

Final Progress Report

Enhanced Program in Occupational  
Injury and Illness Surveillance

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Michigan State University

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## Table of Contents

- A. List of Terms and Abbreviations – Page 3-4
- B. Abstract – Page 5
- C. Section 1 – Pages 6-8
  - Highlights/Significant Findings – Pages 6-8
  - Translation of Findings – Pages 8
  - Outcomes/Relevance/Impact – Pages 8
- D. Section 2 – Pages 9-65
  - Scientific Report – Pages 9 – 61
  - Publications/Abstracts – Pages 62 – 65
- E. Inclusion of Gender and Minority Study Subjects – Page 66
- F. Inclusion of Children – Page 67
- G. Materials Available for Other Investigators – Page 67

## 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

MDA - Michigan Department of Agriculture

MDCH - Michigan Department of Community Health

MDELEG - Michigan Department of Energy, Labor and Economic Growth

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

PAC – Pesticide Advisory Council

PEL - permissible exposure limit

PCCs - Poison Control Centers

PPPM – MDA Pesticide and Plant Pest Management Division

RADS – Reactive Airways Dysfunction Syndrome

REL - recommended exposure limit

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 Community Health and the Michigan Department of Energy, Labor and Economic Growth 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 (4) work-related acute traumatic fatalities. The state has had SENSOR funded projects in work-related asthma from 1988 to date, pesticides from 2001 to date, silicosis from 1988-1992 and 2002 to date, and acute traumatic fatalities from 2002 to date. Since initiation of surveillance 2,825 cases of work-related asthma (601 in the last five years), 691 cases of acute pesticide poisoning (420 in the last five years), 1,051 cases of silicosis (71 in the last five years), and 1,306 acute traumatic fatalities (565 in the last five years) have been confirmed. One thousand six hundred twenty-seven follow back industrial hygiene inspections (234 in the last five years) have been conducted and 9,729 fellow workers interviewed (994 in the last five years) during these inspections. There has been 100% reporting from the 148 acute care hospitals in the state. Two quarterly newsletters (total 125 different newsletters) and 104 annual reports have been written and mailed out to approximately 4,000 targeted physicians and health care professionals. Special projects were initiated for cleaning agents, foundries, abrasive blasting, isocyanates and latex. Evaluation of the effectiveness of our effort to improve working conditions was conducted.

## **C.1. Highlights/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 Energy, Labor and Economic Growth; and the Michigan Department of Community Health (MDCH). 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, work-related noise-induced hearing loss, silicosis, work-related acute traumatic fatalities, work-related amputations, acute work-related pesticide illnesses and elevated blood leads. Additional conditions under surveillance included: elevated blood and urine arsenic, cadmium and mercury, carbon monoxide poisoning and elevated carboxyhemoglobin levels and mesothelioma. Significant in-kind support from the three institutions has contributed to the success of the surveillance program.

Michigan confirmed 601 cases of work-related asthma (WRA). We have identified eight WRA deaths. Michigan has confirmed 565 deaths from acute traumatic work-related injuries; 71 cases of silicosis; and 420 cases of acute pesticide illnesses.

Michigan had a well-established surveillance system, which was based on a state occupational disease reporting law. To encourage reporting there was frequent outreach (two quarterly newsletters (one for lung disease with a distribution of 3,200 and one for noise-induced hearing loss with a distribution of 800), 10 annual reports per year on 10 different conditions, frequent reminders to hospitals, a display booth at medical meetings, presentations at medical meetings and a letter to newly licensed physicians) and since 2009, MIOSHA enforcement audits of occupational health clinics. We compiled the surveillance data each year and issued condition specific annual reports. We published 28 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 29 papers for the peer reviewed literature and eight abstracts. We have delivered 38 presentations at medical Grand Rounds and medical conferences on conditions under surveillance and 73 educational presentations to worker groups.

Michigan OSHA, using State and Federal OSHA funds, has conducted enforcement inspections to follow up the index cases. This includes 37 industrial hygiene inspections for silica, and 99 industrial hygiene investigations for work-related asthma (WRA). Another 77 on-site investigations for acute traumatic fatalities were conducted by MSU. As part of the MIOSHA WRA inspections, MSU has interviewed 994 co-workers of the index cases at 83 of the inspected companies; 16% of fellow workers who reported work-related breathing symptoms received letters recommending that they have medical follow-up. Air sampling for silica found 51% of the air sampling results were above the NIOSH recommended exposure level and 40% above the Michigan OSHA permissible exposure level. The Michigan Department of Agriculture has completed 21 inspections to follow up confirmed pesticide illness cases. MDCH has identified 71 occupational cases for reporting to the EPA, which meet criteria for regulatory concerns. These cases were involved in 15 separate events.

We have highlighted the risk of asthma from exposure to metal working fluids. We have collaborated with other states to highlight the risk of asthma from cleaning agents, among health care workers and among workers in education, and the risk of silicosis in foundries. We are in the process of promulgating new workplace standards

for the isocyanates and latex and reviewing the permissible exposure levels to 10 other substances that the Michigan Occupation Health Standards Commission will consider for new standards. We have used our data to estimate the percentage of asthma in adults that is work-related, produce 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 through contributions to the state's website: [www.getasthmahelp.org](http://www.getasthmahelp.org), through educational materials produced and distributed through the state initiative, and with the WRA surveillance team's involvement in the state plan's work groups. 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 have integrated our surveillance for WRA with separate funding from the CDC Center for Environmental Health to investigate asthma deaths. In conjunction with this other program we have identified eight work-related asthma deaths, including two from isocyanates and one from second hand smoke.

We have promulgated new regulations to expand disease reporting. These new regulations were laboratory reporting of all blood and urine arsenic, cadmium, mercury tests in 2005; laboratory reporting of serum and red cell cholinesterase in 2005; health care provider, hospital and clinic reporting of non intentional chemical poisoning in 2007; and laboratory reporting of carboxyhemoglobin in 2009. Regulations requiring the reporting of all non intentional injuries will be in place in September 2010.

NIOSH has used Michigan FACE investigations in several NIOSH publications, including a hazard alert (Preventing Asthma and Death from MDI Exposure During Spray-on Truck Bed Liner and Related Applications) and a Fact Sheet (Fatal Injuries among Landscape Service Workers). Additionally, NIOSH referenced MIFACE Investigation Report #06MI117: Male Siding Installer Dies After Falling From a Roof While Installing a J Channel on a Dormer as an illustrative case to demonstrate the capabilities of a recently NIOSH-developed fall protection system that would have prevented the death, and MIFACE Investigation Report #05MI095: Municipal Tree Trimmer Dies When Falling Tree Limb Struck Him in NIOSH testimony on the OSHA proposed Tree Trimming rule. Additional references of MIFACE reports include use in MIOSHA-sponsored training programs, trade and safety publications and newsletters, a reference book (Toxicology Principles for Industrial Hygienists), NIOSH e-News, and health and safety websites.

As risks were identified we initiated projects, including a special education project for abrasive blasters, development of contract language to reduce deaths among inmates and prison guards who are contracted to work outside the prison, site visits to assess isocyanate exposure and work practices at 81 of the 91 truck bed liner facilities in the state, development and distribution of Hazard Alerts for specific fatal exposures (trenching, tree trimming, carbon monoxide, asthma), in collaboration with the Michigan Farm Bureau have presented farm safety and health seminars across the State and trained 1,504 farm workers and 3,038 farm employers/owners in hazard recognition and prevention.

Michigan has been a leader in the development of OHIs through its participation and leadership in the Occupational Health Surveillance Workgroup of the Council of State and Territorial Epidemiologists (CSTE), which has been co-chaired by the program's Principal investigator, Dr. Rosenman. Mr. Largo, one of the epidemiologists funded in the current program, has been responsible for maintenance of the how-to-guides for the indicators.

We conducted evaluations of our activity, one example found that our interventions in foundries was associated with a reduction in silica exposures and presumably has or will contribute to a decline in the incidence of silicosis and/or its severity and another found that the effectiveness of MIOSHA inspections initiated from WRA index cases was equivalent to complaint generated inspections.

## **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 Energy, Labor and Economic Growth (MDELEG), through its state OSHA enforcement staff, OSHA consultative staff and education staff. Based on our experience in conducting occupational disease surveillance in Michigan, the collaborative arrangement between the MDELEG 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

There were a number of advantages to locating the Surveillance Center in an academic medical institution: 1) the development of a collegial relationship between practitioners in the community and at a medical center; 2) the increased flexibility outside of state bureaucracy; and 3) the fact that sentinel health care providers view the academic Surveillance Center as a resource rather than a regulatory or governmental agency.

The other strength in this collaboration was that 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.

As NIOSH continues to develop models for state-based surveillance, a variety of models to encompass the varied needs and situations in different states are warranted. Alternative models not solely limited to state health departments or other state agencies are critical. This project has developed a successful occupational injury and illness surveillance project that could be instituted in other states.

## **C.3. Outcomes/Relevance/Impact**

### **C.3.b. Relevance**

This project was relevant to public health, and specifically occupational health, because it addressed all three core functions in public health: collection and analysis of data, building partnerships to promote the goal of reducing occupational injuries and illnesses, and assuring efforts to prevent additional work-related illness. A variety of strategies were used to ensure that surveillance data were of high quality, that stakeholders and the general public were aware and had access to the data, and that the data drove prevention activities.

## **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 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 has been ongoing concern about the increasing morbidity and mortality related to asthma over the last 35 years (Tarlo et al, 2008). Approximately 400 substances have been documented to cause work-related asthma ([www.asmanet.com/asmapro/asmawork.htm#start](http://www.asmanet.com/asmapro/asmawork.htm#start)). OSHA exposure limits for many of these substances are not protective to prevent the development of new onset asthma or for individuals who have developed sensitivity. Various studies and consensus statements have concluded that 2-45% of adult asthma is work-related (Blanc and Toren, 1999). The median estimate from all the studies is 9%. If only the most methodologically sound studies are used, the median estimate is that 15% of asthma in adults can be attributed to work (Blanc and Toren, 1999). The American Thoracic Society consensus statement concluded that 15% of asthma in adults can be attributed to work (ATS, 2003). A recent 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).

