

Final Performance Report
Michigan Fatality Assessment and Control Evaluation

5 U60 OH 008329 - 02
9/1/2004 – 8/31/2008

John Peck, Principal Investigator, Michigan Department of Labor and Economic Growth
Kenneth D. Rosenman, MD, Principal Investigator, Michigan State University

Contact Information for Principal Investigation and Institution to which award was made.

Michigan Department of Energy Labor and Economic Growth
Michigan Occupational Safety and Health Administration
Management and Technical Services Division
P.O. Box 30643
Lansing, MI 48909
517-322-1817
FAX: 517-332-1775
Peckjl@michigan.gov

A. List of Terms/Abbreviations

CET- Consultation, Education and Training Division

CFOI – Census of Fatal Occupational Injuries

FACE – Fatality Assessment and Control Evaluation

MDCH – Michigan Department of Community Health

MDELEG – Michigan Department of Energy, Labor and Economic Growth

MIFACE – Michigan Fatality Assessment and Control Evaluation

MIOSHA – Michigan Occupational Safety and Health Administration

MSU – Michigan State University

NIOSH – National Institute of Occupational Safety and Health

OEM – Occupational and Environmental Medicine

SENSOR – Sentinel Event Notification System for Occupational Risks

B. Abstract

Work-related fatal injuries are a significant problem in Michigan as they are throughout the United States. A comprehensive surveillance system for Michigan work-related fatal injuries was established to: identify work situations at increased risk for work-related fatal injuries; conduct an on-site work place investigation to identify the underlying cause(s) of these fatalities; and, based on the information gathered, formulate and disseminate prevention strategies to stakeholders to reduce the number of these preventable deaths. The results of a comprehensive surveillance system and on-site investigation are needed not only to target educational intervention but also to identify needed regulatory and control technology changes.

Five hundred twenty two individuals died from a work-related fatal injury between September 1, 2004 and August 31, 2008. The Construction industry accounted for 116 (22.2%) of the fatal injuries, followed by Manufacturing (70, 13.4%) and Agriculture (64, 12.3%). The primary cause of a work-related death was due to a motor vehicle incident (114, 21.8%), followed by falls (87, 16.7%), then struck by (75, 14.4%), then machines and homicide (67 each, 12.8%).

September had the highest number of fatal work-related incidents (53, 10.2%), followed by August (50, 9.6%), October (48, 9.2 %), June (48, 9.2%), and November (46, 8.8%).

As expected, of the known time of injury, the work hours of 8:00 a.m. to 5:00 p.m. had the highest number of work-related fatalities (316, 66.1%). Broken out into four-hour time periods, the time period of 12:00 p.m. to 3:59 p.m. had 136 fatal injuries and 8:00 a.m. to 11:59 a.m. had 134 work-related fatal injuries. The time period of 4:00 p.m. to 4:59 p.m. had 31 fatal injuries.

When the day of injury was known, Monday and Friday were the days of the week that individuals were most likely to have a work-related fatal injury; Monday had 87 (16.9%) and Friday had 86 (16.7%). Wednesday had 84 (16.3%), then Tuesday (82, 16.0%), and then Thursday (75, 14.6%).

MIFACE contacted 260 employers to ask for their participation. MIFACE conducted 69 (26.5%) workplace investigations. Two of the 69 investigations found that the death was not-work-related. One hundred ninety one (73.5%) employers chose not to participate.

MIFACE has written and posted to the MSU OEM website 107 summaries of MIOSHA investigations and 7 one-page hazard alerts which identify common factors in a work-related fatality. Seventy two presentations were made to industry, medical professionals and trade groups.

The identification of root cause(s) of a work-related fatality provides a practical tool for employers to assess their workplace to determine if similar factors are present and implement preventive actions to minimize the occurrence of a similar fatality occurring.

SECTION 1.

Highlights/Significant Findings

MIFACE has confirmed 522 individuals died due to a work-related incident between 9/1/04 and 8/31/08, an average of 131 deaths per year. Of the 522 work-related deaths, MIOSHA conducted an enforcement inspection of only 168 (32.2%) of the deaths. Work-related fatal injuries often occur either in industries or circumstances outside of MIOSHA's jurisdiction, such as self-employed workers, mining or railroad workers or are due to causes not routinely investigated by MIOSHA (i.e. homicides, suicides, farmers, and on-the-road motor vehicle deaths).

We have conducted 69 on-site investigations. Two of the fatality inspections determined that the death was not work-related. For each investigation, a report was written that contained a description of the events preceding the death, identified causal factors and made recommendations to prevent similar fatalities in the future. A dissemination plan was developed to maximize their impact within budget constraint for each on-site investigation. All reports were posted on the MSU OEM website.

Seven one-page hazard alerts have been developed to highlight the death and potential life saving interventions. 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 seven hazard alerts are:

- Farmer Died as Result of Starting a Tractor on Ground
- Slippery Clutch Pedal
- 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

Annual reports on Work-Related Fatal Injuries have been prepared for 2004-2007. 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, 107 summaries of fatalities investigated by MIOSHA, but not by MSU. A typical MIOSHA report of a fatality investigation contains information about the citations issued but no description of the circumstances of the death. The summaries included a description of the death and the citations, and were placed on our website so as to be readily available. The summaries we prepared are being used in training programs by MIOSHA, industry, and insurance providers, in "tailgate talks" on the worksite, and by the MIOSHA CET division as a basis for Safety Alerts.

A total of 72 presentations have been made by MIFACE personnel using MIFACE data, findings and recommendations. Presentations have been 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.

D. Translation of Findings

Surveillance findings of all traumatic work-related deaths underscore the limitations of relying on just the deaths investigated by MIOSHA. MIFACE findings highlighted hazards in construction, agriculture, manufacturing and transportation as a priority for prevention efforts in Michigan.

E. Outcome/Relevance/Impact

NIOSH used MIFACE investigations in their efforts to promote safety and health. MIFACE Investigation #02MI075, Landscape Mowing Assistant Dies From Heat Stroke was cited in NIOSH Fact Sheet. *Fatal Injuries Among Landscape Services Workers*. 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. Additionally, MIFACE Investigation Report #05MI095: Municipal Tree Trimmer Dies When Falling Tree Limb Struck Him was cited in NIOSH testimony on the OSHA proposed Tree Trimming rule.

