident Data Entry and Reporting, the pesticide surveillance database system developed for NIOSH SENSOR-Pesticide state programs.

- MDHHS attempted to contact the patient to obtain an interview. When the patient address had been determined, MDHHS sent a letter explaining that MDHHS staff would like to interview him/her about his/her exposure. The letter included a stamped return envelope with a 'best time to call/consent' form. Seven to ten days after the letter was mailed, the Pesticide Surveillance Coordinator called the exposed person to conduct the interview. Up to a dozen attempts were made to contact the patient, with at least three being in the evening or weekend. The interview tool was based on the type of exposure (agricultural/applicator or disinfectant/bystander). The applicator/agricultural module had been translated into Spanish. MDHHS sent a patient thank you letter following the interview.

- If the exposed person received medical care for the exposure, and we did not already have their medical records, their medical records were requested. Medical records were requested whether or not the patient gave permission, under the authority of the Public Health Code. All requests included as enclosures a copy of the OD reporting law and the HIPAA exception.

- Whenever there was information about the pesticide (whether on the initial case report or from follow-up information) the Pesticide Surveillance Coordinator reviewed toxicity information about the pesticide to determine if the exposure was consistent with the symptoms. MDHHS also reviewed the pesticide label to assess if the pesticide was used on the correct pest, with the required personal protection equipment, etc.

- Dr. Rosenman reviewed files of any cases where there were questions about symptoms, the relationship of exposure to illness, or appropriate follow-up for interventions. SPIDER was then updated with all new information from the interview, medical records, and Dr. Rosenman's review.

- Cases were classified according to a standard definition as definite, probable, possible, suspicious, unlikely, insufficient evidence, exposed/asymptomatic, or unrelated based on documentation of a pesticide exposure, documentation of adverse health effects and evidence of a causal relationship between the two. The severity of the case was also determined, taking into account signs and symptoms; whether medical care was sought; whether the person was hospitalized; and whether time was lost from work. The Tracking spreadsheet was updated to note completion of data collection on the case. A narrative of all confirmed occupational cases was written and saved for quarterly reports to MDARD's Pesticide Advisory Committee (PAC) and for MDHHS's annual report.

Data analysis and dissemination: MDHHS provided updated data on all confirmed cases to NIOSH annually, according to NIOSH specifications. Data were also provided to the Fundamental Program for use in the Michigan Occupational Health Indicators report and inclusion on the Michigan occupational disease surveillance summary data web page.

MDHHS provided quarterly summary data to the Pesticide Advisory Committee (PAC) of the MDARD. The PAC provides guidance to MDARD and its affiliates on all matters related to pesticides.

MDHHS provided data to NIOSH for special projects, which resulted in multiple publications.

A report including summary data and discussions of interventions was prepared for each year's data once the data were completed and cleaned, and posted on the MDHHS and MSU websites. Paper and electronic copies were sent to over 200 individuals and agencies and also distributed through several List Serves.

We also completed a special report summarizing non-occupational disinfectant Illness and Injury Surveillance in Michigan, 2006-2013. In addition, these data were presented in a poster session at the annual Michigan Epidemiology conference in March, 2015.

Aim #2: Prioritize and expand ongoing compliance and consultative activity to prevent and reduce work-related pesticide exposure.

The MDARD is the lead agency in the state to investigate pesticide misapplications or other pesticide use violations and enforce the federal Worker Protection Standards (WPS). Specifically, the Pesticide and Plant Pest Management (PPPM) Division is responsible for pesticide application business licensing; commercial and private applicator certification and technician registration; pesticide registration; worker protection standards; use/misuse investigations; planned use inspections; food safety activities; restricted use pesticide dealer licensing; and targeted WPS and urban initiative inspections. Procedures were established between MDHHS and the MDARD for referrals to be made to the PPPM division where a confirmed case report indicated a possible violation of use based on the pesticide label, and/or violations of the Worker Protection Standard. As part of the procedure, MDARD's protocol for response included provisions to safeguard confidentiality of the individual. MDARD then conducted an inspection and prepared a Pesticide Inspection Report (PI-213), and a letter with MDARD findings and actions which was sent to the employer with a copy going to MDHHS for the case file.

Not all potential uses/misuses of pesticides are covered by MDARD's authority. MIOSHA is the lead agency for worker protection in the state and is responsible for worker protections in circumstances outside of those covered by MDARD. When referrals were made to MIOSHA, MDHHS ensured that copies of MIOSHA inspection reports were received by the Pesticide Surveillance Program. In 2009, an agreement was made between MIOSHA and MDHHS specifically to refer employers where employees became sick from exposure to disinfectants.

When an investigation report was received from either MDARD or MIOSHA, information from the report was used to update the exposure information and enforcement actions in the Exposure and Events tables of the SPIDER database. MDHHS captured additional details on inspections and other prevention interventions on its tracking spreadsheet.

Preventive interventions other than worksite inspections included: Referrals to NIOSH and EPA when an illness or injury appeared to have (a) resulted in a hospitalization or death, (b) involved four or more ill individuals, (c) occurred despite using the pesticide according to the label, or (d) indicated the presence of a recurring problem at a particular workplace; and provision of educational materials to the reported individual and others, when illness appeared to have occurred because of lack of understanding and access to educational information. Additionally, specific suggestions from an exposed person on how to improve the safety of total release foggers were sent to the EPA and shared widely.

Other prevention activities included sending pesticide safety information or regulatory information to reported cases and employers as appropriate; developing safety fact sheets on zinc phosphide, pesticides in the home, disinfectants, and pool chemicals that are posted on the MDHHS website; sharing case

narratives for use in pesticide applicator safety training; and recruiting cases who were interviewed for a National Personal Protective Technology Laboratory (NPPTL) video that NIOSH will distribute for safety training.

In conjunction with the CDC's recreational water safety week, MDHHS issued a press release, Facebook postings and tweets.

The project PI presented information about work-related Injuries and illnesses of farm workers, including pesticide illnesses and injuries, to the Michigan Migrant Child Task Force.

MDHHS provided disinfectant safety information to the Michigan Environmental Council for their blog.

Aim #3: Continue and expand on work-related pesticide surveillance collaborative activities within Michigan, among states, and with the National Institute for Occupational Safety and Health (NIOSH).

Staff participated on the MDHHS Bed Bug Working Group, providing information on pesticide safety for the Bed Bug manual posted on the MDHHS website. MDHHS applied for, and was awarded a bed bug education and outreach grant from the EPA.

Staff provided information about pesticide exposures in the home for use in developing the Healthy Homes Strategic Plan for the State of Michigan.

MDHHS and MSU collaborated with the SENSOR pesticides work group in developing integrated data standards and other issues related to interstate data comparability, analysis, and data dissemination. The Pesticides Surveillance Coordinator chaired the SENSOR pesticides "coding committee" which worked on a variety of issues related to data collection, coding, and dissemination.

Staff provided information on water-related illness cases reported to the pesticide surveillance system to the CDC National Outbreak Reporting System (NORS).

D.1.d.4. Results, Discussion and Conclusions

Three institutions have coordinated NIOSH-funded occupational health surveillance in Michigan. The Occupational Health Surveillance Center at MSU which was established in 1988 originally under contract to MIOSHA, currently located in LARA, and MDHHS, which established the NIOSH-funded Core Occupational Health Surveillance program in late 2000. In this current funding cycle from NIOSH (2010-2015), MSU is the bona fide agent of both MIOSHA and MDHHS for conducting Michigan's Expanded Program for Occupational illness and Injury Surveillance. MSU provides funds to MDHHS through a sub-award for the Fundamental and the pesticides surveillance project.

Work-related pesticide illness and injury surveillance data collection began in 2001 with the hiring of an epidemiologist at MDHHS as Pesticide Surveillance Coordinator to develop and implement the system. Using information from NIOSH and other SENSOR pesticides states as well as experience from the many years of case-based surveillance at MSU, MDHHS developed data tracking collection and case follow-up systems; became trained in the NIOSH - supported data management system, SPIDER; and built networks and relationships to promote reporting. Memoranda of Understanding were signed to have access to OD reports maintained by MSU, and with MDARD to access data on pesticide exposure complaints and make referrals for follow-up inspections. The first Annual Report with occupational pesticides data for 2001-

2003 was issued in 2004. Annual data reports have been issued since then; a section on non-occupational pesticide data was added beginning in 2006. These reports include summary descriptive data, results of intervention activities, and brief descriptions of all confirmed occupational cases.

MDHHS began collecting non-occupational pesticide data in 2006 because of interest expressed by environmental groups and MDARD, calls received from the public on the MDHHS "toxics hotline", and interest in collaboration with other SENSOR-pesticides states on non-occupational issues.

A summary of the data on reported cases follows: As of June 30, 2015, 1,588 work-related cases were reported. Most of the cases (1,206, 76%) came from the poison control centers (Figure 1). The other cases came from hospital reports (9%), reports to other state health programs (5%), MDARD (4), and other sources. One thousand eighty two (68%) of the 1,588 met the criteria noted above to be considered a confirmed case, and 313 (67%) of the 468 reported in the current funding period were confirmed. (Table 1)

Figure 1. Occupational Pesticide Illnesses and Injuries by Source of Case (N=1,588)

Table 1. Classification of Occupational Pesticide Illness and Injury Cases

Status	Total Occupational	Occupational, 2011-2015
Definite Case	109	18
Probable Case	258	73
Possible Case	699	215
Suspicious Case	16	7
Subtotal	*1,082*	*313*
Unlikely Case	7	2
Insufficient Information	438	133

Exposed/Asymptomatic	34	6
Unrelated	27	13
Subtotal	*506*	*154*
	1,588	**468**

Among the 1,082 confirmed occupational cases where the product was known, disinfectants accounted for the largest number (546, 47%), followed by insecticides and insect repellents (306, 27%) and then herbicides (159, 14%). Targeted exposures (476, 39%), leaks and spills (355, 29%), and indoor air (196, 16%) were the most common types of exposure.

Reported individuals working in a wide variety of occupations were exposed to pesticides either applying them directly or inadvertently being exposed while performing other duties as someone else applied a pesticide.

Occupation at the time of exposure of confirmed cases for calendar years 2007 through June 30, 2015 are shown in Table 2. Previous years data are not provided because the 1990 Census of Occupation Codes were used prior to 2007 and are not comparable to the 2002 Census codes currently used.

Table 2. Occupational Pesticide Illnesses and Injuries by Occupation, Confirmed Cases 2001-2015

Occupation	Number	Percent all	Percent known
Cleaners/housekeepers/janitors	107	9.9%	18%
Sales and office	69	6.4%	12%
Management, professional, and related	64	5.9%	11%
Production and transportation	60	5.5%	10%
Farming	55	5.1%	9%
Healthcare	45	4.2%	8%
Food preparation and service	44	4.1%	7%
Pest control operators	41	3.8%	7%
Groundskeepers/lawn service	40	3.7%	7%
Protective services	27	2.5%	5%
Personal care	20	1.8%	3%
Construction	13	1.2%	2%
Installation, maintenance, and repair	9	0.8%	2%
Armed forces	2	0.2%	0%
Unknown	486	44.9%	-
Total	1082	100.0%	100%

Factors that contributed to the exposure are shown in Table 3. These may provide insight into prevention activities.