The 2007 Behavioral Risk Factor Surveillance System estimated there were 724,400 adults with asthma in Michigan (9.5% of ~7,600,000 adults 18 years or older). The median estimates that 9-15% of adult asthma can be attributed to work would translate into 65,000 – 109,000 adults in Michigan with work-related asthma. Analysis of self reports of work-related asthma among health maintenance organization (HMO) members classified 33% of those interviewed as potentially having WRA (Vollmer WM et al, 2005). A 3-state analysis (California, Massachusetts and Michigan) of 2001 BRFSS data on asthma and work-related asthma found that 7.4% – 9.7% of adults with asthma can be attributed to workplace exposures (Flattery et al, 2006) and analysis of 2004 Michigan BRFSS data showed 10.2% of adult asthma attributable to work ([www.getastmahelp.org](http://www.getastmahelp.org)). Using a recent estimate of the national costs of work-related asthma per year (Leigh JP et al, 2002), we estimate that the medical expenses and lost earnings in Michigan from work-related asthma are over 55 million dollars per year. In a more recent 3-state (Michigan, Minnesota and Oregon) analysis using the new BRFSS asthma call back survey we found that over half of all adults with asthma (53%) reported that their asthma was caused or made worse by any job they ever had, 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).

### 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 and facilities, and employers; hospital discharge data; and Poison Control Center reports. We worked with the Workers' Compensation staff, part of MDELEG, to obtain data on work-related asthma on individuals who file 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 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 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. A mailing was made 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. It is a misdemeanor and \$50 fine for each case not reported. The results of the investigations and any fines were publicized in the Michigan occupational health community.

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](http://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.

An automated occupational disease reporting system was developed for the electronic medical record used by the family practitioners and internists at Michigan State University.

In addition to receiving OD reports, we actively solicited reports from all of the Michigan hospitals. Each February we requested the 148 acute care hospitals in the state to send us the face sheet, discharge summary and pulmonary function tests on all patients discharged with ICD-9 506 (acute inhalation exposure); and ICD-9 493 (asthma) where workers' compensation was the primary payer. 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. 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.

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.

The two Michigan poison control centers electronically reported all occupational poisoning calls. 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.

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

- 1) Four page quarterly respiratory disease newsletter-"Project SENSOR News"
- 2) Annual report for work-related asthma
- 3) Presentations at Grand Rounds and medical conferences
- 4) Display booths at medical conferences
- 5) Mailing to newly licensed physicians
- 6) Updating of the Surveillance Center website and linkages to other important sites
- 7) Advisory Committee
- 8) Provision of software for electronic medical record reporting system
- 9) WRA Training programs for MIOSHA field staff, Asthma educators and other health and safety representatives

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 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.

Dr. Rosenman gave talks at medical conferences and grand rounds.

We routinely exhibited display booths at major medical conferences around the state. At the booth, we distributed newsletters, annual reports, 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 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.

All new physicians in the state received a letter about the occupational disease reporting law and a copy of the reporting form as part of the packet they received when they applied for a Michigan License.

The MSU Surveillance Center web site ([www.oem.msu.edu](http://www.oem.msu.edu)) contained: Annual reports; quarterly newsletters, resource materials on medical screening for work-related asthma and silicosis; a training course on abrasive blasting; the Michigan occupational disease reporting form; 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.

A website was set up recently for asthma (<http://getastmahelp.com>) by the MDCH. Work-related asthma was integrated into this site. The website was part of the state's strategic plan for asthma in general. Sections on this website included: General information about work-related asthma; Myths about work-related asthma; Types of work-related asthma; Substances at work that can cause asthma; When to suspect asthma is work-related; What to do if diagnosed with work-related asthma; Prevention of work-related asthma; 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. One was able to select a county and see how many people have asthma in the county as well as how many have work-related asthma.

We continued to maintain an advisory committee, for the respiratory diseases. The advisory board members represented the organizations of the targeted physicians. 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.

WRA Training programs for MIOSHA field staff, Asthma educators and other health and safety representatives: We developed and conducted numerous 4-hour training sessions for MIOSHA general industry health and safety, construction health and safety and consultation, education and training divisions. We also conducted training sessions for other health and safety representatives at conferences, at work site locations, and for asthma educators. The programs all used a pre- post-survey, and demonstrated that the information presented increased the participants' knowledge about WRA and Michigan law relating to work-related diseases. In addition to the surveys, we provided educational and informational materials attendees could use in their own work, including sharing with their patients, as well as employers.

One theme that repeats itself when we examine the surveillance data that we have collected over the past 22 years was that there was more work-related illness in the State than what is actually reported (Biddle et al, 1998; Henneberger et al, 1999; Rosenman et al, 2000; Rosenman et al, 2003). A question this surveillance team tried to answer was “Where were the unreported cases of occupational illness?” Were they simply not being recognized as work-related or were they being recognized as work-related but were not being reported either because the health provider was unaware of their obligation to report those cases or unwilling to report those cases. A further question was “Do the characteristics (for example, specialty, location in the state, association with a University or hospital, etc...) of the health practitioners differ by condition?”

To address this issue why practitioners were not reporting, we developed a one page card length questionnaire that was handed out at four state meetings that occur each year: Michigan Thoracic Society, Michigan Allergy Society, Michigan Family Practice Association and the Michigan Chapter of the American College of Physicians. 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? The survey conducted in Year One was analyzed in Year Two. We also mailed these questions on a postage paid return postcard to members of the occupational, pulmonary and allergy societies.

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 5% of the occupational asthma patients reported, and approximately 5% refused to be interviewed. Our questionnaire included demographics, history of onset of symptoms, medication history, health care usage, smoking history, respiratory symptoms, work history and work exposures. 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 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 for work-related asthma. The Surveillance Center maintained and continually updated a mailing list of interested health care providers, 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.

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 been 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 MDLEG 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 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 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. If the plant was small (<50 employees) everyone was interviewed.

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 facility. The reporting physician received a letter from Dr. Rosenman along with a copy of the industrial hygiene report.

In some cases an on-site enforcement inspection was not conducted, either because of limited resources or because of particular circumstances of the illness/exposure. These employers received a letter informing them that a physician has reported a case and asking them to address the possible work-related problems identified by the patient interview. If the company was smaller than 250 employees, then the letter suggested the company request an industrial hygienist from the MIOSHA consultation program to visit the facility in order to help the company assess its exposures and identify feasible ways to remediate the problem.

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

New projects: We implemented the following new projects:

- Re-interview approximately 20% sample of the confirmed cases of work-related asthma.
- Evaluation of the effectiveness of using OSHA enforcement staff for intervention.

We re-interviewed a random sample of approximately 20% of the confirmed work-related asthma patients to determine current breathing symptoms and medication use, current job status and working conditions, and other social and economic indicators. The sample was limited to individuals who we interviewed by phone between

1988 and 1999. We did not attempt to contact people who we were unable to locate or refused to be interviewed initially. A total of 200 cases of occupational asthma, 50 cases of RADS, and 50 cases of aggravated asthma were re-interviewed. When the case could not be located, a new case was selected in their place. To address the limitation that cases that we could not locate or refused to be interviewed either for the initial interview or for the re-interview were different than cases we interview, we compared basic demographic and industry type for cases interviewed and those not interviewed.

The re-interviews provided data on the natural history of WRA and allowed us to determine the current health and economic status of individuals previously diagnosed with WRA. These results are currently being written up.

The surveillance model in Michigan depended on OSHA enforcement staff for the majority of interventions. This model can be used in other states that lack in-house industrial hygiene expertise. Other OSHA jurisdictions have been reluctant to follow-up referrals from state health departments. We compared disease report-generated enforcement inspections with those that were complaint-generated. The source of the list of work place inspections was the US Department of Labor Integrated Management Information System (IMIS). State plan states such as Michigan use this national database for tracking their inspections. We have a file of the Michigan data for 1989-2001. All the SENSOR generated inspections were identified in the file. After quality control to ensure that this identification was complete we selected three control inspections for each asthma surveillance initiated inspection. Control inspections were matched by 2 digit SIC code and within a 4 year time period. There were 588 asthma surveillance initiated inspections and 12,832 non-surveillance inspections from which to choose the 1,764 controls. The results were published (Reed et al, 2007).

Aim #3: To improve reporting and data integration using a developing electronic public health surveillance system based on National Electronic Disease Surveillance System (NEDSS) architecture.

Data integration was performed at the state level combining reporting from laboratories, hospitals, poison control centers, death certificates, workers' compensation, health care provider reports, and clinics. It proved not to be practical or useful to combine with NEDSS.

Aim #4: 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.

Michigan actively participated in preparing joint publications among the SENSOR states (Pechter et al, 2005), and on the prevalence of work-related asthma (Flattery et al, 2006 and Lutzker et al., 2010).

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.

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 3,952 reports and confirmed 2,765 individuals with work-related asthma who worked at 1,557 different facilities. On average, 208 reports were processed annually. Table 1 shows the leading causes of work-related asthma in the Michigan surveillance system.

MIOSHA conducted 706 follow up investigations of the confirmed work-related asthma cases in 600 facilities. Multiple investigations were performed at some of the larger facilities where asthma cases were received from different departments. Every company investigated has received a report of the findings. Air sampling for potential allergens was conducted during 486 of the investigations: 60 (12.3%) of the 486 facilities had sampling results above the National Institute for Occupational Safety and Health recommended exposure limit (REL) and 24 (4.8%) 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		
Agent	Number	Percent
Isocyanates	373	14
Metal-Working Fluids	299	11
Cleaning Solutions	270	10
Exhaust/Smoke/Fumes	151	6
Welding Fume	126	5
Solvents	96	4
Paint Fumes	66	2
Epoxies	63	2
Latex/Rubber	57	2
Formaldehyde	55	2
All Others	1,209	42
<b>TOTAL</b>	<b>2,765</b>	<b>100</b>

Table 2. Results of 706 Industrial Hygiene Inspections in 600 Facilities Where Patients with Confirmed Work-Related Asthma were Exposed to Allergens: 1988-2008		
Inspection Results	Number	Percent
<b>Air Sampling – NIOSH Standard</b>		
Above NIOSH Standard	60	8.5
Below NIOSH Standard	426	60.3
No NIOSH Standard	20	2.8
Unknown (no report yet)	5	0.7
Did Not Sample for an Allergen	22	3.1
Did Not Sample	173	24.5
<b>TOTAL</b>	<b>706</b>	<b>100.1</b>
<b>Air Sampling – MIOSHA Standard</b>		
Above MIOSHA Standard	24	3.4
Below MIOSHA Standard	477	67.6
No MIOSHA Standard	4	0.6
Unknown (no report yet)	5	0.7
Did Not Sample for an Allergen	23	3.3
Did Not Sample	173	24.5
<b>TOTAL</b>	<b>706</b>	<b>100.1</b>

A new method for investigating companies where employees had developed asthma from exposures at their jobs, referred to as “D-letter Investigations” was initiated. These were enforcement investigations where the company was sent a letter requiring them to conduct the investigation internally and report their findings to MIOSHA. If the company refused to conduct the investigation, or did not conduct it in a timely manner or make a reasonable effort to carry out the investigation in a responsible manner, MIOSHA sent an enforcement inspector to the facility to facilitate a broader investigation. The company was required to assess their potential asthma-causing exposures through review of MSDS and air monitoring, complete a survey about their facility’s safety and health program, report all findings to MIOSHA and allow staff at the MSU Surveillance Center to conduct a confidential interview of all employees in the area of exposure. Twenty such inspections were completed; these 20 were included in the 706 inspections previously mentioned. This method was instituted to facilitate a quicker turn-around time from the identification of the index case to the investigation of exposures at the workplace. It has proved to be just as effective in identifying symptomatic co-workers, exposures and potential corrective action.