Additional references of MIFACE reports included 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.

MIFACE investigated two work-related deaths involving isocyanate exposure. One investigation concerned the first work-related death involving isocyanate exposure in the after-market truck bed liner industry. As a result of this investigation, MIOSHA conducted site visits to assess isocyanate exposure and work practices at 81 of the 91 truck bed liner facilities in the state. MIOSHA also conducted air sampling at 5 locations (4 were above the MIOSHA Standard) and prepared recommendations for these facilities. We also published the death and the subsequent investigation in the American Journal of Industrial Medicine. NIOSH used the investigation as a basis of their hazard alert (Preventing Asthma and Death from MDI Exposure During Spray-on Truck Bed Liner and Related Applications), other states referenced the Michigan FACE investigation (New Jersey, Washington, Minnesota) in their educational outreach efforts, and the Alliance for the Polyurethanes Industry (API) joined OSHA regional offices in an alliance to help protect workers in the truck bed liner industry. Additionally, API developed and made available on their website free brochures concerning worker safety and respiratory protection.

The second fatal work-related isocyanate exposure investigation, MIFACE Investigation Report #05MI141: Chemical Worker Died From Work-Related Asthma, conducted by

MIFACE involved a worker who collapsed while working at an adhesive manufacturer. The adhesives contained isocyanates and during the course of his employment at the facility, the decedent had developed work-related asthma. He died in the hospital six days after the collapse. As a result of the two isocyanate deaths and subsequent information learned from the MIFACE investigations as well as our work-related asthma project, renewed emphasis was placed by the MIOSHA Health Standard Commission to promulgate a MIOSHA Diisocyanates standard

A young waitress who died from an acute asthma attack while working in a bar/restaurant was investigated (MIFACE Investigation #04MI223: Young Waitress Died from an Asthma Attack While Working in Bar). MIFACE found inadequate ventilation and the absence of a plan to respond to medical emergencies. The investigation linked the exposure to second-hand smoke and poor ventilation in the bar. The report has frequently been cited by Michigan legislators as they consider legislation to ban smoking in workplaces. The investigation report was also utilized in training sessions in other industries to highlight the necessity of having an emergency plan in place and employees trained to implement the plan. MIFACE personnel have provided information and copies of the report of the investigation and a peer reviewed publication (Stanbury et al, 2008), to public health groups, and the State's chief medical office. The information was used to support the need for smoke-free legislation for the State of Michigan.

Prisons contract out their low risk prisoners to work at public agencies or nonprofit private agencies in their local communities. We had two prisoners and a guard killed in three separate incidents. Prior to MIFACE intervention, the contracts did not require the use of NIOSH or OSHA approved equipment such as safety equipment or ladders and did not specify who ensures work to be performed complies with federal and state safety standards. We worked with the Michigan Department of Corrections to change the contract language and increase awareness about safety and health issues among prison management.

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. Firefighters received no State training on how to position vehicles on a roadway to provide a protected, safe working environment. We worked with the State Fire Marshall to develop such a training module.

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 agreed with or was in opposition to the results of fatal construction fall research has been submitted for publication.

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 average three radio interviews each year in response to the press release.

Michigan, like the rest of the United States, has a higher rate of work-related fatal injuries among Hispanic workers compared to other demographic groups. Michigan Hispanic construction workers were two times more likely to experience a fatal fall than non-Hispanic Caucasians or African Americans. MIFACE was one of the authors of an article in the Morbidity and Mortality Weekly Report (MMWR) that characterized work-related injury deaths among Hispanic workers in the United States (Cierpich et al, 2008).

SECTION 2

Scientific Report

Specific Aims

1. To continue to identify work situations in Michigan at increased risk for work related fatal injuries.
2. To continue to identify the underlying causes of work-related fatal injuries in Michigan.
3. To continue to formulate and disseminate prevention strategies to reduce work-related fatal injuries.
4. To continue collaborative activities among the states with funded Fatality Assessment and Control Evaluation (FACE) programs and with the National Institute for Occupational Safety and Health (NIOSH).

Background:

Since 1983, the National Institute for Occupational Safety and Health has run a Fatality Assessment and Control Evaluation (FACE) program. The goal of the FACE program was to prevent occupational fatalities across the nation by identifying and investigating work situations at high risk for injury and then formulating and disseminating prevention strategies to those who can intervene in the workplace. FACE investigations have provided aggregate data to identify high-risk industries and work practices as well as provided the stories or "faces" necessary to make the statistics real and influence change in the workplace. They have served as an important vehicle for providing technical assistance to employers. Emphasis on information dissemination and translation of information into user-friendly materials was an important part of the program. FACE was a research program and not an enforcement program. Its purpose was not to assess compliance with occupational safety and health standards but rather to understand the underlying cause(s) for the fatality.

Michigan began its occupational fatal injury investigation project in September 2000, with funding obtained after imposition of a large penalty on a company where multiple work-related fatal injuries had occurred. A multi-disciplinary team from Michigan State and Wayne State Universities' was formed. The Michigan surveillance/investigation

program was modeled on the NIOSH FACE program. In 2002, funding was received from NIOSH to continue the program and allowed Michigan to integrate its data with NIOSH FACE data to expand and develop new intervention projects. The collaboration between Wayne State University (WSU), ended August 30, 2007 due to the retirement of the WSU industrial hygienist. The MSU team consisted of an occupational health physician/epidemiologist, two industrial hygienists, and a farm safety specialist.

The underlying causes of Michigan work-related fatal injuries were identified using the NIOSH FACE model of on-site, in-depth investigations and includes 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 focused upon the underlying causes of the fatalities rather than compliance with MIOSHA standards.

Procedures

Multiple sources were utilized to identify an individual who may have died due to a work-related injury. To confirm that the death was work-related, a death certificate, medical examiner report, and police report was obtained. Additional information from MIOSHA was also obtained if a MIOSHA compliance officer conducted an investigation. MIFACE contacted the employer/farm family by letter to ask for their voluntary participation in the study. If the employer/farm family agreed to participate, MIFACE conducted a site visit. An investigation report describing the fatality, remedial actions by the employer and MIOSHA citations (if applicable), and prevention recommendations was written. A dissemination plan was developed for the report, including posting the report on the MSU OEM and NIOSH FACE website.