Table 3. Contributing Factors in Confirmed Occupational Cases, 2001-2015

Contributing Factor	Cumulative	Percent
Spill/Splash of liquid or dust (not equip. failure)	312	22.3%
Mixing incompatible products	147	10.5%
Label violations not otherwise specified	90	6.4%
Required eye protection not worn or inadequate	83	5.9%
Application equipment failure	83	5.9%
Decontamination not adequate or timely	77	5.5%
No label violation identified but person still exposed / ill	74	5.3%

Drift contributory factors	68	4.9%
Excessive application	59	4.2%
People were in the treated area during application	39	2.8%
Applicator not properly trained or supervised	33	2.4%
Notification/posting lacking or ineffective	30	2.1%
Required gloves not worn or inadequate	29	2.1%
Within reach of child or other improper storage	20	1.4%
Structure inadequately ventilated before re-entry	19	1.4%
Early re-entry	17	1.2%
Required respirator not worn or inadequate	13	0.9%
Other required PPE not worn or inadequate	8	0.6%
Illegal pesticide used / Illegal dumping	1	0.1%
Other	41	2.9%
Unknown	154	11.0%
Total	**1397**	**100.0%**

In this grant period 17 cases were referred to MDARD to determine if there were violations of laws and regulations that might pose on-going risks to co-workers or the general public. Three were not investigated. One is still pending. Three investigations found no violations. Ten investigations found violations; four employers were issued warning letters and six were fined for the violations.

One example involved an untrained teenage worker who was spraying an herbicide in a lake, wearing a chemical suit. The herbicide sprayed back on him due to wind and rain, and went through the suit. After two to three hours he took off the suit and his legs had blotchy red spots. No decontamination was available, so he went to a fast food restaurant to wash off. His supervisor told him to put aloe cream on his legs. The burns on his legs became worse and he went to an emergency department where he was diagnosed with first and second degree burns. He was transferred to another hospital and admitted to a burn unit for three days. The case was referred to MDARD and the company received a warning letter.

Another example involved a homeowner who went into his barn to get a tiller for his garden. When he left the barn, he could smell an herbicide being sprayed on the neighboring farm. He developed an upset stomach and a bad taste in his mouth that lasted about four days. This case was referred to MDARD and environmental samples confirmed drift. The farm was fined $750.

Two incidents were brought to the attention of MDHHS through media alerts. Both involved the same application company, and both resulted in multiple people feeling ill. In the first, an emergency responder and five apartment residents went to an emergency department after the apartment complex was sprayed for bed bugs with a pyrethroid insecticide. In the next incident, a letter carrier and two apartment residents had difficulty breathing. MDARD's investigation included both events, and the following violations were found: an applicator applied pesticides without being a certified or registered applicator; the company provided false information in the investigation, claiming only one person applied the pesticides; the company did not notify the apartment management or surrounding apartment tenants about the application; the concentration used was too high; the pesticide was applied to prohibited areas; the pesticide was applied too frequently; the customer information did not include the name of the pesticide, date and time of application or precautionary warnings; the firm did not provide any written

information for one of the applications; the firm did not maintain records of the applications; and the company did not provide a written explanation of the risks and benefits to the customer. A $4,000 fine was issued.

In this grant period 10 cases were referred to MIOSHA to determine if there were violations of laws and regulations that might pose on-going risks to co-workers. Six were not investigated. One was not eligible because the worker was a prison inmate and not covered by MIOSHA. The others were not of interest because there were no known safety violations, or only minor violations, such as no material safety data sheet, or the time between the incident and the report was too long. One referral we never heard back about. One investigation resulted in violations being cited and a fine. One report is still open.

The investigated incident involved a manager of a racquet club who was replacing some tubing from a chlorine tank to a pump when a valve broke. He was wearing PPE, but some chlorine leaked into his glove as he tried to prevent the leak while waiting for responders about 20 minutes. He developed first and second degree burns and went to an urgent care center. The incident was referred to MIOSHA. The MIOSHA investigation found seven serious and one 'other' violation. The racquet club was initially fined $6,500, which was decreased to $3,175 upon abatement of the violations.

In addition, data are reported to NIOSH immediately as "high priority" events when they (a) result in a hospitalization or death, (b) involve four or more ill individuals, (c) occur despite using the pesticide according to the label, or (d) indicate the presence of a recurring problem at a particular workplace. In this grant period, 127 cases (73 occupational, 53 non-occupational) comprising 40 events (22 occupational, 16 non-occupational, and two both occupational and non-occupational) were reported as high priority events.

An example of cases reported this period under (a) involved a mill operator who cleaned a tank that had been flushed with chlorine and water. He went into the tank and inhaled fumes. He developed shortness of breath, a cough and a tickle in his throat. He became nauseated and vomited. He went to an emergency department and was admitted to the hospital. He was discharged the next day.

An example of cases reported this period under (b) was an incident where a pipe carrying chlorine ruptured in a baby food manufacturing plant. Seven employees were taken to emergency departments with symptoms including difficulty breathing, chest tightness, cough, and sore throat.

An example of cases reported this period under (c) involved a pest control operator for a lawn care company who used a pyrethroid insecticide. She said she never got any in her eyes and wore safety glasses, which were not required, but when she was around the fumes her eyes would burn and she would get a headache. She went to an employee health clinic.

Three annual reports were published and disseminated in this grant period. There were nine national publications that included data and editorial input from the Michigan Occupational Pesticide Illness and Injury Program. They are listed in Section D.2.

D.1.d.5. References - Pesticides

Calvert GM, Higgins SA: [2010] Using surveillance data to promote occupational health and safety policies and practice at the state level: a case study. Am J Ind Med 188-193.

Recognition and Management of Pesticide Poisonings 6th Edition: [2013] Edited by J. Routt Reigart, M.D. and James R. Roberts, M.D., M.P.

D.1.e. Silicosis and Other Occupational Lung Diseases (OLD)

D.1.e.1. Specific Aims

The overall goal of this surveillance project was to reduce the occurrence and burden of silicosis and other occupational lung diseases. The following specific aims reflect the activities of this project:

- To continue surveillance for silicosis and other occupational lung diseases.
- To prioritize and expand ongoing compliance and consultative industrial hygiene and education activity for silica and other lung toxins in the State of Michigan.
- To continue and expand on occupational health surveillance collaborative activities within Michigan, among states and with NIOSH.

D.1.e.2. Background and Significance: Silicosis and Other Occupational Lung Diseases

There is ongoing interest in the recognition and management of occupational lung disease, such as the pneumoconioses (Bang et al., 2014, Leung et al., 2012), and for lung diseases where occupational exposures are a contributing cause in an important percentage of cases, such as hypersensitivity pneumonitis (HP) (Fishwick, 2012), COPD (Omland et al., 2014) and bronchiolitis obliterans (Kreiss et al., 2012). The only Occupational Health Indicator where Michigan rates have increased over time was for asbestosis hospitalizations and deaths. Annually, we received 1,400 reports of asbestos-related non-malignant radiograph scarring and 130 cases of mesothelioma. Michigan had two major shipyards, now closed; however, the major exposure to asbestos in Michigan was in manufacturing and construction. In addition to farmer's lung among the 160,000 workers in the Michigan agricultural industry, Michigan's substantial manufacturing base with 530,000 employees had a large number of workers machining metals with metal working fluids (MWF). 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 et al., 1997, Gupta and Rosenman, 2006). Each year approximately 200 individuals were discharged from Michigan hospitals with HP. Based on review of their medical records, 4-10% were known to be work exposures but the exposure causing HP was unknown for 57% of all the hospitalized cases. The 2003 American Thoracic Society (ATS) consensus statement estimated for COPD that 15% of cases are attributable to work exposures (ATS, 2003). There are an estimated 566,000 adults in Michigan with COPD (Fussman, 2013). Fifteen percent of 566,000 translates into 84,900 cases of COPD attributable to work in Michigan.

Interstitial fibrosis from exposure to silica is a disease recognized since antiquity. Despite this recognition and the availability of proven exposure control techniques, the disease continues to occur. We have estimated that there are 3,600 to 7,300 newly recognized cases of silicosis each year in the United States and 147-307 in Michigan (Rosenman et al 2003). With silicosis under our program's continuous surveillance we have been able to measure the trend of new cases since 1987. The number of new cases reported in Michigan has decreased to 20-30 per year.

Since the 1930's there has been a special concern about the incidence of silicosis in Michigan. The United States foundry industry was centered in Michigan and was thought to be at severe economic risk from the large number of workers who might develop silicosis from working in this industry. Caps on workers' compensation were specifically implemented for silicosis and a special compensation fund was set up in Michigan in the 1930's.

Although the number of foundries and foundry workers has decreased since the 1980's in Michigan, there were still 144 foundries employing 10,422 in 2014, 64 of which were ferrous, employing 4,740 individuals in 2014 (source: bls.gov, quarterly census of employment and wages data extract). The Michigan foundry workforce peaked in the 1980's. Given the latency period of silicosis, these workers are just now coming into the time period when they may develop silicosis. We have identified 242 abrasive blasting companies (MSU research team survey, updated in 2011) and 432 open mines and quarries employing 6,637 individuals that are currently active in the state (Michigan Labor Market Information, Industry Census of Employment and Wages, average of 2014 first three quarters, accessed 7-1-2015). In 2014, there were approximately 18,952 construction firms employing 138,928 workers in the state (Michigan Labor Market Information, Industry Census of Employment and Wages, average of 2014 first three quarters, accessed 7-1-2015). Workers in these industries are at increased risk of developing silicosis.

The Michigan silicosis surveillance system has identified 1,163 confirmed cases of silicosis from hospitals, health care providers, workers' compensation reports, and death certificates since 1987. The national systems for estimates of silicosis are based on employer reporting (Bureau of Labor Statistics Annual Survey) or mortality (death certificate data). Neither of these national databases adequately estimates the true burden of silicosis (Windau et al, 1991; Rosenman et al, 2003). We have developed a methodology using state based surveillance to provide a reasonable national estimate of the incidence of silicosis (Rosenman et al, 2003). This incidence estimate is 13-26 times greater than the number of U.S. death certificates which mention silicosis and twice as great as the BLS estimate for the whole United States for all types of pneumoconiosis including asbestosis and coal workers' pneumoconiosis. Since 1987 the MSU Surveillance Center has conducted follow up on 123 cases of coal workers' pneumoconiosis and 392 cases of asbestosis, which were typically reported to the Surveillance Center as pneumoconiosis, unspecified. In addition, the MSU Surveillance Center has identified and conducted follow up (patient interview) since 2010 of 131 cases of hypersensitivity pneumonitis, 104 cases of chemical pneumonitis, 417 cases of chemical inhalation, and 482 cases of other occupational lung diseases.

D.1.e.3. Methods

Aim #1: To continue surveillance for silicosis and other occupational lung diseases

Case reports for silicosis and other occupational lung diseases came from a variety of sources: mandatory reporting by health care providers, health care facilities, and employers; hospital discharge data; the Michigan Poison Control Center; death certificate data; the Michigan 3rd Judicial Court; and workers' compensation claims.

Michigan state law requires clinics, employers, health professionals and hospitals to report all known or suspected occupational illnesses. There is a $50 fine and it is a misdemeanor for failure to report. More

importantly, the law assures the health care provider is not violating confidentiality laws by reporting, and reporting falls under the public health exemptions to the Federal HIPAA rules. The law allows the state to collect additional information as needed, and allows the state to conduct active surveillance (e.g., requesting hospitals or clinics to review medical records and report reportable conditions) without obtaining patient consent. This was the legal basis for the surveillance program.