We interviewed 9,495 fellow workers at 540 facilities during these investigations. A total of 1,509 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.

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. More recently, we 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.

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. We attributed our ability to identify these deaths to a combination of three projects which we conducted: 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. This last project, was done cooperatively between MSU and MDCH, was funded by the Center for Environmental Health at CDC. Michigan was the only state funded to do this activity. All asthma deaths were investigated with review of medical records and next-of-kin interviews conducted with relatives of children and young adults. Fortunately, a very small percent (0.01-0.02%) of asthma patients die from asthma. Since 2003, the Michigan Surveillance Center has identified eight work-related asthma deaths: six of those deaths occurred at work, the other two individuals died at home after long term complications of their asthma, which they had developed while working. As WRA deaths were identified, we shared the stories of

these individuals through a variety of media (newsletter, alert, journal articles, company visits by the MIOSHA Consultation, Education and Training group) in order to get the message out on how to help prevent future deaths.

Most recently, in 2008 a man in his 50s died after working for three months at a factory that made brakes for airplanes and helicopters. His job as a machinist involved the grinding of metal parts using metal working fluid. The MSDS for the metal working fluid indicated soy bean oil, monoethanolamine and diethanolamine. He developed wheezing, cough, and shortness of breath one month after starting to work at this factory. He saw a doctor who told him to wear a mask at work. However, wearing the mask made him feel short of breath. The doctor also recommended if this employee continued to have breathing problems, he may have to change his work environment and find a different job. He had smoked a half pack of cigarettes a day for the past 20 years. He had never been diagnosed with asthma prior to this job. He went to the emergency department and was subsequently hospitalized and placed on a ventilator. He could not be weaned off the ventilator and died one month later. He died four months after beginning to work at this factory.

In 2007, a female laundry worker in her 50s died from an asthma attack at work where she was exposed to a high concentration of bleach fumes. She had worked for 24 years at the nursing home laundry room. On the day of her asthma attack that led to her death, she came to work and noticed a strong smell of bleach in the laundry room. She began coughing and became short of breath. She went to the restroom where she was found unresponsive. She was given CPR and taken to a local hospital, but she never regained consciousness and died three days later. This death is summarized in a MMWR manuscript on disinfectants being written by CDC and the pesticide surveillance states.

In 2005, a male in his 50s collapsed while working at an adhesive manufacturer. The adhesives contained isocyanates. During the course of his employment, the employee developed WRA from exposure to isocyanates. On the day of his collapse, the employee was working in a room where a barrel of isocyanates was opened. He became short of breath and told a fellow worker. He used his asthma inhaler, then collapsed and became unconscious; police and EMS personnel arrived shortly after and administered CPR. The employee was hospitalized but never regained consciousness. He died six days later. This employee had sought medical care from multiple providers, including his primary care physician and a pulmonary specialist prior to his death for treatment of his asthma.

In 2004 a waitress working at a bar died from an asthma attack triggered by exposure to second-hand cigarette smoke. The bar was divided into two separate areas, the bar area with limited seating and a room with a disc jockey (DJ) booth. When the victim arrived at work at 9:45 pm, she talked with the DJ who was setting up in the adjacent room, then walked about 25 feet to an open section of the bar. The bar owner stated she was not experiencing any difficulty breathing at that time. There were approximately 30 people in the bar area. No individuals were in the room with the DJ. According to the owner, the bar was not “overly smoky.” Shortly after the victim went behind the bar, she grabbed the bar manager, saying she needed to get to the hospital and that she needed fresh air. The victim said she wished she had her inhaler with her. As the two walked out from behind the bar toward the back door, the victim collapsed on the dance floor. The bar patrons were asked if anyone had an inhaler. Someone did, and the victim attempted to use the inhaler but was unable to do so. According to the bar manager, the inhaler mist came back into her face. Emergency Medical Service (EMS) was called and she was transported to a local hospital where she was declared dead 30 minutes from the time of the call to EMS.

In 2004, a dairy farmer died from an asthma attack while cleaning out a bulk milk tank. Dairy tank cleaning

involves several steps of different chemical rinses. During the first rinse, a sodium hypochlorite/sodium hydroxide solution was mistakenly mixed with the product used in the second rinse, which was an acid.

Chlorine gas was generated from the mixing of these chemicals, which caused the farmer who had asthma to experience an acute asthma attack. She became acutely short of breath, collapsed and died, despite CPR from a family member and neighbor. A MI FACE Hazard Alert was produced in response to this death, which was sent to stakeholders and is posted on our web site.

In 2003, a worker died after repeated exposure to an isocyanate used in the spray-on truck-bed lining industry. Reasons for his death included poor ventilation, inadequate respiratory protection equipment and lack of awareness of risk by him, his employer and the medical care provider who evaluated him. Site visits by MIOSHA safety and health specialists to the 100 or so small companies around the state that do similar work were conducted in response to this death. Educational materials and the opportunity for free site evaluations were provided. This death illustrated the consequences of the proliferation of a new technology to multiple small business locations without adequate provision to disseminate health and safety information and equipment.

In addition to the six deaths described above, which occurred from asthma attacks at work, two individuals died at home after long term complications of their asthma, which they had developed while working. One of these individuals had developed their asthma from toluene diisocyanate exposure and the other from exposure to styrene in the manufacturing industry.

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## **D.1.b. Work-Related Traumatic Death**

### **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 have been a significant problem both in Michigan and the United States. The U. S. Bureau of Labor Statistics 2008 revised work-related fatality data shows that 5,214 individuals died at work. In Michigan, 128 individuals died due to a work-related injury. On average, 121 work-related fatalities have occurred each of the last 5 years in Michigan. In 2005 there were 110, in 2006 there were 157, in 2007 there were 120, in 2008 there were 121 work-related fatal injuries, and in 2009, 97 work-related fatalities have thus far been identified in Michigan by the Michigan Fatality Assessment and Control Evaluation (MIFACE) surveillance system. 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 statistics (411 of 5,214 (7.8%)), a larger number of work-related fatal injuries in Michigan occurred among workers in the manufacturing sector (14 of 121, 11.6%).

The economic burden of fatal injuries has been compiled by NIOSH in the August 2009 document *The Cost of Fatal Injuries to Civilian Workers in the United States, 1992-2001*. The economic loss to society from the premature deaths of 51,684 workers aged 16 years or older in the 10-year period exceeded \$43 billion (2001 U.S. Dollars). In Michigan, for this same 10-year time period, 1,426 work-related deaths were identified with a lifetime cost of \$1,215,143,000. 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 MIOSHA to investigate work-related deaths. Two-thirds of Michigan's work-related fatal injuries were either not under the legal jurisdiction or considered 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.

### **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 and to assure that the number of deaths ascertained were both complete and equal in number. Each year the numbers have differed by one or two deaths because of differences in interpretation of “work-related”.
- **Newspaper Articles from Clipping Service:** A newspaper service reviewed 58 of Michigan’s daily newspapers, 325 Michigan newspapers that are published less frequently, and 28 Michigan trade journals for work-related deaths. CFOI maintained this newspaper service review and MSU received copies of the fatal work-related newspaper clippings from CFOI.
- **MDCH Vital Statistics:** MDCH provided death certificates selected by two different mechanisms: 1) On a monthly basis all death certificates where the “at work” box was checked were pulled and reviewed; and 2) MDCH searched the death certificate database for information located in the following death certificate information boxes; how injury occurred, place of injury, place of death, injury at work, and manner of death for indications that the death may have occurred to an individual working in the agricultural industry.
- **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 a quarterly 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. Three counties regularly notified MSU when a work-related death was identified by them.
- **Coast Guard:** Michigan is located in the 9<sup>th</sup> Coast Guard District. On a monthly basis, MSU accessed the 9<sup>th</sup> District’s Public information website (<http://piersystem.com/external/index.cfm?CID=443>) 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 ([www.nts.gov/nts/month.asp](http://www.nts.gov/nts/month.asp)) 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 ([www.msha.gov/fatals/fab.htm](http://www.msha.gov/fatals/fab.htm)) 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 and Firefighter Memorial Pages: On a monthly basis, MSU accessed the on-line memorial page for police officers ([www.odmp.org](http://www.odmp.org)) and the on-line page for firefighters ([www.usfa.fema.gov/fatalities/](http://www.usfa.fema.gov/fatalities/)).

The key elements of the surveillance system that provided the greatest number of deaths were the newspaper clipping service, 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: Outreach activity consisted of the following:

1. Work-related Fatality Investigation Reports
2. Annual reports for work-related traumatic deaths
3. Hazard Alerts
4. Presentations at Michigan Safety conferences
5. Display booths at Michigan Safety conferences
6. Updated the MSU Surveillance Center and MIFACE website
7. Press Release on Worker Memorial Day
8. 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](http://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](http://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, and hazard alerts by industry and/or cause of death.

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 was sent to a fire department or EMS agency. 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 within 48-72 hours after a MIOSHA program-related fatality notification as 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. Manufacturing was one priority since a higher percentage of fatal injuries in Michigan are in manufacturing than nationally. Also industries not covered by MIOSHA, e.g., farming were a high priority.

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, police, medical examiners, 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 Alerts that were combined with and emphasized by a death in Michigan that could have been prevented if the employer had followed the recommendations in the Alert. For example, we widely disseminated NIOSH Workplace Solution No. 2007-155, "Preventing Worker Deaths and Injuries from Contacting Overhead Power Lines with Metal Ladders" to appropriate stakeholders that could affect work practice changes, such as home builders and associations, roofing contractors, and painting contractors for posting and use in their training sessions. This NIOSH publication was sent along with the fatality summaries developed by MIFACE that identified the seven work-related deaths by electrocution involving metal ladders.