Methodology

MIFACE used numerous sources to identify persons who died from a work-related injury: (1) MIOSHA, (2) Police Departments, including the Fatality Analysis Reporting System (FARS) State of Michigan Traffic Crash Report, (3) County Clerks, (4) Medical Examiners, (5) Michigan State University County Extension Offices, (6) Newspaper Articles, and (7) Emergency Service Providers, including Fire Departments.

MIFACE has adopted the United States Department of Labor, Bureau of Labor Statistics (BLS), Census of Fatal Occupational Injuries² (CFOI) definitions of traumatic injury, work relationship, and work. BLS collects the official statistics of work-related deaths in all states. A traumatic injury was any unintentional or intentional wound or damage to the body resulting from acute exposure to energy -- such as heat or electricity or kinetic energy from a crash -- or from the absence of such essentials as heat or oxygen caused by a specific event, incident, or series of events within a single workday or shift. A work relationship existed if an event or exposure results in the fatal injury or illness of a person: (1) on the employer's premises and the person was there to work; or (2) off the employer's premises and the person was there to work, or the event or exposure was

related to the person's work or status as an employee. The employer's premises included buildings, grounds, parking lots, and other facilities and property used in the conduct of business. Work was defined as duties, activities, or tasks that produce a product or result; that are done in exchange for money, goods, services, profit, or benefit; and, that are legal activities in the United States. Fatalities to volunteer workers who were exposed to the same work hazards and performed the same duties or functions as paid employees and that met the CFOI work relationship criteria were in-scope. Deaths from natural causes, such as heart attacks that occur at work, were not included (with the exception of fire fighters). Suicides were included, following the protocol established by the NIOSH FACE program as well as that of BLS.

Once an individual had been identified and confirmed as an eligible work-related death, various sources of information were used to describe the circumstances associated with the fatal event. Basic information collected included: the size of the company; the content of the safety program; the decedent's age, gender, and occupation; tasks the decedent was performing; tools or equipment the decedent was using; the working environment; the energy exchange resulting in the fatality; and the role of management in controlling how these factors interact.

The level of information collected for each fatality depended on the type of incident. For homicides, suicides and most transportation-related fatalities that occurred while the individual was at work, MIFACE collected source documents and did not attempt to perform an on-site investigation.

Source documents included reports from agencies that investigate the death or provided emergency services when the event occurred, death certificates, medical examiner reports and, when appropriate, the MIOSHA fatality investigation narrative. Information about work-related fatalities that involved motor vehicles was obtained from the State of Michigan Traffic Crash Report (UD-10) that was completed by the police agency that responded to the incident.

For the remaining work-related fatalities, including agricultural fatalities, MIFACE initiated contact with employers or farm family members to request permission for an on-site investigation. Employer participation in the MIFACE program was voluntary and was unrelated to any regulatory or enforcement procedures. It was important to note that MIFACE investigators did not enforce compliance with MIOSHA rules and regulations and did not assign fault or blame. However, to decrease the burden to the employer of multiple investigations, MIFACE with employer agreement, accompanied the MIOSHA compliance officer. MIFACE also interviewed the compliance officers about their investigations.

When the MIFACE on-site fatality investigation was completed, a report was written based on the information gathered during the investigation and from reviewing the source documents. Neither reports nor educational materials produced by the MIFACE program contained personal identifiers. The MIFACE report contained a summary of the fatal incident, a detailed narrative of the fatal incident, the cause of death, pictures/drawings, and prevention recommendations to minimize the chances of a similar fatality occurring

in the future. Before releasing the MIFACE report, the report was reviewed by members of the MIFACE advisory board and MIOSHA (if MIOSHA conducted an investigation).

The MIFACE report was sent to the employer, business trade organizations, labor unions and trade journals and other groups that could potentially affect work practice changes to eliminate or reduce the chances of a fatality occurring under similar circumstances in the future. The reports were also posted on the MSU OEM website at www.oem.msu.edu/. Also posted on the website were summaries of MIOSHA investigated cases and Hazard Alerts, which summarized individual work-related cases as well as specific targeted industrial sectors.

Hazard Alerts were 1-page documents that reviewed work-related fatalities and provided prevention recommendations that targeted specific industrial sectors or repeated work-related fatality incidents (e.g. trench wall cave-ins). MIFACE summaries of investigations conducted by the MIOSHA program included a summary of the work-related fatality incident and the citations issued to the employer by MIOSHA at the conclusion of the fatality investigation.

The 2002 North American Industry Classification System (NAICS) had 20 sectors that grouped establishments into industries according to primary economic activity. NAICS used a 6-digit coding system to identify particular industries and how those industries were placed within the NAICS coding structure. MIFACE classified an establishment to an industry when the establishment's primary activity met the definition for that industry.

The 2000 Standard Occupational Classification³ (SOC) system was used to categorize occupations of the individuals who died. The 2000 SOC was divided into 23 major groups, which are sometimes called "job families." The "job families" grouped individuals according to the nature of the work performed, placing all people who worked together into the same group regardless of their skill level. The 23 "job families" were further subdivided using a 6-digit structure for its 821 detailed occupations within those groups.

Results and Discussion

There were 522 traumatic work-related fatalities during the four years spanning 9/1/04 to 8/31/08. Ten of the 522 individuals were injured prior to 9/1/04 and succumbed to their injuries after September 1, 2004.

There were on the average 2.5 traumatic work-related fatalities per week although the deaths were not evenly distributed throughout the year. Individuals who died from a traumatic work-related fatality were most likely to be men (92%), white (82%), married (57%) and had at least a high school education (47%). The average age of death was 46 but ranged from 6 to 91. The largest number of deaths occurred in Construction (116, 22%). Despite the high number of work-related deaths in Agriculture, farms with fewer than 11 employees are exempted from many workplace regulations.

Demographics

The demographic characteristics of all workers who died from a traumatic work-related injury between 9/1/04 and 8/31/08 are shown in Table 1.

Gender

Four hundred eighty (92.0%) of the individuals who died were men and 42 (8.0%) were women.