There is a standard reporting form. These reports were received via the mail, electronically, by fax and over the telephone. Web based reporting was accepted at www.oem.msu.edu. For the convenience of reporters we had a toll free 800 number to answer questions and/or receive OD reports. For the sake of efficiency we encouraged electronic reporting but also continued to encourage providers to report in whatever way was most convenient for them.

The automated occupational disease reporting system that was developed for the electronic medical record used by the family practitioners and internists at Michigan State University was updated when new software was introduced to the MSU clinics. Three categories of disease were used to help MSU physicians determine when they should report a patient: Category I (such as silicosis) was automatically reported unless the provider did not allow a report to be submitted; Category II (such as asthma) prompted the provider with a reminder that "for a significant percentage of patients this condition may be caused or aggravated by work"; and Category III (such as rheumatoid arthritis) allowed the provider to report the patient but there was no prompt with a reminder. This EMR was used in the MSU internal medicine clinics where there were 50 providers.

In addition to receiving OD reports, we actively solicited reports from all of the Michigan hospitals. On a quarterly basis, we requested the 136 acute care hospitals in the state (including the four VA hospitals) to send us the face sheet, discharge summary and pulmonary function tests and the most recent chest radiographs on all patients discharged with ICD-9 code 495.0-.9 (hypersensitivity pneumonitis, age >=16 years), ICD-9 code 501 (asbestosis, age <= 60 years), ICD-9 code 502 and 011.4 (silicosis and silicotuberculosis, age >=16 years), ICD-9 code 503 and 505 (pneumoconiosis unspecified, age >=16 years), ICD-9 code 506.0-.9 (acute inhalation exposure, age >=14 years), and ICD-9 code 518.0-.8 (other lung disease paid by workers' compensation if the patient had an overnight stay at the hospital). In order to expand the scope of occupational lung diseases reported to the surveillance system, the ICD-9 codes requested from the hospitals were broadened during the most recent five years of surveillance. The hospitals were required by Michigan's occupational disease reporting law to supply this information. Follow-up calls were made to non-reporting hospitals. There was 100% compliance by the hospitals with this law. A year later, when the preceding complete year of hospital discharge data was cleaned and compiled, the Michigan Health and Hospital Association provided us a database of all hospital discharges with these ICD-9 codes. This file was compared to the OD report file, and any hospital that overlooked a case was required to provide the medical records and report the patient.

Follow-up calls were made until the report was received. Medical records were requested and reviewed and in conjunction with the patient interview used to determine which cases were due to occupational exposure.

Because we received the database of all hospital discharges we were able to confirm that we received reports of all hospitalized patients. Approximately half of the hospitals provided us emergency department records. We were unable to confirm the completeness of the emergency department reports

because there was no computerized record compiled for all emergency department visits as there was for hospitalized patients.

Death certificates: Death certificates were requested annually from the Michigan Department of Health and Human Services' Vital Registration unit for all individuals where the COD or contributing COD was silicosis (ICD-10 code J62.8), silicotuberculosis (ICD-10 code J65), pneumoconiosis, unspecified (ICD-10 code J64), Asbestosis (ICD-10 code J61), Pneumoconiosis from other dusts (ICD-10 code J63), or Hypersensitivity Pneumonitis (ICD-10 code J67) and death certificates where only the underlying COD was Respiratory conditions due to chemical fumes or vapors (ICD-10 code J68).

Michigan 3rd Judicial Court: Annually, an electronic file of all cases, settled or otherwise disposed from the prior calendar year was obtained; 300-400 reports were received each year. The file contained case number, name, up to three asbestos-related disease codes, vital status, age, expert witness (physician), job site, occupation and trial group date. The 3rd Judicial Court handles the majority of asbestos-related cases in Michigan.

Workers' compensation reports of silicosis and other lung diseases were obtained on a quarterly basis, with a computerized listing of any individuals who filed a workers' compensation claim for silicosis or any other lung disease.

Outreach activity to maintain and improve reporting consisted of the following:

1) Four page quarterly respiratory disease newsletter-"Project SENSOR News"
2) Annual report and 2-page Data Fact Sheet for silicosis and other occupational lung diseases
3) Presentations at Grand Rounds and medical conferences
4) Display booths at medical conferences
5) Information on the OD Reporting Law shared with newly licensed physicians
6) An annual reminder to the 6 NIOSH certified B-readers in the state to report pneumoconiosis
7) Updating of the Surveillance Center website and linkages to other important sites
8) Posting educational materials including case reports on the MDHHS and MIOSHA websites, as appropriate
9) Advisory Committee
10) Provision of software for electronic medical record reporting system
11) Creation and maintenance of Face Book and Twitter accounts to highlight work-related lung diseases, maintained by the MSU Surveillance Center
12) Development and distribution of scientific journal articles to raise awareness of and increase reporting of occupational diseases including silicosis and other lung disease

We maintained an updated mailing list of physicians from the following groups: Michigan Thoracic Society; Michigan Chapter of the American College of Physicians; Michigan Occupational and Environmental Medical Association; Michigan Chapter of the American College of Chest Physicians; Occupational Health Clinics in the Michigan yellow pages; any Michigan physician who ever submitted an occupational disease report; Internists in the Department of Medicine at Michigan State University, University of Michigan and Wayne State University; and family practitioners in the Departments of Family Practice at Michigan State University, University of Michigan and Wayne State University. We also

maintained an updated list of non-physician health care providers: nurses who were members of the Michigan Association of Occupational Health Nurses; and nurses in Michigan who were certified by the American Board of Occupational Health Nurses. The mailing list for occupational respiratory disease consisted of approximately 3,200 health care professionals.

We wrote and sent or emailed a four page quarterly newsletter on occupational respiratory disease to these 3,200 health care providers. From calls, letters and surveys, we know that physicians and other health care professionals read the newsletter. An average of 30-50 health care professionals requested material when an announcement was included in the newsletter about material that was available (e.g. list of "B" readers). Dr. Rosenman received 2-3 calls per week from health care providers with occupational medicine questions about their patients. Typically, the health care provider indicated they enjoyed receiving the newsletter and that was how they knew to contact Dr. Rosenman with their questions.

We compiled an annual report and 2-page Data Fact Sheet on tracking Silicosis and Other Occupational Lung Diseases. The Data Fact Sheet was a distillation of the annual report. The annual report and associated Data Fact Sheet summarized the data collected and lessons learned through case identification, interviews, and MIOSHA enforcement inspections at the workplaces where the index cases developed their lung disease. The report and Data Fact Sheet were posted on the MSU Surveillance Center's web site: www.oem.msu.edu and uploaded to the NIOSH Clearinghouse. The Data Fact Sheet was also distributed at medical conferences.

Dr. Rosenman gave talks at medical conferences and grand rounds across the state.

We routinely exhibited a display booth at major medical conferences around the state. At the booth, we distributed newsletters, annual reports, condition-specific data fact sheets, brochures, copies of the reporting law, and a resource sheet of useful contact numbers. We had a signup sheet for health care providers to be placed on the mailing list. We routinely did this at the annual Michigan State Medical Society (MSMS) meeting, annual Michigan Thoracic Society meeting, annual joint meeting of the Michigan Occupational Physicians and Nurses' Association, the University of Michigan Annual Pulmonary meeting and the annual Michigan Safety Conference. We expanded the exhibit booth to other medical groups including: Michigan Association of Physician Assistants, MSU Osteopathic Medicine meeting, Michigan Certified Nurse Practitioner Annual Conference, MSMS House of Delegates, and the MSMS Annual Spring Scientific Sessions.

The OD Reporting Law is available as a link on LARA's Health Professional Licensing Division Page, along with links to other MI requirements such as the Communicable Disease Reporting Law. The OD Reporting Law link replaced the mailing that newly licensed physicians in the state previously received. Most of the licensing process is now conducted electronically; this shift from mailed information to an electronic link followed suit with the state's change to the use of electronic forms submittal for medical licensing.

Special efforts were made to elicit the cooperation of the "B readers" in the state. These physicians were asked to submit a copy of the completed standard "B reader" interpretation form for any patient who had 1/0 or greater opacities and/or pleural thickening. Each year all certified "B readers" received a letter reminding them of their obligation to report occupational diseases. Each then received a follow-up contact from Dr. Rosenman. A list of certified "B-readers" was obtained annually from NIOSH and newly certified "B-readers" in Michigan received a letter informing them of their obligation to report. Every

year "B-readers" received a short survey and either a thank you note if patients had already been reported or a reminder to report any cases that met the above criteria.

The MSU Surveillance Center web site (**www.oem.msu.edu**) contained: annual reports; data fact sheets (2-page condition-specific summaries of the annual reports); quarterly newsletters, resource materials on medical screening for silicosis and other occupational lung diseases; a brochure on reporting occupational diseases; a training course on abrasive blasting; the Michigan occupational disease reporting form; resources for temporary employment agencies; and a mechanism to report occupational diseases online. Regular reporters on our website reporting system were assigned a personal identity number. This made it easier for them to report, since we had their contact information on file and ensured that the reports were truly submitted by the indicated healthcare provider. There were links to this site from both the MDHHS and the MIOSHA web sites.

Advisory Committee: We continued to maintain an advisory committee for the respiratory diseases. The advisory board members represented the organizations of the targeted physicians, including the Michigan Thoracic Society, the Michigan Allergy and Asthma Society and the Michigan Occupational and Environmental Medicine Association. The committee provided a mechanism for us to receive feedback from the targeted physicians. Additionally, the involvement of leaders and prominent members of these organizations was an encouragement to their members to become active in Michigan's occupational disease surveillance efforts.

The automated occupational disease reporting system that was developed for the electronic medical record used by the family practitioners and internists at Michigan State University was updated when new software was introduced to the MSU clinics. Three categories of disease were used to help MSU physicians determine when they should report a patient: Category I (such as silicosis) was automatically reported unless the provider did not allow a report to be submitted; Category II (such as asthma) prompted the provider with a reminder that "for a significant percentage of patients this condition may be caused or aggravated by work"; and Category III (such as rheumatoid arthritis) allowed the provider to report the patient but there was no prompt with a reminder. This EMR was used in the MSU internal medicine clinics where there were 50 providers.

The MSU Surveillance Center created a Face Book (FB) page (Michigan State University Occupational and Environmental Medicine) and a Twitter account (@MSUOEM) during the most recent funding cycle. Through these newer social media outlets, we had 92 posts on FB and 138 tweets/retweets since creation of these accounts in 2010.

Eighteen publications based on the surveillance system and data were completed during the most recent five years of surveillance for occupational diseases, including silicosis and other occupational lung diseases. Publications include: Hydraulic Fracturing and the Risk of Silicosis (Rosenman 2014), Silicosis and Chronic Renal Disease (Millerick-May et al, 2015), Results of Spirometry among Individuals in a Silicosis Registry (Rosenman et al., 2010), and Prevalence of Connective Tissue Disease in Silicosis (Makol et al., 2011), and Comparison of Reliability of Classification for Pneumoconiosis of Film and Digital Radiographs: A Modeling Approach (Sen at al., 2010).