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](http://www.oem.msu.edu)) as another way to disseminate information. With each report was a report evaluation which could be returned by mail. We received, on average 10 returned report evaluations (one report had a high of 264 returned evaluations) with most evaluations indicating ratings of either good or excellent for practical and useful recommendations.

The Surveillance Center webpage had a web page tracking system that counted the number of times a 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

**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 (*Work-Related Injury Deaths Among Hispanics, 1992-2006*, June 6, 2008/57(22);597-600).

**Meetings:** Michigan has participated in the yearly FACE meetings.

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

We have confirmed 1,233 work-related fatal injuries in Michigan for the years 2001-2010; 581 deaths have occurred in the past five years. We contacted 601 companies and have conducted 145 (24.2%) on-site investigations of which 137 have been released. Two fatality inspections determined that the death was not work-related. Seven reports are currently being written or are under review. One report has not been distributed due to litigation between the company and MIOSHA. All investigation reports contained a description of the events preceding the death, identified causal factors and made recommendations for the prevention of similar fatalities in the future. Of the 601 employers contacted for work-related fatalities, 436 (72.5%) companies declined to participate in the MIFACE program. MIFACE did not contact 617 (50.0%) employers. Due to the recentness of the fatality or lack of contact information, MIFACE has not contacted fifteen employers.

Ten one-page hazard alerts have been developed to highlight the death and potential life saving interventions, five in the last five years These hazards 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 10 hazard alerts are:

- Farmer Died as Result of Starting a Tractor on Ground
- Electrocuted While Welding
- Slippery Clutch Pedal
- Pyrotechnician Struck in Head by Firework
- Arborists: Look up, Stay Clear and Stay Secured
- Fatal Asthma Attack While Cleaning Bulk Milk Tank
- Why Bother With A ROPS Retrofit?
- Trench Cave-Ins Kill
- Injury Prevention Strategies for Older Drivers
- Carbon Monoxide

Annual reports on Work-Related Fatal Injuries have been prepared for 2001-2008. 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, 225 summaries of fatalities investigated by MIOSHA, but not by MSU; 145 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 122 presentations were made by MIFACE personnel using MIFACE data, findings and recommendations, 77 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 board 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 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 and at our presentations.

Three of the work-related fatal injuries we investigated that had significant outreach activity overlapped with our work-related asthma surveillance program. In two, the individual died from an acute asthma attack

following exposure to an isocyanate; one at a truck bed liner facility and one at an adhesive manufacturer. After conducting the on-site investigation at the truck bed liner facility, we worked with the CET Division staff of MDELEG to prepare a packet of educational material on the health and safety hazards of and control methods for safe application of truck bed liners. CET staff visited 81 of the 91 truck bed liner application facilities in the state, and distributed the packet that included the MIFACE investigation report to all facility owners. MIOSHA also conducted air sampling at 5 locations (4 were above the MIOSHA Standard) and prepared recommendations for these facilities. We wrote up the death in our quarterly SENSOR newsletter that was sent to 3,000 doctors in Michigan (all allergists, occupational medicine, pulmonologists and family practitioners and internists from the four medical schools in the state). We also published the death and the subsequent investigation in the American Journal of Industrial Medicine. NIOSH has prepared a national hazard alert on this industry.

The third death which overlapped with the work-related asthma surveillance program concerned a young waitress who died from an acute asthma attack while working in a bar/restaurant. We conducted an onsite investigation and found inadequate ventilation and the absence of a plan to respond to medical emergencies. We attributed her death from asthma to exposure to second hand smoke at the bar where she worked. MIFACE personnel have provided information and copies of the report of the investigation and a peer reviewed publication, to public health groups, and the State's chief medical office. The information was used as part of the effort to educate Michigan residents of the benefits of smoke-free legislation in the for Michigan workplaces. This legislation went into effect on 5/1/2010.

Examples of changes in practice and policy that we are continuing to work on based upon work-related fatal injuries that have occurred in Michigan relate to diisocyanate standard promulgation, firefighters, smoke-free workplaces (see above), and construction.

Dr. Rosenman continued to be actively involved with the MIOSHA Occupational Health Standards group to develop and promulgate a diisocyanate standard. Public hearings for this standard are currently being conducted.

Fire department personnel routinely must work in lanes of active traffic. There was a death in Michigan of a firefighter who was struck on the side of the road by an out-of-control vehicle. Currently firefighters receive no formal State training regarding positioning response vehicles on a roadway to provide a protected, safe working environment. We worked with the State Fire Marshall to develop such a training module.

Additionally, MIFACE conducted outreach to construction employers and employees, especially addressing fatal falls. From 2001 to 2006, Michigan had 875 work related fatal events; falls accounted for 125 (14%) of these deaths. The Michigan construction industry was associated with 60% of all fatal work related falls. All fatal falls in construction occurred among males and 45% of these falls occurred at heights of less than 20 feet. Roofers experienced the highest number of fatal falls (20 falls) compared to other construction occupations. A paper detailing the epidemiology of the fatal work-related fall incidents, actions taken by MIFACE, MIOSHA, and the Michigan legislature to address and minimize the occurrence of fatal fall events, and how the Michigan experience agrees with or is in opposition to the results of fatal construction fall research has been submitted for publication.

### **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:

- Annually collect, analyze, and publish surveillance data for the occupational health indicators identified and described by the Council of State and Territorial Epidemiologists (CSTE, 2004).
- Implement three key occupational health surveillance recommendations contained in a report issued by the Michigan Department of Community Health in June 2004: Profiles of Occupational Injuries and Diseases in Michigan (Stanbury et al, 2004).
  - Publish summary data on occupational diseases and injuries annually, and issue a comprehensive update of the Profiles report in 2009
  - Conduct additional in-depth analyses in order to elucidate two findings in the Profiles report: that MI rates of injuries overall and of disorders of repeated trauma were consistently higher than national rates in data published by the Bureau of Labor Statistics.
  - Improve surveillance data by the promulgation of new rules that require health care providers and laboratories to report all cases of injury or illness due to exposure to mercury, arsenic, cadmium and pesticides.
- Maintain the surveillance reporting infrastructure and data systems for mandatory occupational disease reports submitted under the Michigan Public Health Code and ensure their use in expanded surveillance programs.
- 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.

#### **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 (Halperin, 1996). 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, were described in a report published by NIOSH (Stanbury et al, 1995) and updated in 2008 (Stanbury et al, 2008). 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 (CSTE, 2004; Thomsen et al 2007), develop a methodology for collecting the data (CSTE 2009), 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. This multi-year OHI data is at: [www.cste.org/dnn/ProgramsandActivities/OccupationalHealth/OccupationalHealthIndicators/tabid/85/Default.aspx](http://www.cste.org/dnn/ProgramsandActivities/OccupationalHealth/OccupationalHealthIndicators/tabid/85/Default.aspx).

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 10.1 million, it is the nation's eighth 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 1.5 billion dollars in 2006 in workers' compensation claims in Michigan (National Academy of Social Insurance, 2008). 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 145,000 recordable injuries in 2008 in Michigan according to the BLS Annual survey, for a rate of 4.5 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 2008 in Michigan, claims were paid for 312,368 lost work time and medical only injuries and illnesses.

### **D.1.c.3. Methods**

Aim #1. Annually collect, analyze, and publish surveillance data for the occupational health indicators (OHIs) identified and described by the Council of State and Territorial Epidemiologists (CSTE, 2004)

The Principal Investigator was the co-chair of the state partners Workgroup that developed the OHIs and prepared the first CSTE OHI data report. Staff at MDCH were on the Workgroup and had major responsibility

for carrying this project to completion. MDCH staff participated in refining and updating the descriptions of the 19 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 QA committee reviewing all the states’ submissions to CSTE, prior to their publication on the CSTE website.

Using the "How-To" guide developed by the CSTE Workgroup, Michigan OHI data for all 19 indicators and Employment Demographics were generated and submitted to CSTE for publication on their website for all requested years (2000-2006). 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 subsequent report “Thirteen Indicators of the Health of Michigan’s Workforce” was published in March 2006 in both hardcopy and posted on the MSU and MDCH websites. The report was distributed to the occupational health stakeholder’s mailing list and provided to other interested parties (e.g. other states with occupational health surveillance programs). In addition, the report was publicized to occupational health professionals via list serves maintained by NIOSH and Duke University. The extent of the reports’ exposure was defined by the number of hardcopy reports that were distributed, the number of website “hits”, and the estimated number of attendees at oral presentations of the data.

Aim #2: Implement occupational health surveillance recommendations contained in a report issued by the Michigan Department of Community Health in June 2004: Profiles of Occupational Injuries and Diseases in Michigan (Stanbury et al, 2004).

The first recommendation was to improve the availability of occupational injury and illness surveillance data. Actions to accomplish this included the following. Annual reports that summarized the data from reports submitted under the OD reporting law as well as condition-specific surveillance systems were published. These reports used a standardized format for data summarization and including information on worksite interventions and other preventive actions taken in response to the data. In addition, a template for tabular presentation on the web of Michigan OD reports and other occupational disease and injury data was developed, populated and updated periodically, based on the concept for tabular reporting communicable diseases in Morbidity and Mortality Weekly Report. The website included links to pages in reports from MSU and MDCH that had county-specific data on selected conditions. MDCH monitored on the "web traffic" at this site.

In addition, a new case based surveillance system was established for work-related amputations. It followed procedures similar to other case-based occupational disease surveillance systems in Michigan, with case identification from hospital medical records, data management, case interviews, and referrals to MIOSHA where appropriate.

The second recommendation was for additional in-depth analyses in order to elucidate the finding in the Profiles report that rates of disorders of repeated trauma were consistently higher than national rates in data published by the Bureau of Labor Statistics (BLS). Data were obtained from BLS, using a revised definition of cases from BLS and analyzed. Results were prepared for presentation at a conference.