Race

Four hundred twenty eight (82.0%) individuals who died were identified as Caucasian on their death certificate, 58 (11.1%) were identified as African-American, 10 (1.9%) were identified as Asian/Pacific Islander, 2 (0.4%) were identified as American Indian/Alaskan Native. Twenty three (4.4%) individuals were identified as Hispanic and one (0.2%) individual was identified as Cuban for race on their death certificates. Three hundred ninety four (82.1%) men were identified as Caucasian, 52 (10.8%) men were identified as African-American, 9 (1.9%) men were identified as Asian/Pacific Islander, 2 (0.4%) men were identified as American Indian/Alaskan Native, and 1 (0.2%) man was identified as Cuban. Twenty two (4.6%) men were identified as Hispanic. Thirty four (80.9%) women were identified as Caucasian, 6 (14.3%) women were identified as African-American, 1 (2.4%) woman was identified as Asian/Pacific Islander and 1 (2.4%) woman was identified as Hispanic for race on her death certificate.

Ethnicity

Thirty six (7.5%) individuals were identified as Hispanic for their ethnicity. Eight men were identified as Caucasian for race and identified as Hispanic for ethnicity. One man identified as Cuban for race was identified as Cuban for ethnicity and was included in the total number of Hispanic individuals. Four women identified as Caucasian for race were identified as Hispanic for ethnicity.

Age

The age distribution of the individuals who died from a work-related injury is shown in Table 1. The ages ranged from 6 to 91, with 6 deaths in youths under the age of 18 and 38 deaths in individuals 70+ years old. The average age at time of death was 46.1 years.

Individuals 40-49 years of age had the greatest number of deaths (143, 27.4%), followed by individuals in the age group of 50-59 years of age (125, 23.9%). These middle-aged workers comprised over 50% of the traumatic work-related deaths.

Marital Status

Two hundred ninety seven (57.2%) individuals who died from traumatic incidents were married, 125 (24.1%) were never married, 85 (16.4%) were divorced, and 12 (2.3%) were widowed. Marital status was unknown for 3 individuals.

Educational Level

Table 1 shows the distribution of educational level. Overall, 76 (14.7%) individuals had not completed high school, 243 (47.0%) completed high school and received a high school diploma, 85 (33.3%) completed 1-4 years of college, and 27 (5.2%) had over five years (5+) of college. The educational level for 5 individuals was unknown.

Work-Related Death Details

Day of Injury

Table 2 shows the day of the week the fatal work-related injury occurred. Overall, the largest number of work-related fatal injuries occurred on a Monday (87, 16.9%). Friday had 86 (16.7%) fatal work-related fatal injuries, Wednesday had 84 (16.3%), Tuesday had 82 (16.0%), and Thursday had 75 (14.6%). Saturday had 56 (10.9%) fatal injuries and Sunday had 44 (8.6%) fatal injuries. The day of the fatal injury resulting in a work-related death was unknown for 8 individuals.

In the Construction industry, the day of the week that the fatal work-related injury occurred was fairly evenly distributed through the traditional workweek: Wednesday had 23 (20.2%) fatal injuries, Monday and Friday had 22 (19.3%) each, and Tuesday and Thursday had 15 (13.2%) each. In Manufacturing, Monday was the day when most fatal injuries occurred (15, 22.4%), followed by Friday (14, 20.9%), then Wednesday (12, 17.9%) and then Tuesday and Thursday (10 each, 14.9%). Manufacturing did not have a work-related fatal injury occur on Sunday. In Agriculture, Saturday had the highest number of fatal injuries (13, 20.6%), followed by Monday (12, 15.9%), Sunday (10, 15.9%), Tuesday (9, 14.3%), Wednesday (7, 11.1%) and then Monday and Friday (6 each, 9.5%). Friday was the weekday when most work-related fatal injuries in the Transportation and Warehousing industry occurred (13, 23.6%), followed by Tuesday (21.8%), Monday (9, 16.4%), Wednesday and Thursday (7 each, 12.7), and Sunday (4, 7.3%).

Tuesday and Wednesday were the days of the week when the most work-related homicides occurred (11, 16.4%), followed by Saturday, Sunday and Monday (10, 14.9%), Friday (8, 11.9%) and Thursday (7, 10.4%).

Month of Injury

Table 3 shows the month of injury for select industry sectors and Table 4 shows the month of injury by means of death. September had the highest number of injuries

resulting in fatalities with 53 (9.6%), followed by August (50, 9.6%), and October and June (48 each, 9.2%). November had 46 (8.8%), July and February had 45 each (8.7%), May had 44 (8.5%), and January had 40 (7.7%). March, April and December had the fewest (36 (6.0%), 32 (6.2%), and 33 (6.3%) respectively).

September and October had the largest number of fatal injuries (15 each, 12.9%) in Construction. Thirteen (11.2%) fatal injuries occurred in August, 11 (9.5%) in May and 10 (8.6%) in December. September and October injuries accounted for 26.1% of all fatal injuries in the Construction industry. The number of fatal injuries was largest in January and November (9 each, 13.0%) in Manufacturing, followed by February and March with 8 (11.6%) each. In Agriculture, June was the month with the greatest number of fatal injuries (12, 18.8%), followed by October (11, 17.2%) and September and May (8 each, 12.5%). May and June planting and September and October harvesting accounted for 60.1% of all work-related fatal injuries in Agriculture. February was the month with the largest number of fatal injuries (10, 18.2%) in Transportation and Warehousing. August had 6 (10.9%) fatal injuries, and the months of March, July, November and December each had 5 deaths (9.1%).

The largest number of work-related homicides occurred in September (13, 19.4%), followed by January, October, and November (7 each, 10.4%).

Table 4 shows the means of death by the month the injury occurred. Motor vehicle incidents were fairly evenly distributed throughout the year; the largest number of the incidents occurred in June (13, 11.4%), followed by July and November (12 each, 10.5%) and then March and September (10 each, 8.8%). The number of falls was fairly evenly distributed throughout the year; 9 (10.3%) falls each occurred in October and May. Five months (January, February, March, July and September each had 8 (9.2%) falls. Struck by fatal work-related injuries most frequently occurred in the months of April and August (10 each, 13.3%), followed by April and June (8 each, 10.7%). Machine-related incidents were most likely to occur in September (10, 14.9%), followed by October (8, 11.9%) and then May, June and August (7 each, 10.4%).