We followed our standard procedure for following up on silicosis and other occupational lung disease reports that have been used for previous funding periods. We first wrote the patient, or next of kin if the

patient was known to be deceased, a letter to inform them we would like to interview them on the phone. We were unable to contact only 8% of the silicosis and other occupational lung diseases patients reported and approximately 9% refused to be interviewed. For over half of those for whom we were unable to contact or refused to be interviewed, we were able to obtain sufficient information from the medical records to complete the questionnaire. Our questionnaire collected information on the patient's lifetime work history, health care usage, smoking history, and respiratory symptoms. Other occupational lung disease cases (not silicosis) were also asked whether they were employed at the company through a temporary employment agency. All interviewed cases were sent a thank you note with a link to our website with information on silicosis and other lung hazards.

Medical records, including the most recent chest x-rays, and lung pathology reports, were collected from hospitals. We used the work history and a review of the actual chest x-ray interpreted by Dr. Rosenman who is a "B reader" to determine if the patient met the NIOSH criteria for confirmed silicosis or asbestosis (CDC, 1990, Reilly et al., 1993). The other occupational lung disease cases were assigned a disease code based on the findings of the interview and medical records.

Questionnaire responses were computerized for data analysis. A computer tracking system was used to manage the day-to-day follow-up of the cases, including the results of work site MIOSHA inspections, medical results (ILO “B” readings) and case confirmation. The questionnaire database and the tracking file, an Access file, were managed by the MSU Surveillance Center. Quality control procedures were routinely conducted, running frequencies and reviewing outliers. Data were kept in password- and firewall- protected computer sites accessible only by authorized staff.

An annual report with statistical data, progress reports, and highlights of interesting new findings were prepared and disseminated. The Annual Report was placed on the Surveillance Center web site and provided during medical conferences where our OEM educational booth was displayed. A 2-page data fact sheet was produced; this was based on the annual reports. The data fact sheet was available on-line at www.oem.msu.edu as well as at our educational display booth exhibited during medical conferences across the state.

Silicosis record-specific data was submitted to the Division of Respiratory Disease Surveillance (DRDS), NIOSH, in the format specified by NIOSH without identifiers, and summary data on Silicosis was submitted to NIOSH for publication in the Worker Chart Book. We were active in disseminating information about the risk of silicosis with other state-funded silicosis states through various initiatives including the Multi State Initiative on the Hazards of Working in the Manufactured Stone Industry, which included a blog, and contribution to a MMWR article, Notes from the Field—Silicosis in a Countertop Fabricator (2015). We worked on these issues with the other states doing silicosis surveillance.

Provide Testimony for the Proposed OSHA Silica Standard: On September 12, 2013 Federal OSHA proposed a comprehensive standard for exposure to silica.

Hearings on the proposed standard were held in Washington, DC for 14 days beginning March 18, 2014. Michigan surveillance data was used to make the following three points:

Point 1: Mortality from silicosis as collected and reported by the CDC in national statistics is an inadequate marker of the burden of silica’s toxicity.

Point 2: Silica-related disease is a health disparity issue.
Point 3: OSHAs proposed comprehensive standard is needed to ensure that medical surveillance is provided to workers exposed to silica.

These three points are further explained below:

Point 1: Current National Mortality Statistics are Inadequate as a Marker for the Burden of Silica.

- Silicosis is only listed on the death certificate of 14% of individuals with confirmed silicosis.

- In the last 25 years, the ratio of individuals with new onset silicosis who are living is 7.17 times that found on death certificates. The living-to-dead ratio has increased from 6.44 in 2003 to 15.2 times in more recent years. A similar ratio and increase in the ratio of living-to-dead was found in New Jersey surveillance data, increasing from 5.97 to 11.5 times.
- Consistent with the increasing ratio of living-to-dead individuals with silicosis is that while the recording of silicosis has decreased on death certificates, the number of hospitalizations where silicosis is one of the discharge diagnoses has remained constant. In 1993, there were 2,028 hospitalizations nationwide with silicosis as one of the discharge diagnoses. In 2011 there were 2,082 hospitalizations, approximately 60 more. (Source: Nationwide Inpatient Sample. Agency for Healthcare Research and Quality (AHRQ), http://hcupnet.ahrq.gov/).

- The ratio of living-to-dead people with silicosis is not a function of silicosis being a benign condition but reflects the lack of familiarity by health care providers with silicosis and the lack of awareness of the patient's medical history by the health care provider who completes the disease information on the death certificate. Silicosis is listed as the cause of death in a small percentage of individuals who have an advance stage of silicosis, in those with progressive massive fibrosis only 18% and in those with category 3 profusion only 10%, while pneumonia, COPD, lung cancer and unspecified interstitial fibrosis or respiratory failure are more commonly listed, 35% and 51%, respectively. In other words, 53% of individuals with PMF and 61% of those with category 3 are dying from a respiratory condition as compared to the general population where approximately 10% would die from a respiratory condition.

- Silicosis is just one of multiple adverse health outcomes of silica exposure. As just discussed, silicosis mortality is a poor indicator of the occurrence of silicosis and even less useful as a marker of the frequency of lung cancer, COPD, kidney disease, connective tissue disease and tuberculosis. Some examples from Michigan research projects include: 1) 44 individuals from MI with silicosis who developed connective tissue diseases such as rheumatoid arthritis; 2) 40% of the cases in the Michigan database have kidney dysfunction; and 3) Dose-response studies to silica have found adverse outcomes in the absence of silicosis. In a study of foundry workers in Indianapolis, where workers with silicosis were excluded from the analysis, a significant decrease in pulmonary function at the existing OSHA PEL was found.

- There are two aspects to the frequency of occurrence of disease 1) the risk of disease is based on the level of exposure and 2) the number of individuals at risk. One can attribute almost all the

decrease seen in silicosis to a decrease in the population at risk: For example:

1. The number of workers in Michigan foundries decreased 75% from 1973 to 1991. The number of cases identified in the Michigan surveillance system decreased 83% from 1993 to 2011, factoring in a 20-year latency for silicosis development.
2. The number of abrasive blasting companies in Michigan using silica decreased 71% from 125 to 36, from 1995-2011. The percent of abrasive companies using silica went from 89% to 43%, a 52% decrease.
3. The number of deaths nationwide from 1973 to 2008 went from 765 to 148, an 80% decrease.

Industries where there has been an increased number of workers exposed to silica, such as construction doing highway repair or in oil and gas hydraulic fracturing have not had sufficient time since the increase in employment for silicosis to develop and accordingly have not caused an increase in silicosis statistics.

Point 2: Silica-related disease is a health disparity issue.

- The disease is unevenly distributed across the US; minority populations who are more likely to work at higher risk jobs are at higher risk. Michigan data shows that the incidence of silicosis in African-Americans is 6 fold greater than in Caucasians.

Point 3: OSHA's proposed comprehensive standard is needed to ensure that medical surveillance is provided to workers exposed to silica.

- Although OSHA, NIOSH and the National Industrial Sand Association have encouraged silica users since the 1970's to provide medical surveillance for silica exposed workers, this is not happening. No Michigan abrasive blasting companies or any construction companies are known to have implemented these recommendations on medical surveillance and only 2.3% of Michigan foundries are following these medical surveillance recommendations.

We collaborated with the MDHHS to prepare data for the Occupational Health Indicators Project that was coordinated by CSTE. Hospitalization and mortality data for pneumoconiosis/silicosis were two of the Indicators.

We implemented the following new projects:

- Pilot Project to Evaluate COPD and other lung-related hospitalizations
- Multi-State Initiative on the Hazards of Working in the Manufactured Stone Industry

Pilot Project to Evaluate COPD and other lung-related hospitalizations: We conducted follow up chart review of 2010 and 2011 MI hospital discharge records where the expected payer was workers' compensation. ICD-9 codes 496, 491, 492 and select other lung disease codes were identified (ICD-9 470-478, 480-487, 512, 518). We evaluated 26 cases from 2010 and 96 cases from 2011 hospitalization data where the primary or secondary discharge diagnosis was COPD or other lung disease not already covered by the surveillance system. Medical records were requested for the 122 cases. A total of 3 cases had possible work-related lung disease. Of the remaining 119 cases: 40 were non-work, non-lung disease, 16

were work trauma, not lung disease, 2 were interviewed and determined to have no lung disease, 9 were work-related, but not a lung disease, 4 had insufficient information in the medical record to determine if the lung disease was work-related or not, for 3 there was no follow up because the patients were in substance abuse rehab hospitals, and for 45 cases the hospital could not locate the patient records.

Multi-State Initiative on the Hazards of Working in the Manufactured Stone Industry: Collaboration with NIOSH and the silicosis surveillance states shared information on manufactured stone hazards related to silica dust. We worked with the MIOSHA Consultation, Education and Training (CET) Division to develop a plan to disseminate information on the hazards of manufactured to stone to the MI companies that would benefit. CET agreed to send a letter to companies along with the NIOSH Hazard Alert, as well as include the Hazard Alert during silica training sessions and on-site consultations. CET recently posted the Hazard Alert on its Air Contaminants Initiative webpage under its MI Case Studies, Success Stories and Emerging Issues Section at: http://www.michigan.gov/lara/0,4601,7-154-61256_11407-318422--,00.html

In-depth knowledge of associated medical conditions: We published studies previously on the cause of death among silicotics (Rosenman et al, 1995), on the association of connective tissue disease and silicosis with an update published in 2011 (Rosenman and Zhu, 1995; Rosenman et al, 1999, Makol et al., 2011), on the association of kidney disease and silicosis with an update published in 2015 (Rosenman et al, 2000; Steenland et al, 2002, Millerick-May et al., 2015), the association of COPD and silicosis (Rosenman and Zhu, 1995), the risks of silicosis from hydraulic fracturing (Rosenman 2105), and the results of spirometry among individuals in the silicosis registry (Rosenman et al., 2010). We continued to collect data on pulmonary function results and associated medical conditions such as connective tissue and kidney disease from confirmed silicosis cases. We conducted updated analyses of these data to assess associations of these conditions with silicosis. We disseminated this information in presentations, in our annual reports, our quarterly newsletter and in medical publications.

Aim #2*:* To prioritize and expand ongoing compliance and consultative industrial hygiene and education activity for silica and other occupational lung diseases in Michigan.

MIOSHA Inspections: The Surveillance Center provided MIOSHA with the name and address of the company where a patient with confirmed silicosis or other occupational lung disease was exposed. We averaged 4 work place inspections per year following up these cases since 1989. No individual lost their job because of the inspections.

All new workplaces identified by case reports were inspected. During these inspections, air sampling was performed, the OSHA log was examined for additional cases of silicosis or other occupational lung diseases, and if available, for silicosis-related inspections, chest x-rays of employees who had worked ten years or more were collected for review by Dr. Rosenman. During inspections for other occupational lung diseases, co-workers of the index case in the same exposure area were interviewed about their respiratory health, and whether they were employed at the company through a temporary staffing agency. If co-workers reported daily or weekly respiratory symptoms, they were sent a letter from the MSU Surveillance Center recommending they follow up with their doctor. The MIOSHA inspector completed a 2-page form on work practices and exposures at all facilities inspected, based on their findings during the inspections. We added questions to this MIOSHA Inspection check list on health and safety practices for temporary employees.

The employer received the industrial hygiene report, which often included recommendations for medical surveillance. In unionized facilities the union president received a copy of the industrial hygiene report. The report was prominently posted in an accessible area in both unionized and non-unionized facilities. The reporting health care providers received a letter from Dr. Rosenman along with a copy of the industrial hygiene report. Information about the inspections were collected in the computerized case data tracking systems and included information about exposure measurements taken and results, the number of potentially exposed workers, and whether the company was cited for violations.