The last recommendation was to improve illness and injury surveillance data by the promulgation of new rules requiring reporting by health care providers and laboratories and implementation of surveillance systems based on reported data. In collaboration with the MDCH Office of Regulatory Affairs we followed procedures in

Michigan's Administrative Procedures for promulgating three sets of rules. The first was for requiring health care providers and clinical laboratories to report individuals, with identifiers, with injury or illness due to exposure to mercury, arsenic, cadmium, and cholinesterase-inhibiting pesticides. The second was for reporting of unintentional, non-medicinal chemical poisonings. The third was a set of rules requiring health care provider reporting of injuries. For each the rulemaking process included: drafting by the MDCH, review by the another agency, reviewed by the Joint Committee on Administrative Rules, published as a proposed rule and went through a public vetting and hearing process, reviewed by any interested legislators, submitted to the Legislative Services Bureau for review, submitted again along with a report and response to public comments and other information including fiscal impact (e.g., economic impact on small businesses), submitted to the Senate and House fiscal committees, and ultimately, published as final rule.

Following rules promulgation, MDCH established and implemented procedures for processing and following up on case reports and making referrals as appropriate. Data collection for the first set of rules, laboratory reporting of arsenic, mercury, and cadmium tests, and cholinesterase began in late 2005. The chemical poisoning rules went into effect in 2007. Injury reporting rules are expected to go into effect in September 2010. Pesticide poisoning reports and cholinesterase laboratory reports were incorporated into the Pesticide Illness and Injury Surveillance system.

**Aim #3: Maintain the surveillance reporting infrastructure and data systems for mandatory OD reports**

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](http://www.oem.msu.edu)), and MDCH and MIOSHA maintained links to the site from their web sites. MSU continue 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.

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 Centers (PCC) of occupationally related calls with reported adverse health effects, and receipt of laboratory results of lead tests in adults from the MDCH childhood lead program.

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 reports were assigned disease codes, occupation and injury codes, industry codes and county codes and were data entered into an Access database. Additional information on race, gender, and age of the case, name and number of employees of the company and name and source of report including specialty of the health care provider were also entered in the database. MSU conducted case-based follow-up activities, including interviews and MIOSHA referrals, and provided cases of pesticide toxicity to MDCH.

MIOSHA began conducting enforcement activities by auditing occupational medicine clinics. Like disease reporting laws for communicable disease, no attempt has ever been made to penalize a health care provider for

non-compliance. A mailing was made 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 being received. It is a misdemeanor and \$50 fine for each case not reported. The results of the investigations and any fines 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 developed a one page card length questionnaire that was handed out at four state meetings that occur each year: Michigan Thoracic Society, Michigan Allergy Society, Michigan Family Practice Association and the Michigan Chapter of the American College of Physicians. 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? The survey conducted in Year One was analyzed in Year Two. We also mailed these questions on a postage paid return postcard to members of the occupational, pulmonary and allergy societies.

To ensure the availability and usefulness of administrative databases for occupational health surveillance, MDCH developed a compendium of 13 data sources, including a summary table about each data source and supporting materials such as data dictionaries and copies of source documents such as a death certificate. The compendium ("Assessment of Thirteen Data Sources for Occupational Health Surveillance in Michigan") was posted to the MDCH website.

Finally, MSU implemented a new way of reporting: 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 automatically by e-mail to the MSU Surveillance Center.

MSU conducted an analysis of workers' compensation data to compare companies' compensation claims experiences in order to generate prevention activities (Rosenman et al, 2007). MSU obtained the complete computerized workers' compensation data file for the years 1999, 2000 and 2001 from MDELEG and employment data including Standard Industrial Classification (SICs) and North American Industry Classification System (NAICS) codes for all companies in Michigan from the Michigan Employment Securities Commission. We replicated work performed by Dr. Harry Shannon at McMaster University in Toronto, which he presented at the National Occupational Injury Symposium in Pittsburgh in October 2003. Dr. Shannon used Ontario workers' compensation data to examine the rate of workers' compensation claims by companies in three digit SIC codes. We calculated the number of workers' compensation claims that could have been prevented if all companies in a given three digit SIC code had as few claims as the top 25% companies in that three digit SIC code. Using estimates of costs per claim we estimated how much money would have been saved if all employers had as few claims as the top 25% employers. By standardizing by SIC code, we controlled for increased risk by type of company such as specific type of manufacturing versus retail or wholesale. The results

of the analysis showed that it is feasible to reduce the occupational illnesses and injuries burden, since peer companies in Michigan already have reduced costs. In future years we plan to initiate projects at the individual SIC/company level to determine why some companies have lower workers' compensation claims (e.g., primary prevention vs. management of injury/illnesses), and we will conduct outreach to disseminate results of the study.

**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.

The primary mode for delivering information and surveillance products (annual reports, Project SENSOR News etc) shifted in this period from mailing to use of e-mail. MSU and MDCH performed regular updates of their stakeholder mailing lists in response to returned mail, undeliverable emails, and forwarding addresses and other responses. 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. MDCH 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 or updated, including the MDCH Toxic Substances Information Directory and a web-based tool for obtaining information about chemicals that was developed in collaboration with the MDCH chemical emergencies preparedness project.

#### **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 the MIOSHA (currently located in MDELEG); MDCH became involved in 2000. These collaborations continued to be strengthened during this five year project.

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 priority conditions, including work-related asthma, silicosis, work-related noise-induced hearing loss, work-related fatalities (FACE), work-related amputations, adult blood lead, pesticides, and occupationally-related exposure to mercury, arsenic and cadmium. Analysis and dissemination of these surveillance data have taken place regularly over the 21 years in peer-reviewed publications, annual reports, and newsletters. Summary data and key accomplishments of the Priority Conditions surveillance systems are in separate reports for work-related asthma, silicosis, pesticides, and traumatic work-related fatalities. Highlights of accomplishments not addressed in Priority Condition proposals include:

- Publication of a multi-year OHI report for Michigan (Largo, 2005).
- Promulgation of rules for laboratory reporting of heavy metals and cholinesterase, and laboratory and health care provider reporting of chemical poisonings; and development of rules for reporting of all injuries

- Development of a case-based, work-related amputations surveillance system (Largo et al, 2009).
- Publication and dissemination of a quarterly newsletters over the five years (see <http://www.oem.msu.edu/Newsletters.aspx> for links to all 125 newsletters published since 1988) and annual reports with data from occupational disease reports (at <http://www.oem.msu.edu/AnnualReports.aspx>).
- Delivery of multiple presentations at medical Grand Rounds and medical conferences on conditions under surveillance by Dr. Rosenman and by Ms. Chester.
- Multiple publications in peer reviewed journals.
- Activities integrating the program with other public health programs including: sharing of data on cases relevant to MDCH's ATSDR-funded Hazardous Substance Emergency Event Surveillance (HSEES) program, data sharing with the CDC waterborne diseases surveillance program on chemicals causing illnesses in water-related recreational settings, data sharing with the Consumer Products Safety Commission on cleaning agents and water proofing products, integration of the MDCH heavy metals surveillance system into the overall SENSOR disease surveillance model and systems, and coordination with MDCH's CDC-funded state asthma initiative.
- Enforcement of the occupational disease reporting law.
- Participation in a multi-state initiative to collect and analyze data on work-related injury incidents from the Behavioral Risk Factor Surveillance System (BRFSS). An article ("Incidence of Nonfatal Work-injured Persons and Payment by Workers' Compensation Systems – 10 States, 2007") based on this initiative was accepted for publication by MMWR.

Summary data from surveillance activities:

Occupational Disease Reports: 1987-2009	
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	20,254
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

<b>Number of Inspections by Surveillance Initiative</b>		
<u>Initiative</u>	<u># Inspections</u>	<u>Years of Surveillance</u>
ABLES (lead)	197	1997-2009
NIHL	136	1992-2009
FACE (fatalities)	134	2001-2009
Work-Related Asthma*	706	1988-2009
Silicosis	117	1988-2009
Welding Fume Local Emphasis Program	77	2002-2004
Metal Working Fluids Local Emphasis Program	45	1996-2003
Pesticides	17	2001-2009
Work-Related Amputations	163	2006-2009

Amputations: During the three-year period, 2006-2008, nearly 700 Michigan residents sustained a work-related amputation each year. Rates for males were more than six times the rates for females. Workers aged 20-24 had the highest rates for both genders.

Average annual number of work-related amputations and corresponding rates

by age group and gender

Michigan residents, 2006-2008

Age Group	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
16-19	28	26.2	4	4.1	32	15.0
20-24	75	32.7	12	5.5	87	19.4
25-34	137	28.3	15	3.5	153	16.6
35-44	133	21.8	23	4.4	156	13.8
45-54	157	25.8	19	3.4	176	15.2
55-64	64	19.6	11	3.5	75	11.7
65+	14	15.8	2	2.1	16	9.5
Total	609	24.8	86	3.9	695	14.9

\* Rates are number of work-related amputations per 100,000 workers.

Ages for two males were unknown. These two cases are included in the totals.

Numbers may not appear to sum correctly – this is due to rounding.

Sources: MI hospital medical records and MI workers' compensation claims

Table of Heavy Metal Reports Received by Month and Year: July 2007 through June 2010, All Ages

Month/Year Reported	Arsenic Lab Reports	Cadmium Lab Reports	Mercury Lab Reports
July 2007, 2008, 2009	1,501	707	1,382
August 2007, 2008, 2009	1,844	1,019	1,706
September 2007, 2008, 2009	1,733	873	1,619
October 2007, 2008, 2009	1,818	555	1,782
November 2007, 2008, 2009	1,564	725	1,551
December 2007, 2008, 2009	1,378	617	1,360
January 2008, 2009, 2010	1,422	638	1,332
February 2008, 2009, 2010	1,636	759	1,596
March 2008, 2009, 2010	1,892	939	1,898
April 2008, 2009, 2010	1,045	578	1,133
May 2008, 2009, 2010	1,065	503	1,012
June 2008, 2009, 2010	1,000	531	1,016
Total*	17,898	8,444	17,387

\*Total number of reports: 43,729

2006 Annual Report (October 2005 – December 2006) – 15,755 reports.

2007 Annual Report (January 2007 – December 2007) – 13,245 reports.

2008 Annual Report (January 2008 – December 2008) – 17,066 reports.

2009 Annual Report (January 2009 – December 2009) – 15,982 reports.

Total number of reports based on four annual reports – 62,048.