Time of Injury

The time of the injury could be placed within a 4-hour time period in 478 of the 522 (91.6%) work-related deaths. The 24-hour day was divided into 4-hour time periods: 12:00 a.m. - 3:59 a.m., 4:00 a.m. - 7:59 a.m., 8:00 a.m. - 11:59 a.m., 12:00 p.m. - 3:59 p.m., 4:00 p.m. - 7:59 p.m., and 8:00 p.m. - 11:59 p.m.

Table 5 shows the 4-hour time periods for industries with the highest number of work-related deaths. Overall, 136 (28.5%) fatal injuries occurred between 12:00 p.m. - 3:59 p.m., 134 (28.0%) occurred between 8:00 a.m. - 11:59 a.m., 80 (15.3%) occurred between 4:00 p.m. - 7:59 p.m., 53 (11.1%) occurred between 4:00 a.m. - 7:59 a.m., 42 (8.8%) fatal incidents occurred between 8:00 p.m. - 11:59 p.m., and 33 (6.9%) occurred between 12:00 a.m. - 3:59 a.m.

Within Construction, nearly 50% of all work-related fatal injuries occurred during the time period of 12:00 p.m. and 3:39 p.m.; 50 (45.0%) individuals had a fatal injury during this 4-hour period. Thirty six (32.4%) were fatally injured during the time period of 8:00 a.m. and 11:59 a.m. In Manufacturing, the time period having the largest number of fatal injuries was 8:00 a.m. to 11:59 a.m.; 18 (27.7%) individuals were fatally injured. Interestingly, 4:00 p.m. to 7:59 p.m. was the time period with the next largest number of fatal injuries (14, 21.5%). The early morning hours of 4:00 a.m. to 7:59 a.m. had 13 (20.0%) fatal injuries. Like construction, 12:00 p.m. to 3:59 p.m. had the largest number of work-related fatal injuries (23, 38.3%). The hours of 4:00 p.m. to 7:59 p.m. was next, with 17 (28.3%), followed by 8:00 a.m. to 11:59 a.m. with 13 (21.7%) fatal injuries. One quarter (13, 25.5%) of all work-related fatal injuries in Transportation and Warehousing occurred during 8:00 a.m. to 11:59 a.m. Ten (19.6%) injuries occurred during 12:00 a.m. to 3:59, and 7 each (13.7%) occurred during 4:00 p.m. to 7:59 p.m. and 8:00 p.m. and 11:59 p.m.

Most homicides with a known time of injury occurred during the morning hours of a standard work shift, 8:00 a.m. – 11:59 a.m. (16, 29.1%), followed by 12:00 a.m. to 3:59 a.m. (12, 21.8%).

Geographic Distribution

Table 6 and Figure 1 show the county in which the decedent worked where he/she was fatally injured. The county of incident was known for 520 (99.6%) of the 522 incidents. Sixty eight (81.9%) of the 83 Michigan counties had a traumatic fatal work-related injury occur. The southeast Michigan counties of Wayne, Oakland, Macomb, and Washtenaw accounted for 38.1% of the fatal work-related injuries. Wayne County accounted for 108 (20.8%) work-related fatal injuries, Oakland County had 37 (7.1%) fatal injuries, Washtenaw had 28 (5.4%) and Macomb had 26 (5.0%) fatal injuries. Kent County had 42 (8.1%) work-related fatal injuries.

Industry Information

Number of Deaths by Industry Sector

Table 7 shows the number of work-related fatalities and the industry's percent of the total number of deaths.

The number of deaths occurring in Construction (116) accounted for 22.2% of all the work-related fatal injuries in Michigan. Manufacturing had 70 (13.4%) deaths, followed by Agriculture (64, 12.3%), Transportation and Warehousing (55, 10.5%), and Retail Trade (43, 8.2%). Within Construction, Specialty Trade Contractors accounted for 76 of the 116 deaths (65.5%). Truck transportation accounted for the largest number of deaths in Transportation and Warehousing (25, 45.4%). In Retail Trade, 12 deaths occurred in Food and Beverage Stores and 11 deaths occurred in Motor Vehicle and Parts Dealers.

Means of Death by Industry Sector

Table 8 shows the means of death by industry sector. The largest number of deaths were caused by motor vehicles (114, 21.8%). Motor vehicles were the primary cause of death in Wholesale Trade (10 of 16, 62.5%), Health Care and Social Assistance (8 of 15, 53.3%), Public Administration (42.3%), and Transportation and Warehousing (22 of 55, 40.0%). Fall from a height fall from a height was the leading cause of death in the Construction industry (46, 39.7%). Homicides were the leading cause of death in Accommodation and Food Services (12 of 14, 85.7%) and Retail Trade (23 of 43, 53.4%). Struck by incidents were the second leading cause of death in Agriculture (15 of 64, 23.5%), Transportation and Warehousing (12 of 55, 21.8%), and Construction (21 of 116, 18.1%). Machine-related incidents were the leading cause of death in Agriculture (22 of 64, 34.4%) and Manufacturing (23 of 70, 32.9%).

Occupations

Table 9 shows the distribution of Standard Occupational Classification categories. The occupational category with the highest number of work-related deaths was Transportation and Material Moving Occupations accounting for 102 (19.7%) of the 517 work-related deaths where the occupation was known. Within this major grouping, 67 (65.7%) were Motor Vehicle Operators. Within the Motor Vehicle Operators group, 47 individuals were Truck Drivers, Heavy and Tractor-Trailer.

Construction and Extraction Occupations were the next highest occupational category grouping and accounted for 95 (18.4%) of the work related deaths. Seventy three (76.8%) were construction trade workers. Within this group, 15 were construction laborers and 14 were roofers.

Management Occupations had the next largest number of work-related deaths (89, 18.2%). Within this grouping, farmers and ranchers accounted for 39 (43.8%) of the 89 deaths.

Hispanic Initiative

The US Department of Labor, Bureau of Labor Statistics (BLS) has analyzed the Census of Fatal Occupational Injury (CFOI) data and reported a higher fatal work injury rate for Hispanic workers than for other racial/ethnic groups. As a result, Federal OSHA currently collects additional information during all investigations that includes the primary language and country of origin of the decedent. OSHA has also formed the Hispanic Worker Task Force that includes hazard awareness and workplace rights.