Intervention Projects:

Outreach to Michigan miners with potential silica exposure: During the most recent funding period, we identified 100 out of 448 active or intermittent mine locations in MI with at least one personal air measurement above the NIOSH REL for respirable silica, from MSHA inspections conducted 1/1/08 through 2/22/11. In July 2011, we mailed the mine operators a letter with resources on silicosis and offered free B readings of chest radiographs of employees with 20 or more years of service. We followed up with calls to determine if the mines were interested; ultimately, none of the mines accepted this service for their employees.

Resurvey abrasive blasting companies: In 2011, we re-surveyed the 192 abrasive blasting companies in the state; 40% used silica as an abrasive. In previous abrasive blasting surveys we conducted for silica use, the percentages of companies using silica was: 1995, 89%; 1999, 72%; and 2005, 55%.Literature was distributed to the facilities that performed abrasive blasting using silica, with information on the hazards associated with the use of silica as well as information on alternative media.

Aim #3: To continue and expand on occupational health surveillance collaborative activities among states and with NIOSH.

Surveillance data was provided to NIOSH according to NIOSH specifications.

All existing educational products developed through the Michigan Surveillance Center were uploaded to the CDC's NIOSH Clearinghouse. As new products such as data fact sheets and annual reports were produced, they were also shared with the NIOSH Clearinghouse.

We worked with the other surveillance states to finalize the "How To" Guides for the various Reporting Sources used to identify new cases of Silicosis and OLDS (Hospitals, death certificates, Physicians, Poison Control Centers, etc.).

Four joint publications were written.

CSTE/Occupational Health meetings: Dr. Rosenman was active in CSTE and participated in planning for the annual CSTE/Occupational Health meetings. He was the Co-Lead for the CSTE Occupational Health Workgroup.

Dr. Rosenman and other staff participated in the Consortium of Occupational Health States (COSS) meetings and related joint activities.

D.1.e.4. Results, Discussion and Conclusions

The Surveillance Center received 3,303 reports of possible pneumoconiosis and other occupational lung diseases, and confirmed that 1,163 were silicosis from 481 facilities. An average of 122 reports was processed annually. Table 1 shows the major industrial groups where the confirmed silicosis cases had been exposed to silica.

Table 1. Primary Industry Where Michigan Silicosis Cases Worked		
Industry	**Number**	**Percent**
Manufacturing	980	84
Construction	96	8
Mining	43	4
Transportation & Warehousing	7	1
Health Care Services	7	1
Other	30	3
Total	1,163	

MIOSHA conducted 88 follow up investigations at workplaces of the confirmed silicotics. Air sampling for silica dust was conducted in 63 of the facilities. Thirty-seven companies had dust levels above the NIOSH REL and 23 were above the Michigan OSHA PEL. See Table 2 for a summary of the status of the facilities where the cases of silicosis worked.

Table 2. Status of Facilities Where 1,163 Individuals Confirmed with Silicosis for the Years 1985-2015 were Exposed to Silica			
	# Individuals Represented	**# Facilities**	**% Facilities**
Inspected	484	88	18.3
Closed	422	154	32.0
Out of State	72	68	14.1
No Longer Use Silica	31	26	5.4
Unknown	71	71	14.8
Building Trade	70	70	14.6
Inspected by Mine Safety	11	2	0.4
Scheduled for Inspection	2	2	0.4
Total	1,163	481	100.0

D.1.e.5. References - Silicosis and Other Occupational Lung Diseases

Biddle J, Roberts K, Rosenman KD, Welch EM: [1998] What Percentage of Workers with Work-Related Illnesses Receive Workers' Compensation? Journal of Occupational and Environmental Medicine 40:325-331.

DeLaHoz RE, Rosenman KD, Borczuk A: [2004] Silicosis in Dental Supply Factory Workers. Respiratory Medicine 98:791- 794.

Henneberger PK, Kreiss K, Rosenman KD, Reilly MJ, Chang Y-F, Geidenberger CA: [1999] An Evaluation of the Incidence of Work-Related Asthma in the United States. International Journal of Occupational and Environmental Health 5:1-8.

Makol A, Reilly MJ, Rosenman KD: [2011] Prevalence of Connective Tissue Disease in Silicosis. Am J Ind Med 54:255-262.

Millerick-May M, Schrauben S, Reilly MJ, Rosenman KD: [2015] Silicosis and Chronic Renal Disease. Am J Ind Med 58:730-736.

Quinn M, Henneberger PK, Braun B, Delclos GL, Fagan K, Huang V, Knaack JL, Kusek L, Lee SJ, LeMoual N, Maher KA, McCrone SH, Hogan Mitchell A, Pechter E, Rosenman KD, Sehulster L, Stephens AC, Wilburn S, Zock JP: [2015] Cleaning and Disinfecting Environmental Surfaces in Healthcare: Towards an Integrated Framework for Infection and Occupational Illness Prevention. Am J Infect Control 43:424-434.

Rosenman KD, Reilly MJ, Gardiner J. Results of Spirometry among Individuals in a Silicosis Registry: [2010] J Occup Environ Med 52:1173-1178.

Rosenman KD: [2014] Hydraulic Fracturing and the Risk of Silicosis. Clinical Pulmonary Medicine 21:167-172.

Rosenman KD: [2015] Occupational Diseases in Individuals Exposed to Metal Working Fluids. Current Opinion in Allergy and Clinical Immunology 2:131-136.

Rosenman KD: [2012] Rheumatoid Arthritis and Pneumoconiosis. Am J Respir Crit Care Med 85:1024; author reply 1025-1026.

Rosenman KD, and Zhu Z [1995]. Pneumoconiosis and Associated Medical Conditions. Am J of Ind Med 27:107-113.

Rosenman KD, Stanbury MJ, and Reilly MJ: [1995] Mortality Among Persons With Silicosis Reported to Disease Surveillance Systems in Michigan and New Jersey in the United States. Scand J of Work, Environ and Health 21 (suppl 2):73-76.

Rosenman KD, Reilly MJ, Kalinowski DJ, and Watt FC: [1997] Silicosis in the 1990's. Chest 111:779-786.

Rosenman KD, Reilly MJ, Moore-Fuller M: [1999] Connective Tissue Disease and Silicosis. Am J of Ind Med 35:375-381.

Rosenman KD, Reilly MJ, Henneberger PK: [2003] Estimating the Total Number of Newly-Recognized Silicosis Cases in the United States. Am J of Ind Med 44:141-147.

Rosenman KD, Pechter E, Schill DP, Valiante DJ, Bresnitz EA, Cummings KR, Socie E, Filios MS: [2004] Silicosis in Dental Laboratory Technicians. MMWR 53:195-197.

Sen A, Lee SY, Gillespie BW, Kazerooni EA, Goodsitt MM, Rosenman KD, Lockey JE, Meyer CA, Petsonk EL, Wang ML, Franzblau A: [2010] Comparison of Reliability of Classification for Pneumoconiosis of Film and Digital Radiographs: A Modeling Approach. Academic Radiology 17:511-519.

Steenland K, Rosenman KD, Socie E, Valiante D: [2002] A Linkage Study of Silicosis and End-Stage Renal Disease. Scandinavian Journal of Work and Environmental Health 28:439-442.

Valiante DJ, Schill DP, Rosenman KD, Socie E: [2004] Highway Repair: A New Silicosis Threat. American Journal of Public Health 94:876-880.

Windau J, Rosenman KD, Anderson H, Hanrahan L, Rudolph L, Stanbury M, and Stark A: [1991] The Identification of Occupational Lung Disease from Hospital Discharge Data. J of Occup Med 33:1061-1066.

D.2. Reports, Publications and Abstracts

D.2.a. Reports

D.2.a.1. Surveillance Annual Reports (41)

All annual reports are available at http://www.oem.msu.edu/AnnualReports.aspx

Occupational diseases

- *2013 Annual Report: Summary of Occupational Disease Reports to the Michigan Dept. of Licensing & Regulatory Affairs.* Feb 12, 2015
- *2012 Annual Report: Summary of Occupational Disease Reports to the Michigan Dept. of Licensing & Regulatory Affairs.* Nov 11, 2013
- *2011 Annual Report: Summary of Occupational Disease Reports to the Michigan Dept. of Licensing & Regulatory Affairs.* Jan 9, 2013
- *2010 Annual Report: Summary of Occupational Disease Reports to the Michigan Dept. of Licensing & Regulatory Affairs.* Aug 6, 2012
- *2009 Annual Report: Summary of Occupational Disease Reports to the Michigan Dept. of Licensing & Regulatory Affairs.* Feb 28, 2011

Amputations

- *Work-related Amputations in Michigan 2012*. August 2014
- *Work-related Amputations in Michigan 2011*. September 2013
- *Work-related Amputations in Michigan 2009*. May 2012
- *Work-related Amputations in Michigan 2008*. January 2011

Work-Related Burns

- *Work-related burns in Michigan: Third Annual Report Jan 2011-Dec 2012.* Dec 19, 2014
- *Work-related burns in Michigan: Second Annual Report Jan 2010-Dec 2010.* June 19, 2014
- *Work-related burns in Michigan: First Annual Report Jan 2011-Dec 2012.* June 19, 2014

Work-Related Skull Fractures

- *Work-Related Skull Fractures in Michigan: Second Report (January 2012 - December 2013).* May 4, 2015
- *Work-Related Skull Fractures in Michigan: First Report (January 2010 - December 2011).* October 21, 2013

Heavy Metals

- *Heavy Metals Surveillance in Michigan: Eighth Annual Report (January - December 2014)*. July 2015
- *Heavy Metals Surveillance in Michigan: Seventh Annual Report (January 2012 – December 2013)*. April 10, 2014
- *Heavy Metals Surveillance in Michigan: Sixth Annual Report (January - December 2011)*. April 27, 2012
- *Heavy Metals Surveillance in Michigan: Fifth Annual Report (January – December 2010)*. Sept 1, 2011

Pesticides

- *Pesticide Illness and Injury Surveillance in Michigan 2012.* April 2014
- *Pesticide Illness and Injury Surveillance in Michigan 2011.* September 2012
- *Pesticide Illness and Injury Surveillance in Michigan 2010.* March 2012
- *Pesticide Illness and Injury Surveillance in Michigan 2010.* December 2010

Silicosis and Other Work-Related Lung Diseases

- *Tracking Silicosis & Other Work-Related Lung Diseases in Michigan 2013.* March 10, 2015
- *Tracking Silicosis & Other Work-Related Lung Diseases in Michigan 2012.* July 1, 2014
- *Tracking Silicosis & Other Work-Related Lung Diseases in Michigan 2011*. August 14, 2013
- *2010 Annual Report on Silicosis in Michigan.* February 17, 2012
- *2009 Annual Report on Silicosis in Michigan.* February 28, 2011

Work-Related Asthma

- *Tracking Work-Related Asthma in Michigan 2013.* July 10, 2015
- *Tracking Work-Related Asthma in Michigan 2012.* April 4, 2014
- *Tracking Work-Related Asthma in Michigan 2011.* February 28, 2013
- *Tracking Work-Related Asthma in Michigan 2010.* January 9, 2012
- *Tracking Work-Related Asthma in Michigan 2009.* January 11, 2011