Patient Interviews 2005 through 2010, Heavy metals:

	Elevated Arsenic	Elevated Cadmium	Elevated Mercury
Cumulative Interviews	Completed=342 Pending= 97 Total= 439	Completed=76 Pending= 49 Total=125	Completed= 136 Pending= 21 Total= 157

**D.1.c.5. References**

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#### **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.
- Prioritized and expanded ongoing compliance and consultative activity to prevent and reduce work-related pesticide exposure.
- Integrated work-related pesticide illness and injury surveillance with related public health programs in Michigan.
- Continued and expanded on occupational pesticide surveillance collaborative activities 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. In 2007, there were 15,501 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 exposure 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. 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 most poison control centers in the United States. The AAPCC system identified over 6,300 occupational pesticide-related illnesses from calls between 1993 and 1996 (NIOSH, 2000). However, calls to poison control centers do not capture all cases of work-related pesticide poisonings. Another source of data is the estimate from the Bureau of Labor Statistics. Lost-work-time illnesses from pesticide exposure ranged from 504 to 914 per year for 1992 through 1996 (private sector only). These numbers are clearly an underestimate. 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 23 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 8,000 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 (MDA) for intervention and enforcement activities. MDA 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 MDCH 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. MDA 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. MDCH's involvement provides a public health and medical role to complement MDA'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.

MDCH 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](http://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 February 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 printout 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 MDCH, under a Memorandum of Understanding Agreement.

MDCH also received and processed case reports from the two Poison Control Centers (PCCs) in Detroit and Grand Rapids, Michigan, which jointly provided statewide PCC coverage until they merged in 2009 at the Detroit PCC. The PCC used a program contracted by NIOSH and written by the company that designs and maintains the data management system, Toxicall©, to electronically transmit the case reports, with personal identifiers, of calls involving occupational exposure to pesticides. These reports were e-mailed to the Pesticide Surveillance Coordinator at MDCH, usually within one day of the call. If the Toxicall© database was updated with follow-up information, that case report would be e-mailed again with the additional information.

MDCH received and processed reports submitted to MDA of pesticide misuse complaints resulting in adverse health effects. Pesticide complaints were made to either the MDA headquarters or to their regional offices. MDA staff generated a case report, which included name, address, and telephone number of complainant, a narrative of the problem, including as much information about the pesticide as possible, and information about possible violations. When the case investigation was completed, regional investigators sent the entire file to MDA (if it did not originate in Lansing). The file may have contained laboratory sampling results, photos, and other information about the investigation. Every other month the Pesticide Surveillance Coordinator reviewed files at MDA and collected basic information on each new case determining if there was 1) human exposure, 2) occupational exposure, and 3) an adverse health effect. Cases that satisfied all these requirements were tracked on an Excel spreadsheet. When these cases were closed, the Pesticide Enforcement Manager at MDA allowed the MDCH Pesticide Surveillance Coordinator to copy the inspection reports for follow-up.

MDCH 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 MDCH 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 reviews and interview procedures were implemented.

Outreach to maintain and improve reporting: Some outreach activities were conducted to improve reporting of all occupational disease/injury 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 MDCH. Each year, in the late spring the Pesticide Surveillance Coordinator conducted mailings reminding these health centers of pesticide poisoning and reporting requirements. In 2009, we were involved in a one-day training of migrant health outreach workers and, as well, organized a Webinar on pesticides poisoning for health care providers which was provided by the PI on this grant.

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 MDCH Pesticide Surveillance Coordinator as per the SOP.

MDCH entered data from the initial case report into the SPIDER\* database and the pesticide surveillance administrative tracking spreadsheet (“Tracker”). 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 added 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.

MDCH attempted to contact the patient to obtain an interview. When the patient address had been determined, MDCH sent a letter explaining that MDCH 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 and a brochure explaining the project. 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. If the exposed person received medical care for the exposure, and we did not already have their medical records, their medical records were requested. MDCH sent a patient thank you letter following the interview.

Medical records were requested whether or not the patient gave permission, under the authority of the Public Health Code. There were different letters for physician or hospital requests and for requests with or without a release form. All letters 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. MDCH 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 are 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.

Data analysis and dissemination: MDCH 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.

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

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

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

A summary report including summary data and discussions of interventions was prepared each year and posted on the MDCH and MSU websites. Paper and electronic copies were sent to over 200 individuals and agencies and also distributed through several List Serves. In 2009 the report was picked up by new media.

Aim #2: Continue and expand ongoing compliance and consultative activity to prevent and reduce work-related pesticide exposure in the state of Michigan.

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

Not all potential uses/misuses of pesticides are covered by MDA'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 MDA. When referrals were made to MIOSHA, MDCH ensured that copies of MIOSHA inspection reports were received by the Pesticide Surveillance Program. In 2009, an agreement was made between MIOSHA and MDCH specifically to refer employers where employees became sick from exposure to disinfectants.

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

MDCH maintained a file of interesting case history success stories that linked surveillance data with successful interventions, and two were used for a CSTE project to compile occupational health success stories from state programs.

Preventive interventions other than worksite inspections included: Referrals to EPA and NIOSH 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.

Aim #3: Integrate work-related pesticide illness and injury surveillance with related public health programs in Michigan.

MDCH continued to maintain a surveillance system for exposure to pesticides used for mosquito control, related to West Nile Virus illness (WNV) control. However by 2006, the epidemic was over in Michigan, and this was no longer a priority for the project, except that we monitored reports of cholinesterase testing done by one of the mosquito control commissions.

Rulemaking was initiated to make all chemical poisonings (unintentional, non-medicinal) reportable, which made all pesticide illnesses reportable. In 2006, MDCH began tracking all pesticide illness/injury cases, including non-occupational cases, using procedures described above and reported on results in the Annual Reports.

Aim #4: Continue and expand on occupational pesticide surveillance collaborative activities among states and with NIOSH.

MDCH 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.

An evaluation of the surveillance system was proposed by a preventive medicine fellow at NIOSH and is being planned for July and August 2010.

#### **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 MDELEG, and MDCH, which established the NIOSH-funded Core Occupational Health Surveillance program in late 2000. In this current funding cycle from NIOSH (2005-2010), MSU is the bona fide agent of both MIOSHA and MDCH for conducting Michigan’s Expanded Program for Occupational illness and Injury Surveillance. MSU provides funds to MDCH through a contract for the occupational health indicator/basic program and the pesticides surveillance project.

Work-related pesticide illness and injury surveillance data collection began in 2001 with the hiring of an epidemiologist at MDCH as Pesticide Surveillance Coordinator to develop and implement the system. Using information from NIOSH and other SENSOR pesticides states as well as information from the many years of case-based surveillance at MSU, MDCH 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 MDA 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. Reports have been issued annually 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.

MDCH began collecting non-occupational pesticide data in 2006 because of interest expressed by environmental groups and MDA, calls received from the public on the MDCH “toxics hotline”, and interest in collaboration with other SENSOR-pesticides states on non-occupational issues. A multi-state publication that included both occupational and non-occupational data on pesticide cases in schools (including Michigan data) received wide recognition and publicity.

A summary of the data on reported cases follows: As of June 30, 2010, 1,053 work-related cases were reported. Most of the cases (807, 77%) came from the poison control centers (Figure 1). The other cases came from OD reports (10%), MDA (2%), HSEES (6%), and coworker reports, advocate reports, etc (5%). Seven hundred

thirty-three (70%) of the 1,053 met the criteria noted above to be considered a confirmed case, and 481 (69%) of the 696 reported in the current funding period were confirmed. (Table 1)

Figure 1. Occupational pesticide illnesses and injuries by source of case (N=1,053)

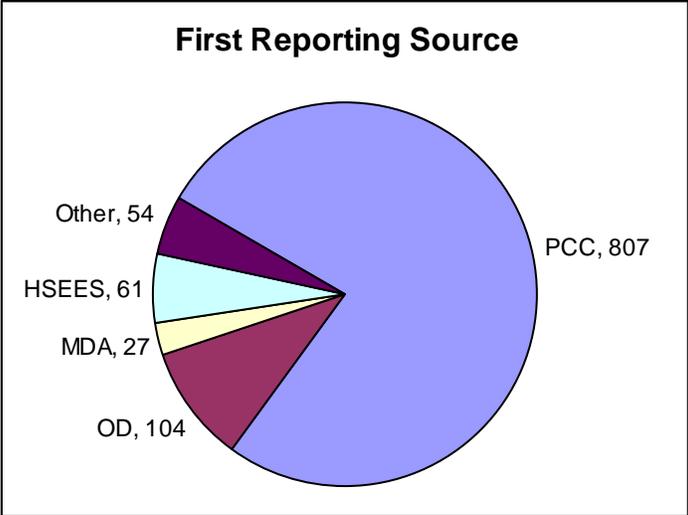


Table 1. Classification of occupational pesticide illness and injury cases

Classification	Total		7/1/05-6/30/10	
	N	%	N	%
Definite	102		58	
Probable	155		108	
Possible	446		294	
Suspicious	30		21	
Total confirmed	733	70%	481	69%
Unlikely	3		0	
Insufficient information	278		202	
Exposed/asymptomatic	28		6	
Unrelated	11		7	
Total unconfirmed	320	30%	215	31%
Total	1053	100.0%	696	100.0%

Among the 733 confirmed occupational cases, where the product was known, disinfectants accounted for the largest number (349, 47%), followed by insecticides and insect repellents (230, 31%) and then herbicides (109, 15%). Targeted exposures (215, 26%), leaks and spills (193, 23%), and indoor air (142, 17%) 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.

Occupations at the time of exposure of confirmed cases for calendar years 2007 through June 30, 2010 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. Twenty nine of the Building and Grounds Cleaning and Maintenance workers were pest control operators.

Table 2. Occupational pesticide illnesses and injuries by occupation, confirmed cases 2007-2010

Occupation	N	% all	% known
Building and Grounds Cleaning and Maintenance	96	26.5	32.1
Farming, Forestry, and Fishing	29	8.0	9.7
Food Preparation and Serving Related	26	7.2	8.7
Sales and Related	23	6.4	7.7
Management	16	4.4	5.4
Office and Administrative Support	14	3.9	4.7
Personal Care and Service	13	3.6	4.3
Production	13	3.6	4.3
Transportation and Material Moving	13	3.6	4.3
Protective Service	12	3.3	4.0
Education, Training, and Library	11	3.0	3.7
Healthcare Practitioners and Technical	10	2.8	3.3
Healthcare Support	7	1.9	2.3
Construction and Extraction	6	1.7	2.0
Installation, Repair, and Maintenance	5	1.4	1.7
Other	5	1.4	1.7
Unknown	63	17.4	
Total	362	100.0%	100.0%

In this grant period 22 cases were referred to MDA to determine if there were violations of laws and regulations that might pose on-going risks to co-workers. Seven were not investigated. Seven are still pending. Three investigations found no violations. In one case it was decided to send the employer a reminder to enforce their integrated pest management plan. The remaining four employers received warning letters, citing 9, 4, 3, and 2 violations.