In partnership with Federal OSHA, NIOSH added fatalities among Hispanic workers to the list of current targets for the Federal in-house FACE program. Information gathered will be made available to the OSHA Hispanic Worker Task Force. The MIFACE program supports the concept and rationale of this initiative. As a result, we have utilized an Immigrant Workers/Limited English Speakers Workers investigation guide, which was developed in conjunction with the other FACE states, during on-site investigations.

There were 36 deaths of Hispanic workers in Michigan in the 4-year time period. The ages at time of death were between 15 and 83 years of age. Twelve Hispanic individuals worked in Construction. Agriculture and Manufacturing each had 5 Hispanic deaths. Wholesale Trade, Retail Trade, and Administrative and Support and Waste Management and Remediation Services had 3 Hispanic deaths. Two Hispanics died in the Health Care and Social Assistance and Other Services industry sectors, and one Hispanic worked in Transportation and Warehousing.

Comparison to the Census of Fatal Occupational Injuries Data

Each year, MIFACE collaborates with Michigan's CFOI personnel to confirm the number of work-related deaths in Michigan. At times, our final number of deaths per year differs due to interpretation of work-relatedness.

References

1. North American Industry Classification System (NAICS), 2002. Executive Office of the President, United States Office of Management and Budget. Lanham, MD: Bernan Press. Internet Address: www.census.gov/naics
2. U.S. Department of Labor, Bureau of Labor Statistics, Census of Fatal Occupational Injuries. Internet Address: <http://www.bls.gov/>
3. Standard Occupational Classification Manual: 2000. U.S. Office of Management and Budget. Lanham, MD: Bernan Press; and Springfield, VA: National Technical Information Service. Internet Address: www.bls.gov/soc/

Conclusion

MIFACE was a research effort and relied on the voluntary cooperation of employers and for the self-employed, their family members. Traumatic occupational fatalities are an important public health issue in Michigan as they are throughout the United States.

We were unable to explain the relatively large variations in deaths over time noted in certain industries. For example, in Construction, there were 32 deaths in 2004, 23 deaths in 2005, 42 deaths in 2006 and 18 deaths in 2007. In Agriculture, there were 33 deaths in 2003 when in the years before and after 2003 the number of deaths ranged from 13-21. An explanation for these variations might provide insights into preventing future deaths.

Understanding the root cause of these tragic events and then sharing that information with stakeholders - from individuals to groups - is what made these efforts worthwhile. If what we learned from any of these deaths helped prevent another death, then the surveillance program has been successful in its goal. An awareness of the hazards of one's job, the provision of safe equipment, and an attitude of safety-mindedness on the part of labor and management are critical to prevent future fatal events. All of these

factors would be useful in reducing the even larger burden of nonfatal traumatic work-related injuries.

Publications

Chester DA. Michigan FACE: Work-Related Fatality Prevention Through Research and Investigation. Michigan Municipal Review, March/April 2004. (Aim 3)

Chester DA. Five Municipal/County Workers Died On-The-Job in 2003. Michigan Municipal Review, July/August 2004. (Aim 3)

Chester DA, Hanna EA, Pickelman BG, Rosenman KD. Asthma Death After Spraying Polyurethane Truck Bedliner. American Journal of Industrial Medicine 2005; 48:78-84.(Aims 1, 2, 3)

Stanbury M, Chester D, Hanna EA, Rosenman KD. How Many Deaths Will It Take? A Death From Asthma Associated With Work-Related Environmental Tobacco Smoke. American Journal of Industrial Medicine 2008; 51:111-116. (Aims 1, 2, 3)

Cierpich H, Styles L, Harrison R, Davis L, Chester D, Lefkowitz D, Valiante D, Richardson S, Castillo D, Romano N, Baron S. Work-Related Injury Deaths Among Hispanics ---United States, 1992-2006. Morbidity and Mortality Weekly Review 2008; 57(22); 597-600. (Aim 4)

Michigan's Focus on Fatal Falls: Factors, Fixes, and Followup. (submitted) (Aim 3)

Inclusion of Gender and Minority Study subjects

Study Title: Michigan Fatality Assessment and Control Evaluation
Total Enrollment: 522 **Protocol Number:** _____
Grant Number: 5 U60 OH 008329 - 02

PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race				
Ethnic Category	Sex/Gender			Total
	Females	Males	Unknown or Not Reported	
Hispanic or Latino	5	31		36 **
Not Hispanic or Latino	37	447		484
Unknown (individuals not reporting ethnicity)		2		2
Ethnic Category: Total of All Subjects*	42	480		522 *
Racial Categories				
American Indian/Alaska Native		2		2
Asian		9		9
Native Hawaiian or Other Pacific Islander	1			1
Black or African American	6	52		58
White	34	394		428
More Than One Race				0
Unknown or Not Reported	1	23		24
Racial Categories: Total of All Subjects*	42	480		522 *
PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)				
Racial Categories	Females	Males	Unknown or Not Reported	Total
American Indian or Alaska Native				
Asian				
Native Hawaiian or Other Pacific Islander				
Black or African American				
White	4	8		
More Than One Race				
Unknown or Not Reported	1	23		
Racial Categories: Total of Hispanics or Latinos**	5	31		36 **

I. Inclusion of Children

MIFACE conducted a site visit and spoke to the parents of one child who was fatally injured in an agricultural-related incident.

J. Materials Available for Other Investigators

On our web site, www.oem.msu.edu/, are copies of the completed MIFACE Investigation Reports, Hazard Alerts, and MIFACE summaries of investigations conducted by the MIOSHA program. Hazard Alerts are 1-page documents that review work-related fatalities and provide prevention recommendations that target specific industrial sectors or repeated work-related fatality incidents (e.g. trench wall cave-ins). MIFACE summaries of investigations conducted by the MIOSHA program include a summary of the work-related fatality incident and the citations issued to the employer by MIOSHA at the conclusion of the fatality investigation.

The NIOSH FACE website <http://www.cdc.gov/niosh/face/> has posted the MIFACE reports.

Additionally, MIFACE materials can be found on the Michigan Farm Bureau Agricultural Labor and Safety Services website <http://www.michfb.com/safety/alss>.