FACE

- *Tracking Work-Related Deaths in Michigan 2013.* June 2, 2015
- *Tracking Work-Related Deaths in Michigan 2012.* May 23,2014
- *Tracking Work-Related Deaths in Michigan 2011.* June 19, 2013

- *Tracking Work-Related Deaths in Michigan 2010.* February 21, 2012
- *Tracking Work-Related Deaths in Michigan 2009.* March 22, 2011

Carbon Monoxide

- *2012 Annual Report on Carbon Monoxide Poisoning in Michigan.* December 2014
- *2011 Annual Report on Carbon Monoxide Poisoning in Michigan.* July 24, 2013
- *2010 Annual Report on Carbon Monoxide Poisoning in Michigan.* November 6, 2012
- *2009 Annual Report on Carbon Monoxide Poisoning in Michigan.* April 4, 2012

D.2.a.2. Other reports (21)

A 2-page Data Fact Sheet was developed to highlight key elements of condition specific surveillance data (all are available at www.oem.msu.edu). There are 12 Data Fact Sheets:

- Tracking Work-Related Burns in MI – Data Fact Sheet. 11/4/2014
- Heavy Metals Surveillance in MI – Data Fact Sheet. 12/18/2014
- Work-Related Skull Fractures in MI –Data Fact Sheet. 6/1/2015
- Tracking Work-Related Amputations in MI-Data Fact Sheet. 11/2014
- Tracking Work-Related Diseases in MI – Data Fact Sheet. 2/9/2015
- Tracking Adult Blood Lead in Michigan – Data Fact Sheet. 11/4/2014
- Tracking Carbon Monoxide Poisoning in Michigan – Data Fact Sheet. 10/17/2013
- Tracking Work-Related Lung Diseases in Michigan – Data Fact Sheet. 3/9/15
- Tracking Acute, Traumatic Work-Related Deaths in Michigan – Data Fact Sheet. 4/21/2015
- Occupational Pesticide-Related Illnesses and Injuries in Michigan – Data Fact Sheet. 12/2014
- Tracking Work-Related Asthma in Michigan – Data Fact Sheet. 6/8/2015.
- Tracking Asbestos-Related Lung Disease in Michigan – Data Fact Sheet. 3/9/2015
- NIOSH e-News: Michigan Behavioral Risk Factor Survey on Work-related Skin Disease. Dec 2012
- NIOSH Blog: Rosenman KD. Work-Related Amputations: Who's Counting? March 21, 2013.
- NIOSH Blog: Worthington K, Filios M, Reilly MJ, Harrison RJ, Rosenman KD. Silica Hazards from Engineered Stone Countertops. NIOSH Blog 3/11/14. http://blogs.cdc.gov/niosh-scienceblog/2014/03/
- Largo T, Stanbury M, Rosenman K. Thirteen Indicators of the Health of Michigan's Workforce. Report from the Michigan Department of Community Health. June 2013. Available at

http://www.michigan.gov/documents/Michigan_Indicator_Report_revised_41206_156036_7.pdf

- Tijerina V. *Working Youth: Michigan's Occupational Teen Injuries*. December 1, 2014. http://oem.msu.edu/userfiles/file/WorkingYouthOccTeenInjFinal.pdf
- NIOSH e-News, March 2012: Work-Related Burns Identified. Available at: http://www.cdc.gov/niosh/enews/enewsv9n11.html#news
- Elhindi A, Stanbury M, Schwartz A. Non-Occupational Disinfectant Illness and Injury Surveillance in Michigan: 2006-2013. April 2015. http://www.michigan.gov/documents/mdch/Disinfectant_report_4_23_15_final_487815_7.pdf
- YouTube Video - Methylene Chloride Digital Story: Methylene Chloride and Bathtubs: A Dangerous Combination Posted September 10, 2013
- Chester D and MSU Extension. Safety Awareness for your Agricultural Employees July 30, 2013. (http://www.progressiveforage.com/forage-production/management/safety-awareness-for-your-agricultural-employees)

D.2.a.3. Newsletters (22)

All newsletters are available on our web site at www.oem.msu.edu

- Update on Silicosis, Winter 2009-2010
- Keeping Track: Occupational Injuries and Illnesses, Spring 2010
- COPD and Work, Summer 2010
- Asthma and Welding, Fall 2010
- Irritative Vocal Cord Dysfunction, Winter 2010-2011
- Hypersensitivity Pneumonitis - Identifying the Causal Agent, Spring 2011
- New Causes of Occupational Asthma, Summer 2011
- Work-Exacerbated Asthma, Fall 2011
- Chemical/Dust Irritants and Lung Disease, Spring 2012
- Updated Software for Use with a Peak Flow Meter to Evaluate Patients Whose Asthma Symptoms are Worse at Work, Summer 2012
- Swimming Pools and Asthma, Fall 2012
- Silicosis and Fracking, Winter 2012-2013
- Update on Isocyanates, Spring 2013
- Psychiatric Disorders and Work-related Asthma, Summer 2013
- Enzymes and Work-related Asthma, Fall 2013
- Elevated Blood Lead Levels, Winter 2013-2014
- Proposed OSHA Rule on Occupational Exposure to Respirable Crystalline Silica, Spring 2014

- Resources for Health Practitioners to Identify Exposures That Can Cause Work-Related Asthma, Summer 2014
- Health Disparities are an Occupational Health Issue, Fall 2014
- Metal Working Fluids and Lung Disease, Winter 2014-15
- Pesticides and Asthma, Spring 2015
- Lung Cancer Screening for Asbestos-Exposed Workers?, Summer 2015

D.2.a.4. Hazard Alerts (10)

All hazard alerts are available on our web site at www.oem.msu.edu

- Look for Mobile Equipment Blind Spots, 5/5/2011
- CA Storage: Respiration Halted for Fruit and People, 5/9/2011
- Look Up For Overhead Lines, 6/10/2011
- Methylene Chloride Causes Death of Three MI Bathtub Refinishers, 10/26/2011
- Falls from Scaffolds Can Be Prevented, 11/2/2012
- STOP Work-Related Homicides, 8/12/2013
- Stop Fatal Falls in Construction, 5/23/2013
- Don't Get Nailed by a Nail Gun, 3/18/2014
- Temporary Worker Safety - A Shared Responsibility, 5/23/2014
- Stop Work-Related Assaults in the Health Care Setting: 11 health care workers assaulted and sustained a skull fracture at work, 4/27/15.

D.2.a.5. FACE Investigation Reports (41)

All investigation reports are available on our web site at www.oem.msu.edu

- 09MI009: Construction Laborer Pinned Under Tire of Articulated Machine, 7/25/11
- 09MI049: Commercial Roofer Died When Struck by a Falling Load of Palletized Roofing Material, 7/25/11
- 09MI082: Golf Course Mechanic Died When Struck by Falling Ash Tree, 7/25/11
- 09MI085: Truck Driver Struck by Semi-Tractor When Walking in Parking Lot, 7/25/11
- 10MI006: Maintenance Supervisor Killed by Fall While Changing Light Bulb, 7/25/11
- 10MI019: Farmer Died When He Fell From a Ladder, 9/13/11
- 10MI082: Worker Crushed Under Car That Dislodged from Tow Straps, 10/6/2011
- 10MI067: Volunteer Mowing Grass Pinned by Overturned Tractor, 10/7/2011
- 10MI013: Tub Refinisher Died Due to Methylene Chloride Overexposure While Stripping a Bathtub, 10/26/11

- 10MI032: Sewer Administrator Died When Chop Saw Spark Caused a 55-Gallon Drum to Explode, 10/27/11
- 10MI075: Farmer Run Over By Tractor During Idle Adjustment, 10/31/2011
- 10MI021: Farmer Grading Field Pinned Under Overturned Tractor, 12/29/11
- 10MI137: Carpenter Died From Extension Ladder Fall, 5/1/12
- 10MI200: Farmer's Head and Neck Crushed Between Semi Trailer and Loading/Unloading Chute, 5/29/12
- 09MI163: Tree Trimmer Working in Tree Died When a Tree Branch Supporting Rigging Rope Broke Below the Crotch and Struck His Head, 7/19/2012
- 10MI038: Heavy Equipment Operator Killed When Ejected From Cab, 8/2/12
- 10MI144: Hispanic Roofer Dies After Falling Through an Improperly Secured Roof Hatch Cover 11/14/12
- 11MI006: Farmer Died When Front End Loader Bucket Struck Propane Tank Hidden by Snow, 11/15/12
- 10MI069: Hispanic Farm Laborer Electrocuted in Potato Field, 12/17/2012
- 10MI183: Fire Chief Died After Falling to Floor and Striking His Head, 1/16/13
- 11MI115: Farmer Run Over and Pinned Under Tractor Tire, 5/15/13
- 10MI122: Farmer Pinned Under Driver's Side Front Tire of a Front-end Loader, 5/15/13
- 11MI059: Hispanic Farm Laborer Struck by 550-gallon Water Tank When Wood Support Structure Collapsed, 6/4/13
- 11MI005: Logger Killed by Falling Tree, 6/6/13
- 12MI008: Farm Laborer Died When Struck By Front End Loader Bucket, 8/6/13
- 12MI033: Handyman Died When Tree He Was Felling Split Vertically and Struck Him, 10/1/13
- 12MI069: Business Owner Killed When Pulled Into Wood Chipper, 10/26/13
- 12MI121: Pipefitter Dies When Excavation Wall Collapses, Causing Water Tank to Rotate and Pin Him Against Excavation Wall, 10/28/13
- 12MI059: Land Owner Pinned by Tractor Bucket When Working in Ditch, 2/11/14
- 13MI019: Bus Driver Died While Attempting To Open Bus Doors While Bus Was Moving, 3/17/14
- 13MI020: Roofer Falls From Roof Edge When He Stepped on Insulation Overhang, 4/17/14
- 13MI009: Assistant Manager at Fertilizer Mixing Facility Dies When Pinned Under Overturned 1972 Tractor Without a ROPS, 5/1/14
- 13MI091: Painter Died When Elevated Scissor Lift Tipped to Side When Tire Entered Pavement Depression, 5/20/14
- 13MI090: Laborer Died Due to Hypertensive and Arteriosclerotic Cardiovascular Disease with a Contributing Factor of Hyperthermia, 6/25/14

- 09MI075: Semi-Truck Driver Died When Struck by Precast Concrete Panel That Fell from Semi Trailer, 1/28/2015
- 13MI102: Airport Manager Killed When Homemade Drag Struck Him While Smoothing a Runway, 3/4/15
- 13MI149: Truck Mechanic Pinned By Truck's Sway Bar and Link, 3/4/15
- 13MI197: Hunt Club Member Died When Struck by the Top of the Tree He Had Felled, 3/4/15
- 12MI218: Horse Breeder Falls 11-12 Feet From Hayloft When Throwing Hay Bale, 5/20/15
- 13MI043: Truck Driver Crushed By Roll Off Scrap Metal Box During Unloading From Truck, 7/9/15
- 12MI054: Truck Porter Dies From Head Injury Complications When He Fell From Either the ICC Bumper or Deck of a Semi-Trailer, 7/27/15

D.2.b. Publications (42)

- Banga A, Reilly MJ, Rosenman KD: [2011] A Study of the Characteristics of Michigan Workers with Work-Related Asthma from Exposure to Welding Fumes. J Occup Environ Med 53:415-419.*
-
- Bonauto DK, Fan JZ, Largo TW, Rosenman KD, Green MK, Walters JK, Materna BL, Flattery J; St. Louis T, Yu L, Fang S, Davis LK, Valiante DJ, Cummings KR, Hellsten JJ, Prosperie SL: [2010] Proportion of Workers Who Were Work-Injured and Payment by Workers' Compensation Systems --- 10 States, 2007. MMWR 59:897-900.*
-
- Cartier A, Boudreau N, Phenix P, Rosenman KD: [2013] Assessment of the Worker. Asthma In The Workplace, 4th Edition. Eds. Bernstein DI, Malo JL, Yeung MC, Bernstein L. Boca Raton, Florida: CRC Press 73-84.