One example was a groundskeeper at a theme park who applied an herbicide and an algacide to a lake from a boat. She was told to wear gloves, but not long pants. The wind blew the product back onto her bare legs, and about an hour later they began to itch. She then washed them off, but they began to burn and she developed a red rash. She went to an urgent care clinic and was diagnosed with leg burns. The case was referred to MDA

because she was neither certified nor registered as a pesticide handler and was not under the direct supervision of a certified handler. In addition, she did not wear the protective clothing required by the label. MDA found that the employer did not maintain records of pesticide applications, the applicator was not certified, the applicator did not wear proper personal protective equipment (PPE) as required by the label, and that required posting after pesticide application did not occur.

Another example involved an administrative assistant working in an aluminum can recycling office that was frequently sprayed for roach control. She had an asthma attack with headache, dizziness and cough. The case was reported to MDA, which investigated and found information missing from the pesticide application firm's application records and written customer information as well as irregularities related to the firm's name and contracts. MDA issued the application firm a warning letter, requiring a written response indicating what changes have been made to bring the firm into compliance. This case was also referred to Michigan's work-related asthma surveillance program.

In an example of a case where no violations were substantiated, a worker was inspecting power poles for carpenter ants or hollow spots. When found, he would drill holes and fill them with a fungicide. Some traveled through a hollow area and out another of the drilled holes, directly into his mouth. He swallowed some and had a sore throat and nausea. He felt dizzy and was acting "high". He sat in the truck for a couple of hours and then went back to light duty work. This case was reported to MDA because the worker was not a certified or registered applicator. Upon investigation, MDA was told that a coworker, who was certified, was the person who made the application.

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. A total of 168 cases have met these criteria for priority reporting. In this grant period, 126 cases (77 occupational, 49 non-occupational) comprising 22 events (14 occupational, 7 non-occupational, one both occupational and non-occupational) were reported as high priority events.

An example of cases reported this period under (b) involved two separate events in veterinary offices, where a dog had swallowed a rodenticide, and was induced to vomit, releasing phosphine gas which was a product of the zinc phosphide-containing rodenticide mixed with stomach acids. A total of 12 employees at these offices were exposed to the phosphine gas and experienced symptoms including shortness of breath, headache, dizziness, and nausea. MDCH worked with the PCC to develop a letter to go to all veterinarians in the state warning them of this problem. We then sent a similar letter to the American Veterinary Medical Association. They responded by putting up a web page with links to our letter and our fact sheet, as well as other links. They also sent out an email alert to about 20,000 veterinarians put it on their twitter feed. There was also a blurb in the Journal of Veterinary Medical Association News.

Another reported event involving multiple exposures was an incident where a dipyriddy herbicide was sprayed outside a school in a light wind. Nine employees and nineteen students developed symptoms including difficulty breathing, wheezing, chest tightness, cough, diaphoresis, numb lips, flushed skin, anxiety, nausea, vomiting, and diarrhea. They were seen by the school nurse and taken to an emergency department. The school was evacuated and paramedics were called to the scene. The fire department cleaned the hazardous material and the Michigan Department of Agriculture (MDA) inspected the clean up and provided information about required integrated pest management (IPM). The school implemented new spray policies, including parental

notification in advance of any spraying, posting signs, not spraying within 150 feet of the building except on weekends, and not spraying during school hours.

There were two deaths reported in this period. A man in his 30s took a second job repairing a home and cleaning water and mold damage from a burst pipe. He went to the house to work one evening. When he didn't show up for his day job, his brother and a friend went to the house and found him dead. There was a strong bleach odor throughout the house, which was not well ventilated. He had recently been seen at an urgent care center for an upper respiratory infection. EMS and the police responded. He was taken to a hospital and pronounced dead. The medical examiner diagnosed acute pulmonary edema and dilated cardiomyopathy. The cause of death was listed as acute pulmonary edema due to exposure to chlorinated fumes. There were no other injuries or natural diseases contributing to his death. The case was referred to the Michigan FACE program.

The other death involved a woman in her 50s who worked in a nursing home laundry. One day, bleach was left out overnight. When the dryer was turned on in the morning, the fumes from the bleach became more noticeable. She was exposed to the fumes for about 10-15 minutes. She had a history of asthma and developed shortness of breath and asked someone to get her inhaler. She lost consciousness and EMS was called. They evacuated the laundry room and took her to a hospital where she was intubated and admitted. She never regained consciousness and died five days later. This case was also investigated by the work-related asthma surveillance and Michigan FACE programs. Of four other workers reported to have also been exposed, one met the criteria to be a confirmed case.

There were six national publications that included data and editorial input from the Michigan Occupational Pesticide Illness and Injury

In addition, six annual reports (2003-2008) are available through the MSU (<http://www.oem.msu.edu/AnnualReports.aspx>) and MDCH ([http://www.michigan.gov/mdch/0,1607,7-132-2945\\_5105-127397--,00.html](http://www.michigan.gov/mdch/0,1607,7-132-2945_5105-127397--,00.html)) websites.

Other pesticide information developed by the pesticide surveillance staff and available at the MDCH website include the booklet "What You Need to Know About Pesticides and Your Health" (averaging 105 web hits/month) and "Pesticide Information Resources" providing over 150 links to websites pests; lawn and garden care; alternatives to chemical pesticides; and other topics (averaging 33 hits/month).

Information about the Pesticide Surveillance program was presented to the Michigan Association of Local Public Health Information Integration conference (2005), the Michigan Grower and Farm worker conference (2005) and the SENSOR-Pesticides 'Winter fest' meeting (2010). "Occupational Illnesses and Injuries from Antimicrobials in Michigan" was presented at the Michigan Epidemiology Conference (2006), "Pesticides Surveillance and Mandatory Reporting Laboratory Cholinesterase Test Results" was presented at the 2008 CSTE conference, and "Evaluation of Migrant Outreach Worker Pesticide Safety Training" was presented at the 2010 CSTE conference.

In 2009, MDCH collaborated with four other agencies, The Michigan Primary Care Association, Migrant Health Promotion, Farm Worker Legal Services, and InterCare Community Health Network, to address the lack of information among farm workers and health professionals about pesticide safety, rights, and reporting requirements. As a result, these agencies hosted two statewide pesticide education events in May 2009: (1) An interactive day-long training for outreach workers and others who have direct contact with farm worker families and (2) An hour-long webinar for health professionals at migrant health clinics. Fifty people participated in the outreach worker training. They demonstrated a statistically significant increase in knowledge after the training

which persisted for at least four months. Fifty-seven people pre-registered for the webinar. Of the 21 who responded to our survey, 15 rated the webinar as excellent, five as good and one as average.

### **D.1.e. Silicosis**

#### **D.1.e.1. Specific Aims**

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

- To continue surveillance for silicosis.
- To prioritize and expand ongoing compliance and consultative industrial hygiene and education activity for silica in the State of Michigan.
- To improve reporting and data integration using a developing electronic public health surveillance system based on NEDSS architecture.
- To continue and expand on occupational health surveillance collaborative activities among states and with the NIOSH.

#### **D.1.e.2. Background and Significance: Silicosis**

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 in recent years, in Michigan there were still 180 foundries employing 12,652 in 2007, 65 of which were ferrous, employing 5,782 individuals in 2007 (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 262 abrasive blasting companies (MSU research team survey, 2005) and 452 open mines and quarries employing 5,700 individuals that are currently active in the state. There are approximately 27,000 construction firms employing 170,000 workers in the state. Workers in these industries are at increased risk of developing silicosis.

The Michigan silicosis surveillance system has identified 1,045 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.

### D.1.e.3. Methods

Aim #1: To continue surveillance for silicosis

Case reports for silicosis came from a variety of sources: mandatory reporting by health care providers, health care facilities, and employers; hospital discharge data; death certificate data; and workers' compensation claims, including reports to the Michigan Silicosis Dust Fund.

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.

Inspections were conducted to enforce the reporting law. Like disease reporting laws for communicable disease, no attempt was ever made to penalize a health care provider for non-compliance. A mailing was made 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 being received. The results of the investigations were publicized in the Michigan occupational health community.

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](http://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 encouraged providers to report in whatever way it was most convenient for them.

An automated occupational disease reporting system was developed for the electronic medical record used by the family practitioners and internists at MSU.

In addition to receiving OD reports, we actively solicited reports from all of the Michigan hospitals. Each February we requested the 148 acute care hospitals in the state 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 502 (silicosis), and ICD-9 code 505 (pneumoconiosis unspecified). 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 and where silica exposure occurred.

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 Community Health's Vital Registration unit for all individuals with silicosis or pneumoconiosis, unspecified, as the underlying or contributing causes of death (ICD-10 J62 and J65) who died in the previous calendar year.

Workers' compensation reports of silicosis were obtained annually from a special compensation fund entitled the Silicosis, Dust Disease and Logging Industry Compensation Fund. All employers in the state pay an extra assessment on their workers' compensation premium into this fund. The fund picks up the cost of workers' compensation after the first \$25,000 in claims paid out to workers with silicosis. Therefore, it is to the advantage of any employer who has to pay workers' compensation for silicosis to apply to the fund in order to limit the company's liability. In addition, workers' compensation shared with us on a quarterly basis, a computerized listing of any individuals who filed a workers' compensation claim for silicosis.

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

- 1) Four page quarterly respiratory disease newsletter-"Project SENSOR News"
- 2) Annual report for silicosis
- 3) Presentations at Grand Rounds and medical conferences
- 4) Display booths at medical conferences
- 5) Mailing to newly licensed physicians
- 6) An annual reminder to the 11 NIOSH certified B-readers in the state to report pneumoconiosis
- 7) Updating of the Surveillance Center website and linkages to other important sites
- 8) Advisory Committee
- 9) Study to Address Under-Reporting
- 10) Provision of software for electronic medical record reporting system

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 out 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.

Dr. Rosenman gave talks at medical conferences and grand rounds.

We routinely exhibited display booths at major medical conferences around the state. At the booth, we distributed newsletters, annual reports, 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 State Medical Society 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.

All new physicians in the state received a letter about the occupational disease reporting law and a copy of the reporting form as part of the packet they received when they applied for a Michigan License. The licensing division is part of MDCH.

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](http://www.oem.msu.edu)) contained: Annual reports; quarterly newsletters, resource materials on medical screening for work-related asthma and silicosis; a training course on abrasive blasting; the Michigan occupational disease reporting form; 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 MDCH 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. 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.