**Table 1. Demographic Characteristics of Traumatic
Work-Related Fatalities, Michigan 9/1/04-8/31/08**

Demographic Characteristics, Michigan 9/1/04-8/31/08		Number	Percent
Sex			
	Male	480	92.0
	Female	42	8.0
Race			
	White	428	82.0
	Black	58	11.1
	Asian/Pacific Islander	10	1.9
	American Indian/Alaskan Native	2	0.4
	Hispanic (Race as noted on DC)	23	4.4
	Cuban (as identified on DC)	1	0.2
Age			
	<20	15	2.9
	20-29	67	12.8
	30-39	85	16.3
	40-49	143	27.4
	50-59	125	23.9
	60-69	49	9.4
	70-79	25	4.8
	80-89	12	2.3
	90+	1	0.2
Marital Status			
	Never Married	125	24.1
	Married	297	57.2
	Divorced	85	16.4
	Widowed	12	2.3
	Unknown	3	--
Educational Level			
	Less than High School	76	14.7
	High School Graduate	243	47.0
	Some College (1-4 years)	171	33.1
	Post College (5+ years)	27	5.2
	Unknown	5	---
Total		522	

Table 2. Traumatic Work-Related Fatalities by Day of the Week, Michigan, 9/1/04-8/31/08

Day of Injury	All Deaths		Construction (NAICS 23)		Manufacturing (NAICS 31-33)		Agriculture, Forestry, Fishing and Hunting (NAICS 11)		Transportation and Warehousing (NAICS 48-49)		Homicides	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Sunday	44	8.6	7	6.1	0	--	10	15.9	4	7.3	10	14.9
Monday	87	16.9	22	19.3	15	22.4	6	9.5	9	16.4	10	14.9
Tuesday	82	16.0	15	13.2	10	14.9	9	14.3	12	21.8	11	16.4
Wednesday	84	16.3	23	20.2	12	17.9	7	11.1	7	12.7	11	16.4
Thursday	75	14.6	15	13.2	10	14.9	12	19.0	7	12.7	7	10.4
Friday	86	16.7	22	19.3	14	20.9	6	9.5	13	23.6	8	11.9
Saturday	56	10.9	10	8.8	6	9.0	13	20.6	3	5.5	10	14.9
Total	514*		114⁺		67⁺⁺		63⁺⁺⁺		55		67	

* Day of Week unknown for 8 individuals.

⁺ Day of Week unknown for 2 individuals.

⁺⁺ Day of Week unknown for 3 individuals.

⁺⁺⁺ Day of Week unknown for 1 individual.

Table 3. Traumatic Work-Related Fatalities by Month of Injury, Michigan, 9/1/04-8/31/08

Month of Injury	All Deaths		Construction (NAICS 23)		Manufacturing (NAICS 31-33)		Agriculture, Forestry, Fishing and Hunting Deaths (NAICS 11)		Transportation and Warehousing (NAICS 48-49)		Homicides	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
January	40	7.7	7	6.0	9	13.0	3	4.7	1	1.8	7	10.4
February	45	8.7	6	5.2	8	11.6	1	1.2	10	18.2	5	7.5
March	36	6.9	8	6.9	8	11.6	3	4.7	5	9.1	3	4.5
April	32	6.2	9	7.8	1	1.4	4	6.3	4	7.3	4	5.9
May	44	8.5	11	9.5	5	7.2	8	12.5	4	7.3	3	4.5
June	48	9.2	6	5.2	2	2.9	12	18.8	4	7.3	2	3.0
July	45	8.7	8	6.9	4	5.8	6	9.4	5	9.1	6	9.0
August	50	9.6	13	11.2	8	11.6	3	4.7	6	10.9	5	7.5
September	53	10.2	15	12.9	5	7.2	8	12.5	4	7.3	13	19.4
October	48	9.2	15	12.9	5	7.2	11	17.2	2	3.6	7	10.4
November	46	8.8	8	6.9	9	13.0	2	3.1	5	9.1	7	10.4
December	33	6.3	10	8.6	5	7.2	3	4.7	5	9.1	5	7.5
Total	520*		116		69⁺		64		55		67	

* Month of Injury unknown for 2 individuals.

⁺ Month of Injury unknown for 1 individual.

Table 4. Traumatic Work-Related Fatalities by Means of Death and Month of Injury, Michigan, 9/1/04-8/31/08

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
	Number												
Aircraft	1	4		2		1	1	4			1		14
Animal						1				3		2	6
Asphyxiation		1					1				1		3
Drowning						1	2	1		1			5
Drug Overdose*	3	1			1	1		1					7
Electrocution	1	1			3	3	3	2	6	6			25
Fall*	8	8	8	5	9	6	8	7	8	9	5	5	86
Fire/Explosion	4	2			1		1	1	1		2	1	13
Heat/Cold										1			1
Homicide	7	5	3	4	3	2	6	5	13	7	7	5	67
Machine	2	4	3	5	7	7	5	7	10	8	4	5	67
Motor Vehicles	7	10	11	7	10	13	12	8	11	6	12	7	114
Other						1		1			1	1	4
Struck By	4	6	10	8	7	8	5	10	3	4	5	5	75
Suicide		1	1	1	2	3	1	2	1		6	1	19
Toxic Exposure	3	2			1	1		1		3	2	1	14
Total	40	45	36	32	44	48	45	50	53	48	46	33	520*

* Month of Injury unknown for two individuals

Table 5. Traumatic Work-Related Fatalities by 4-Hour Time Periods, Michigan, 9/1/04-8/31/08

Time of Day	All Deaths		Construction (NAICS 23)		Manufacturing (NAICS 31-33)		Agriculture, Forestry, Fishing and Hunting (NAICS 11)		Transportation and Warehousing (NAICS 48-49)		Homicides	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
12am-3:59am	33	6.9	0	--	6	9.2	0	--	10	19.6	12	21.8
4am-7:59am	53	11.1	6	5.4	13	20.0	1	1.7	9	17.6	4	7.3
8am-11:59am	134	28.0	36	32.4	18	27.7	13	21.7	13	25.5	16	29.1
12pm-3:59pm	136	28.5	50	45.0	9	13.8	23	38.3	5	9.8	6	10.9
4pm-7:59pm	80	15.3	15	13.5	14	21.5	17	28.3	7	13.7	8	14.5
8pm-11:59pm	42	8.8	4	3.6	5	7.7	6	10.0	7	13.7	9	16.4
Total	478*		111⁺		65⁺		50⁺⁺		51⁺⁺		55⁺⁺⁺	

* Time period unknown for 44 individuals.