- CDC: [2010] Acute antimicrobial pesticide-related illnesses among workers in health-care facilities – California, Louisiana, Michigan, and Texas, 2002-2007. MMWR 2010; 59: 551-556. Reprinted in JAMA 304(2):152-154.*
- Chaumont Menendez C, Castillo D N, Rosenman KD, Harrison RJ, Hendricks S: [2012] Evaluation of a Nationally Funded State-based Program to Reduce Fatal Occupational Injuries. Occup Environ Med 69: 810-814.
- Chester D, Rosenman KD, Grimes GR, Fagan K, Castillo DN: [2012] Fatal Exposure to Methylene Chloride in Bathtub Refinishers—Nine States, 2000-2011. MMWR 61: 119-122. *
- Davis L, Rosenman KD, Shor G, Simms E, Miller K: [2013] State health agencies' access to state workers' compensation data: results of an assessment conducted by the council of state and territorial epidemiologists, 2012. Proceedings from June 2012 Workshop;

NIOSH; Cincinnati, OH; DF Utterback and TM Schnorr, eds.; DHHS (NIOSH) Publication No. 2013-147; 203-208.*

- Hudson NL, Kasner EJ, Beckman J, Mehler L, Schwartz A, Higgins S, Bonnar-Prado J, Lackovic M, Mulay P, Mitchell Y, Larios L, Walker R, Waltz J, Moraga-McHaley S, Roisman R, Calvert GM: [2013] Characteristics and Magnitude of Acute Pesticide-Related Illnesses and Injuries Associated With Pyrethrin and Pyrethroid Exposures—11 States, 2000–2008. Am. J. Ind. Med. 9999:1–16.*
- Jacobson J, Wheeler K, Hoffman R, Mitchell Y, Beckman J, Mehler L, Mulay P, Schwartz A, Langley R, Diebolt-Brown B, Prado JB, Newman N, Calvert GM, Hudson N: [2011] Acute Illnesses Associated With Insecticides Used to Control Bed Bugs — Seven States, 2003–2010 MMWR Vol. 60 / (37); 1269-1274*
- Kasner EJ, Keralis JM, Mehler L, Beckman J, Bonnar-Prado J, Lee S-J, Diebolt-Brown B, Mulay P, Lackovic M, Waltz J, Schwartz A, Mitchell Y, Moraga-McHaley S, Roisman R, Gergely R, Calvert GM: [2012] Gender Differences in Acute Pesticide-Related Illnesses and Injuries Among Farmworkers in the United States, 1998–2007. Am J Ind Med 55:571–583
- Kica J, Rosenman, KD: [2012] Multisource Surveillance System for Work-Related Burns, J Occup Environ Med 54: 642-647.*
- Kica J, Rosenman KD: [2014] Multi-Source Surveillance System for Work-Related Skull Fractures. J Safety Research 51: 49-56.*
- Largo TW, Rosenman, KD: [2013] Michigan Work-related Amputations, 2008. J Occup Environ Med 55: 280-285.*
- Largo TW, Rosenman KD: [2015] Surveillance of work-related amputations in Michigan using multiple data sources: Results for 2006-2012. Occup Environ Med 72(3):171-6.*
-
- Lee SJ, Mulay P, Diebolt-Brown B, Lackovic M, Mehler L, Beckman J, Waltz J, Prado J, Mitchell Y, Higgins S, Schwartz A, Calvert GM: [2010] Acute illnesses associated with exposure to fipronil – surveillance data from 11 states in the United States, 2001–2007. Clinical Toxicology 48:737–744*
- Lee SJ, Mehler L, Beckman J, Diebolt-Brown B, Prado J, Lackovic M, Waltz J, Mulay P, Schwartz A, Mitchell Y, Moraga-McHaley S, Gergely R, Calvert GM: [2011] Acute Pesticide Illnesses Associated with Off-Target Pesticide Drift from Agricultural Applications — 11 States, 1998–2006. Environ Health Perspect 119:1162–1169.*
- Lefkowitz D, Pechter E, Lumia M, Stephens A, Fitzsimmons K, Davis L, Flattery J, Weinberg J, Harrison RJ, Reilly MJ, Filios MS, White GE, Rosenman KD: [2015] Isocyanates and Work-related Asthma: Findings from California, Massachusetts, Michigan, and New Jersey, 1993-2008. Am J Ind Med Accepted 06-Aug-2015.*
- Lutzker LA, Rafferty AP, Bruner WM, Walters JK, Wasilevich EA, Green MK, Rosenman KD: [2010] Estimates of the Prevalence of Work- Related Asthma in Michigan, Minnesota and Oregon. J of Asthma 47:156-161.*

*

- Makol A, Reilly MJ, Rosenman KD: [2011] Prevalence of Connective Tissue Disease in Silicosis. Am J Ind Med 54:255-262*
- Mehler L, Schwartz A, Diebolt-Brown B, Badakhsh R, Calvert GM, Lee SJ. Acute Antimicrobial Pesticide-Related Illnesses Among Workers in Health-Care Facilities - California, Louisiana, Michigan, and Texas, 2002—2007: [2010] MMWR 59:551-556 and JAMA 304(2):152-154.*
- Mehler L, Beckman J, Badakhsh R, MPH, Diebolt-Brown B, Schwartz A, Higgins S, Gergely R, Calvert GM, Hudson N. Acute Illness and Injury from Swimming Pool Disinfectants and Other Chemicals --- United States, 2002—2008: [2011] MMWR 60(39); 1343-1347.*
- Millerick-May M, Reilly MJ, Schrauben S, Rosenman KD. Silicosis and Chronic Renal Disease: [2015] Am J Ind Med DOI 10.1002/ajim.22465.
- Quinn M, Henneberger PK, Braun B, Delclos GL, Fagan K, Huang V, Knaack JL, Kusek L, Lee SJ, Le Moual N, Maher KA, McCrone SH, Hogan Mitchell A, Pechter E, Rosenman KD, Sehulster L, Stephens AC, Wilburn S, Zock JP: [2015] Cleaning and Disinfecting Environmental Surfaces in Healthcare: Towards an Integrated Framework for Infection and Occupational Illness Prevention. Am J Infect Control 43: 424-434.*
- Rosenman KD, Reilly MJ, Gardiner J: [2010] Results of Spirometry among Individuals in a Silicosis Registry. J Occup Environ Med 52: 1173-1178.
- Rosenman KD: [2010] Lung Disease in the Automotive Industry. In: Environmental and Occupational Lung Disease. Eds. Nemery B, Cullinan P, Tarlo S. West Sussex: Wiley – Blackwell 211-222.*
- Rosenman KD: [2012] Rheumatoid Arthritis and Pneumoconiosis (Letter). Am J Resp Crit Care Med 185: 1024.
- Rosenman KD: [2012] Talc. Patty's Toxicology, 6th Edition, eds. Bingham E and Cohrssen B. Hoboken, New Jersey: John Wiley and Sons Inc Volume 5, Chapter 84: 257-272.*
- Rosenman KD, Kica J, Largo T: [2013] Completeness of workers' compensation data in identifying work-related injuries in use of workers' compensation data for occupational safety and health. Proceedings from June 2012 Workshop; NIOSH; Cincinnati, OH; DF Utterback and TM Schnorr, eds.; DHHS (NIOSH) Publication No. 2013-147; 89-95.*
- Rosenman KD, Fussman C: [2014] Prevalence of work-related dermatitis in the working population. (Letter). Am J Ind Med 57:127–128
- Rosenman KD: [2014] Hydraulic Fracturing and the Risk of Silicosis. Clinical Pulmonary Medicine 21; 167-172.*
- Rosenman KD, Millerick-May M, Reilly MJ, Flattery J, Weinberg J, Harrison RJ, Lumia ME, Stephens AC, Borjan M: [2015] Swimming Facilities and Work-Related Asthma. J Asthma 52:52-58.
- Rosenman KD, Beckett WS: [2015] Web Based Listing of Agents Associated with New Onset Work-Related Asthma. Respiratory Medicine 109: 625-631.

- Rosenman KD: [2015] Occupational Diseases in Individuals Exposed to Metal Working Fluids. Current Opinion in Allergy and Clinical Immunology 2: 131-136
- Rosenman KD: [2015] Health Disparities in Occupational Exposures in Health Disparities in Respiratory Disease. Eds Lynn G, Berry C. Springer (in press).
- Rosenman, KD: [2015] "Silicosis." In Oxford Bibliographies in Public Health. Ed. David McQueen. New York: Oxford University Press (in press)*
- Schwartz A, Walker R, Sievert J, Calvert GM, Tsai RJ: [2012] Occupational Phosphine Gas Poisoning at Veterinary Hospitals from Dogs that Ingested Zinc Phosphide — Michigan, Iowa, and Washington, 2006–2011. MMWR 61(16): 286-288.*
- Sen A, Lee SY, Gillespie BW, Kazerooni EA, Goodsitt MM, Rosenman KD, Lockey JE, Meyer CA, Petsonk EL, Wang ML, Franzblau A: [2010] Comparison of Reliability of Classification for Pneumoconiosis of Film and Digital Radiographs: A Modeling Approach. Academic Radiology 17:511-519.*
- Simms E, Tai C, Towle M: [2013] Rosenman KD. Workers' compensation-related CSTE occupational health indicators. Proceedings from June 2012 Workshop; NIOSH; Cincinnati, OH; DF Utterback and TM Schnorr, eds.; DHHS (NIOSH) Publication No. 2013-147; 135-139.*
- Stanbury M, Rosenman KD: [2014] Work-related health disparities: A state public health-based approach. Am J Ind Med 57:596-604.
- St. Louis, T, Ehrlich E, Bunn T, Kanotra S, Fussman C, Rosenman KD: [2014] Proportion of Dermatitis Attributed to Work Exposures in the United States Working Population. Am J Ind Med 57:653-9
- Tsai R, Sievert J, Prado J, Incident Reporting Program, Buhl K, Stone D, Forrester M, Higgins S, Mitchell Y, Schwartz A, Calvert GM: [2014] Acute Illness Associated with Use of Pest Strips — Seven U.S. States and Canada, 2000–2013. MMWR 63 (2): 42-43.
- White GE, Seaman C, Filios MS, Mazurek JM, Flattery J, Harrison RJ, Reilly MJ, Rosenman KD, Lumia ME, Stephens AC, Pechter E, Fitzsimmons K, Davis LK: [2014] Gender Differences in Work-Related Asthma: Surveillance Data from California, Massachusetts, Michigan, and New Jersey, 1993–2008. J Asthma 51: 691-702.*

D.2.c. Presentations (154)

There are 49 presentations listed below. In addition, Debra Chester made 105 educational presentations to worker groups.