Study to address under-reporting: One theme that repeated itself when we examined the surveillance data that we collected over the past 22 years 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). A question this surveillance team tried to answer was "Where were the unreported cases of occupational illness?" Were they simply not being recognized as work-related or were they being recognized as work-related but not being reported either because the health provider was unaware of their obligation to report those cases or unwilling to report those cases. A further question was "Do the characteristics (for example, specialty, location in the state, association with a University or hospital, etc...) of the health practitioners differ by condition?"

To address this issue why practitioners were not reporting, we developed a one page card length questionnaire that we handed out at four state meetings that occur each year: Michigan Thoracic Society, Michigan Allergy Society, Michigan Family Practice Association and the Michigan Chapter of the American College of Physicians. 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? The survey was conducted in Year One and the data analyzed in Year Two.

We followed our standard procedure for following up on silicosis 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 <5% of the silicosis patients reported and approximately 10% refused to be interviewed. Our questionnaire collected information on the patient's lifetime work history, health care usage, smoking history, and respiratory symptoms. 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 (CDC, 1990). We were able to obtain sufficient information from medical records on 89% of the 15% of patients who could not be located or who did not wish to be interviewed.

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 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 Surveillance Center maintained and continually updated a mailing list of interested health care providers, industry and union groups, public health professionals, and others with an interest in occupational health. The mailing list was used to distribute the Annual Reports. The Annual Report was also placed on the Surveillance Center website.

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 in industries identified by the Michigan silicosis surveillance data where the risk of silicosis is less well known. This includes dental technicians (Rosenman et al, 2004) the dental supply industry (DeLaHoz et al, 2004) and highway repair work (Valiante et al, 2004). We worked on these issues with the other states doing silicosis surveillance. This not only included the published medical articles but also fact sheets distributed to employers and press releases for the media.

We collaborated with the MDCH 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.

The MDCH Core Occupational Health Surveillance project produced an Annual Report on Occupational Illness and Injury in Michigan, in collaboration with MSU (Stanbury M et al, 2004). This report included a chapter on silicosis using Michigan silicosis surveillance data.

### Special surveillance studies

Silicosis disease study with University of Michigan: We conducted a follow-up study on a sample of the silicotic cases. Individuals were invited to the University of Michigan and provided CT scans of their chest, and chest radiographs. Participants also completed a questionnaire. Dr. Al Franzblau and his colleagues at the University of Michigan had funding from NISOH for this study. Dr. Rosenman was one of the "B" readers on the panel. Although the primary aim of the study was to compare CT scan interpretations, digital radiographs and standard radiographs, data was generated on the progression of silicosis. Thirty-six silicotics from Michigan participated in this study. Analysis of the data from these 36 silicotics was conducted.

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 (Rosenman and Zhu, 1995; Rosenman et al, 1999), on the association of kidney disease and silicosis (Rosenman et al, 2000; Steenland et al, 2002) and the association of COPD and silicosis (Rosenman and Zhu, 1995). 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.

Special populations: We have noted through our surveillance activity that African Americans were at increased risk of silicosis (7 fold increased risk) (Rosenman et al, 1997) We have learned anecdotally from silicotics we interviewed that historically African-Americans were given the dirtier jobs in foundries and were not allowed to transfer out of these jobs. We reviewed our databases and examined industry, occupation, duration and smoking history in African-American silicotics versus white silicotics. We recruited an historian, Alice Dreger, PhD at MSU who interviewed African-Americans with silicosis that worked in Michigan foundries to further elucidate this issue.

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

MIOSHA Inspections: The Surveillance Center provided MIOSHA with the name and address of the company where a patient with confirmed silicosis was exposed. We averaged 5 work place inspections per year following up silicosis cases. 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, and if available chest x-rays of employees who had worked ten years or more were collected for review by Dr. Rosenman. 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

Highway reconstruction: We contacted the Michigan Department of Transportation (MDOT) and determined that silica was banned as an abrasive blasting media in highway reconstruction activities. We encouraged MDOT to implement changes in contract language to address silica safety and health issues when cutting or breaking up cement. We shared with them contract language used in New Jersey. Dr. Rosenman met with the State Advisory Standards committee to share silicosis data on the hazards of dry-cutting cement.

Resurvey abrasive blasting companies: In 1996 we identified 306 abrasive-blasting companies in Michigan and determined that 191 (62%) used silica as the abrasive. Our survey of these companies revealed: two-thirds had a respiratory protection program but in only one-third was it written. Two-thirds required protective clothing and one-half used control technology such as containment or ventilation. Almost none (4%) conducted air monitoring and most (73%) had no medical monitoring. After the survey we developed an educational program and training manual. In 2005, we resurveyed the 191 silica-using abrasive-blasting companies and identified

new abrasive-blasting companies from internet and industry directories, along with a 10% sample of the companies that originally reported no silica use. Resurveyed companies were asked about current blasting activity, type(s) of abrasives used, and number of employees who performed blasting. Analysis of 223 completed resurvey responses revealed 151 (68%) companies performing abrasive blasting, and 82 of the 151 (54%) reported the continued use of silica. Ten of the 30 companies among the 10% sample that originally reported no blasting activities were currently performing blasting. Seven of the companies that reported no silica use noted the use of other media such as beach sand, quartz sand, washed beach sand or baby sand. In addition, 10 of the 46 (21.7%) companies that originally indicated no blasting activities during the 1990 survey responded to the 2005 survey as performing blasting activities. Two of those 10 (20%) companies indicated the use of silica. 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. In addition, the training program for abrasive blasting was updated in 2007 and posted on the Surveillance Center's website at: [www.oem.msu.edu](http://www.oem.msu.edu).

Re-inspections of foundries: We re-inspected 44 MI foundries. Personal air monitoring for silica was conducted in 40 of the 44 facilities; 26 companies had silica levels below the MIOSHA PEL and 14 were above the PEL. Key information collected during these inspections included silica air monitoring and information on medical surveillance programs used by the establishment. Data on inspection results was computerized. We compared the results of the inspections in companies where we have had silicosis cases reported to those where no cases had been reported. There were 13 inspections at foundries where a SENSOR case had previously been identified; 5 had silica levels above the PEL, 7 were below the PEL and for one company there was no air sampling performed. There were 31 inspections at foundries that had no associated SENSOR cases; 9 had silica levels above the PEL, 19 were below the PEL and 3 foundries had no air monitoring performed.

Aim #3: To improve reporting and data integration using a developing electronic public health surveillance system based on National Electronic Disease Surveillance System (NEDSS) architecture.

Data integration was performed at the state level combining reporting from laboratories, hospitals, poison control centers, death certificates, workers' compensation, health care provider reports, and clinics. It proved not to be useful or practical to combine with NEDSS.

Aim #4: 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.

Multiple publications were written.

CSTE/Occupational Health meetings: Dr. Rosenman was been 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.

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 1,856 reports of possible pneumoconiosis, and confirmed that 1,045 were silicosis from 416 facilities. An average of 88 reports were processed annually. Table 1 shows the major industrial groups where the confirmed cases had been exposed to silica.

<u>Industry</u>	<u>Number</u>	<u>Percent</u>
Manufacturing	912	87
Construction	71	7
Mining	34	3
Transportation & Utilities	7	1
Services	6	1
Government	4	<1
Trade	3	<1
Farming	2	<1
Total	1039	
*Industry was unknown for six cases.		

MIOSHA conducted 85 follow up investigations at workplaces of the confirmed silicotics. Air sampling for silica dust was conducted in 60 of the facilities. Thirty-five companies had dust levels above the NIOSH REL and 22 were above the Michigan OSHA PEL. See Table 2 for a summary of the status of the facilities where the cases of silicosis worked.

	# Individuals Represented	# Facilities	% Facilites
Inspected	457	85	20.4
Closed	395	145	34.9
Out of State	67	63	15.1
No Longer Use Silica	26	24	5.8
Unknown	49	49	11.8
Building Trade	48	48	11.5
Inspected by Mine Safety	3	2	0.5
Total	1045	416	100.0

In addition to the above-mentioned inspections, we identified all the foundries in Michigan, which were still operating and conducted enforcement inspections at each facility. Ninety-three facilities were identified through multiple sources, including federal OSHAs on-line IMIS system, the Michigan Manufacturing Directory published annually by Pick Publications, and on-line searches. Forty-four facilities were inspected, 4 were pending, 27 were identified as out of business, and 18 were confirmed as not using silica. Personal air monitoring for silica was conducted in 40 of the 44 facilities; 26 companies had silica levels below the MIOSHA PEL and 14 were above the PEL. Key information collected during these inspections included silica air monitoring and information on medical surveillance programs used by the establishment. Data on inspection results was computerized. We compared the results of the inspections in companies where we have had silicosis cases reported to those where no cases have been reported. There were 13 inspections at foundries where a SENSOR case had previously been identified; 5 had silica levels above the PEL, 7 were below the PEL and for one company there was no air sampling performed. There were 31 inspections at foundries that had no

associated SENSOR cases; 9 had silica levels above the PEL, 19 were below the PEL and 3 foundries had no air monitoring performed.

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## D.2. Publications and Abstracts

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E. Inclusion Enrollment Report

**Study Title:** Enhanced Program in Occupational Injury and Illness Surveillance

**Total Enrollment:** 3,631 **Protocol Number:** \_\_\_\_\_

**Grant Number:** 5 U60 OH 008466-4

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative)</b>				
<b>by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino	27	129	0	156 **
Not Hispanic or Latino	402	589	0	991
Unknown (individuals not reporting ethnicity)	511	1,954	19	2,484
<b>Ethnic Category: Total of All Subjects*</b>	940	2,672	19	3,631 *
<b>Racial Categories</b>				
American Indian/Alaska Native	2	6	0	8
Asian	5	13	0	18
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	151	242	0	393
White	484	1,542	0	2,026
More Than One Race	10	16	0	26
Unknown or Not Reported	288	853	19	1,160
<b>Racial Categories: Total of All Subjects*</b>	940	2,672	19	3,631 *
<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native	0	0	0	0
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	1	0	1
White	7	18	0	25
More Than One Race	3	4	0	7
Unknown or Not Reported	17	106	0	123
<b>Racial Categories: Total of Hispanics or Latinos**</b>	27	129	0	156 **

\* These totals must agree.\*\* These totals must agree.

#### **F. 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.

#### **G. 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](http://www.oem.msu.edu)