- Rosenman KD. Diagnosis and Management of Work-Related Asthma. Medical Grand Rounds, Sparrow Medical Center, Lansing, January 6, 2010.
- Rosenman KD. The Future of Occupational Health and Safety in the United States. Michigan Safety Conference, Lansing, April 20, 2010.

- Rosenman KD. Work-Related Asthma: An Overlooked Asthma Trigger. 2010 Clinical Update in Women's Health. East Lansing, May 7, 2010.
- Rosenman KD. New Advances in Occupational and Environmental Lung Disease. Medical Grand Rounds, Borgess Hospital, Kalamazoo, May 26, 2010.
- Rosenman KD. Occupational/Environmental Lung Diseases Update. 13th Annual Clinical Chest Conference. Wm. Beaumont Hospital, Royal Oak, September 15, 2010.
- Rosenman KD. Update Occupational Disease Surveillance in Michigan. 2010 Michigan Occupational Health Conference, Port Huron, October 1, 2010.
- Rosenman KD. Work-Related Asthma: An Overlooked Asthma Trigger. Ohio Asthma Coalition Education and Research Conference. Columbus, Ohio, October 8, 2010.
- Rosenman KD. Work-Related Asthma: An Overlooked Asthma Trigger. Michigan State Medical Society 145th Annual Scientific Meeting, Troy, October 22, 2010.
- Rosenman KD. Asthma Mortality in Michigan. Michigan Health Gaps. Michigan State Medical Society 145th Annual Scientific Meeting, Troy, October 23, 2010.
- Rosenman KD. Welding and Asthma. Work-Related Asthma Meeting, NIOSH, Oakland, California, March 22, 2011.
- Rosenman KD. Silicosis Surveillance in Michigan. Silicosis Meeting, NIOSH, Oakland, California, March 24, 2011.
- Rosenman KD. Kidney Disease and Silicosis, Silicosis Meeting, NIOSH, Oakland, California, March 24, 2011.
- Rosenman KD. Work-Related Asthma: An Overlooked Asthma Trigger. Michigan Asthma Conference, Michigan Department of Community Health, Lansing, Michigan, May 10, 2011.
- Rosenman KD. Asthma Mortality in Michigan. Michigan Asthma Conference, Michigan Department of Community Health, Lansing, Michigan, May 10, 2011.
- Rosenman KD. Developing a state-based approach to evaluate and address occupational health disparities. 2011 MSU Symposium on Multicultural Psychology. E. Lansing MI, Sept 22-23, 2011.
- Stanbury M. Work-related health disparities in Michigan. 2011 MSU Symposium on Multicultural Psychology. E. Lansing MI, Sept 22-23, 2011.
- Rosenman KD. Work-Related Asthma: An Overlooked Asthma Trigger. Annual Meeting of Michigan Physician's Assistants Association, Traverse City, Michigan, October 12, 2011.
- Rosenman KD. Occupational Injury and Illness Surveillance. Frontiers in Industrial Hygiene, Wayne State University, Detroit, Michigan, November 15, 2011.
- Rosenman KD. Update in Occupational and Environmental Medicine. Medical Grand Rounds, Sparrow Medical Center, Lansing, Michigan, January 10, 2012.

- Rosenman KD. Update on Occupational Disease Surveillance in Michigan. MIOSHA General Industry Safety and Health Field Inspectors, Lansing, Michigan, January 11, 2012.
- Rosenman KD. Occupational and Environmental Lung Disease. Pulmonary Conference, University of Michigan, Ann Arbor, Michigan, January 31, 2012.
- Stanbury M, Rosenman KD. Work-related health disparities in Michigan. Poster presented at the annual meeting of the epidemiology section of the Michigan Public Health Association. April 2012.
- Rosenman KD. Occupational and Environmental Lung Disease, Annual Scientific Meeting of the Michigan Thoracic Society, Novi, Michigan, April 27, 2012.
- Rosenman KD, Kica J, Largo T. Completeness of Workers' Compensation Data in Identifying Work-Related Injuries. Use of Workers' Compensation Data for Occupational Safety and Health Washington, DC, June 19 – 20, 2012.
- Rosenman KD. Occupational Injury and Illness Surveillance. University of Washington, Seattle, Washington, October 4, 2012.
- Kica J, Rosenman KD. Tracking Work-Related Burns in Michigan at the 5th National Occupational Injury Research Symposium (NOIRS) in Morgantown, October 2012.
- Rosenman KD. Work-Related Asthma: An Overlooked Asthma Trigger. University of Washington, Seattle, Washington, October 4, 2012.
- Rosenman KD. Hypersensitivity Pneumonitis. Annual Scientific Meeting, Michigan State Medical Society, Troy, Michigan, October 26, 2012.
- Rosenman KD. State Based Occupational Injury and Illness Surveillance. Mine Safety and Health Meeting, Washington, DC, March 28, 2012.
- Rosenman KD. IgE Reporting. Work-Related Asthma Meeting, NIOSH, Morgantown, West Virginia, April 27, 2012.
- Rosenman KD. Tracking Work-Related Asthma in Michigan. NIOSH, Oakland, California, April 9-11, 2013.
- Rosenman KD. Tracking Silicosis in Michigan. NIOSH, Oakland, California, April 9-11, 2013.
- Rosenman KD. The Burden of Occupational and Environmental Lung Disease. Topics in Pulmonary and Critical Care Medicine, Spectrum Medical Center, Grand Rapids, Michigan, April 20, 2013.
- Marchese M, Wahl R. Cameron L, Rosenman KD. Evaluation of the Michigan carbon monoxide surveillance system, 2009-2011. Annual CSTE Meeting Pasadena CA, June 11, 2013.
- Rosenman KD, Kica J, Largo T. State surveillance for identifying work-related injuries. Annual CSTE Conference. Pasadena, California June 9-13, 2013

- Rosenman KD. Work-Related Injury and Illness Surveillance in Michigan**.** Annual Meeting Michigan College and University Environmental Health Staff, East Lansing, Michigan, July 31, 2013.
- Rosenman KD. Update on Occupational and Environmental Lung Disease. Munson Medical Center Traverse, City, Michigan, August 23, 2013.
- Rosenman KD. Update on Occupational and Environmental Medicine. Medical Grand Rounds, Sparrow Medical Center, Lansing, Michigan, October 1, 2013.
- Largo T, Reilly MJ, Rosenman KD. Work-related amputation surveillance: methods, obstacles, successes. Roundtable at the Annual CSTE Conference, Nashville, Tennessee, June 22-26, 2014.
- Tijerina V. Identification of Preventive Strategies for Occupational Injuries in Teens. Mid-Michigan Symposium for Undergraduate Research Experiences. July 23, 2014.
- Rosenman KD. Health Risks for Agricultural Workers. Medical Grand Rounds, Sparrow Medical Center, Lansing, Michigan, October 7, 2014.
- Rosenman KD. Tracking Work-Related Asthma in Michigan. NIOSH, Atlanta, Georgia, March 25-27, 2014.
- Rosenman KD. Tracking Occupational Lung Disease in Michigan. NIOSH, Georgia, March 25-27, 2014.
- Rosenman KD. Health Risks for Agricultural Workers. Medical Grand Rounds, Sparrow Medical Center, Lansing, Michigan, October 7, 2014.
- Rosenman KD. Work-Related Asthma. UAW Black Lake Educational Conference. Onaway, Michigan, March 12, 2014.
- Rosenman KD. Occupational Injury/Illness Surveillance, University of Michigan Occupational Health and Safety Seminar, Ann Arbor, February 20, 2015
- Kica J, Rosenman KD. Identification of work-related skull fractures not receiving workers' compensation. Hopkinton , MA, March 3, 2015
- Rosenman KD, Reilly MJ, Chester D. Temporary Worker Activity Regarding Health & Safety, Michigan, NIOSH Manufacturing and Service Sectors, Cincinnati, Ohio, April, 30, 2015. The presentation was summarized in a NIOSH Science Blog: http://blogs.cdc.gov/niosh-science-blog/2015/06/16/temp-workers/
- Rosenman KD, Reilly MJ, largo TW. OSHA's New Rule on Reporting Severe Injuries: What to Expect, Kingwood, West Virginia, National Occup Injury Research Symp, May 20, 2015

D.2.d. Abstracts (9)

- Banga A, Reilly MJ, Rosenman KD. Prevalence of Respiratory and Eye Symptoms among Welders and Association with Different Welding Techniques. ATS Annual Meeting, New Orleans, May 16-19, 2010.

- Banga A, Reilly MJ, Rosenman KD. Work Up And Management Of Work Related Asthma: How Are We Doing? American Thoracic Society, San Francisco, California, May 18-23, 2012.

- Maile M, Rosenman KD. Tracking Unintentional Carbon Monoxide Poisoning in Michigan. Annual CSTE Meeting, Omaha, Nebraska, June 3-6, 2012.

- Kica J, Rosenman KD. Multi-Source Surveillance System for 2010 Work-Related Skull Fractures in Michigan. Annual CSTE Meeting, Omaha, Nebraska, June 3-6, 2012.

- Lefkowitz D, Pechter E, Lumia M, Stephens A, Fitzsimmons K, Davis L, Flattery J, Weinberg J, Harrison R, Reilly MJ, Filios M, Rosenman KD. Diisocyanates and Work-related Asthma: Findings from California, Massachusetts, Michigan, and New Jersey, 1993–2008. Poster at Isocyanates and Health Conference April 3-4, 2013, Bethesda, Maryland

- Rosenman KD, Reilly MJ. Are U.S. Companies that Use Isocyanates Providing Medical Surveillance? Presentation and poster at Isocyanates and Health Conference April 3-4, 2013, Bethesda, Maryland

- Schleiff PL, Rosenman KD, Reilly MJ, Lumia ME, Worthington K, Filios M, White, G. Characterization of Reported Silicosis Cases: Michigan and New Jersey 1993–2009. CSTE National Meeting, Nashville TN. June 22-26, 2014.

- Kica J, Rosenman KD, Largo T and Reilly MJ. Use of OSHA Enforcement Inspections to Follow-Up Reports of Occupational Injuries and Illnesses. CSTE National Meeting, Nashville TN. June 22-26, 2014.

- Kica J, Rosenman KD. Multi-source surveillance system for 2013 work-related crushing injuries in Michigan. Annual CSTE Conference Boston, MA, June 14-18,

E. Inclusion of Children

Children who had occupational illnesses or injuries for the conditions under surveillance were included. If a child under 18 was interviewed, then permission to speak with the child was first obtained from the parent or legal guardian.

F. Materials available for other investigators

In addition to peer reviewed publications, multiple condition specific annual reports and quarterly newsletters were published for each of the five years of the project. Multiple educational brochures, a training program for abrasive blasters and a training program on work-related asthma were developed. This material is available on our web site, www.oem.msu.edu

G. Inclusion Enrollment Report

Cumulative Inclusion Enrollment Report

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

Study Title: Expanded Program in Occupational Injury and Illness Surveillance

Comments: July 1, 2010 - June 30, 2015

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native	3	6	0	0	0	0	1	0	0	10
Asian	3	16	0	0	0	0	21	24	0	64
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	0	0	0	0	0
Black or African American	25	120	1	0	2	0	212	313	0	673
White	186	1009	0	7	34	0	1209	4129	1	6,575
More Than One Race	2	7	0	2	8	0	21	31	0	71
Unknown or Not Reported	4	11	0	87	335	3	1736	4585	2948	9,709
Total	223	1,169	1	96	379	3	3,200	9,082	2,949	17,102