⁺ Time period unknown for 5 individuals.

⁺⁺ Time period unknown for 4 individuals.

⁺⁺⁺ Time period unknown for 12 individuals.

**Table 6. Traumatic Work-Related Fatalities by County of Injury,
Michigan, 9/1/04-8/31/08**

County	Number	Percent	County	Number	Percent	County	Number	Percent
Alcona			Gratiot	3	0.6	Missaukee		
Alger			Hillsdale	4	0.8	Monroe	5	1.0
Allegan	8	1.5	Houghton	1	0.2	Montcalm	4	0.8
Alpena			Huron	4	0.8	Montmorency		
Antrim	3	0.6	Ingham	13	2.5	Muskegon	3	0.6
Arenac	1	0.2	Ionia	3	0.6	Newaygo	1	0.2
Baraga			Iosco	3	0.6	Oakland	37	7.1
Barry	6	1.1	Iron	1	0.2	Oceana	3	0.6
Bay	4	0.8	Isabella	4	0.8	Ogemaw		
Benzie			Jackson	13	2.5	Ontonagon	1	0.2
Berrien	14	2.7	Kalamazoo	7	1.0	Osceola	1	0.2
Branch	2	0.4	Kalkaska	1	0.2	Oscoda		
Calhoun	15	2.9	Kent	42	8.1	Otsego	6	1.1
Cass	5	1.0	Keweenaw			Ottawa	9	1.7
Charlevoix			Lake			Presque Isle	1	0.2
Cheboygan	1	0.2	Lapeer	2	0.4	Roscommon	1	0.2
Chippewa	7	1.0	Leelanau			Saginaw	10	1.9
Clare	1	0.2	Lenawee	3	0.6	St. Clair	9	1.7
Clinton	3	0.6	Livingston	9	1.7	St. Joseph	8	1.5
Crawford	1	0.2	Luce	1	0.2	Sanilac	5	1.0
Delta	2	0.4	Mackinac	2	0.4	Schoolcraft		
Dickinson	2	0.4	Macomb	26	5.0	Shiawassee	4	0.8
Eaton	7	1.0	Manistee	1	0.2	Tuscola	2	0.4
Emmet	3	0.6	Marquette	6	1.1	Van Buren	4	0.8
Genesee	16	3.1	Mason	4	0.8	Washtenaw	28	5.4
Gladwin	3	0.6	Mecosta	1	0.2	Wayne	108	20.8
Gogebic			Menominee	3	0.6	Wexford	2	0.4
Grand Traverse	5	1.0	Midland	2	0.4	Unknown	2	

**Table 7. Traumatic Work-Related Fatalities by Industry Sector,
Michigan 9/1/04-8/31/08**

Industry Sector (NAICS Code)	Number	Percent
Agriculture, Forestry, Fishing and Hunting (11)	64	12.3
Crop Production (111)	34	6.5
Animal Production (112)	21	4.0
Forestry and Logging (113)	6	1.1
Support Activities for Crop Production (115)	3	0.6
Mining (21)	5	1.0
Mining (except Oil and Gas) (212)	4	0.8
Support Activities for Mining (213)	1	0.2
Utilities (22)	2	0.4
Electric Power Generation, Transmission and Distribution (221)	2	0.4
Construction (23)⁺	116	22.2
Construction of Buildings (236)	14	2.7
Heavy and Civil Engineering Construction (237)	24	4.6
Specialty Trade Contractors (238)	76	15.6
Manufacturing (31-33)⁺⁺	70	13.4
Food Manufacturing (311)	7	1.3
Beverage and Tobacco Product Manufacturing (312)	1	0.2
Wood Product Manufacturing (321)	1	0.2
Paper Manufacturing (322)	3	0.6
Printing and Related Support Activities (323)	1	0.2
Chemical Manufacturing (325)	1	0.2
Plastics and Rubber Products Manufacturing (326)	6	1.1
Nonmetallic Mineral Product Manufacturing (327)	5	1.0
Primary Metal Manufacturing (331)	9	1.7
Fabricated Metal Product Manufacturing (332)	5	1.0
Machinery Manufacturing (333)	7	1.3
Transportation Equipment Manufacturing (336)	22	4.2
Miscellaneous Manufacturing (339)	1	0.2
Wholesale Trade (42)	16	3.1
Merchant Wholesalers, Durable Goods (423)	3	0.6
Merchant Wholesalers, Nondurable Goods (424)	12	2.3
Wholesale Electric Markets and Agents and Brokers (425)	1	
Retail Trade (44-45)	43	8.2
Motor Vehicle and Parts Dealers (441)	11	2.1
Furniture and Home Furnishing Stores (442)	1	0.2
Building Material and Garden Equipment and Supplies Dealers (444)	3	0.6
Food and Beverage Stores (445)	12	2.3
Health and Personal Care Stores (446)	2	0.4
Gasoline Stations (447)	4	0.8

Industry Sector (NAICS Code)	Number	Percent
Clothing and Clothing Accessories Stores (448)	2	0.4
General Merchandise Stores (452)	2	0.4
Non-Store Retailers (454)	6	1.1
Transportation and Warehousing (48-49)	55	10.5
Air Transportation (481)	5	1.0
Rail Transportation (482)	2	0.4
Truck Transportation (484)	25	4.8
Transit and Ground Passenger Transportation (485)	5	1.0
Support Activities for Transportation (488)	15	2.9
Warehousing and Storage (493)	3	0.6
Information (51)	4	0.8
Publishing Industries (except Internet) (511)	1	0.2
Motion Picture and Sound Recording Industries (512)	2	0.4
Telecommunications (517)	1	0.2
Finance and Insurance (52)	1	0.2
Securities, Commodity Contracts, and Other Financial Investments and Related Activities (523)	1	0.2
Real Estate and Rental and Leasing (53)	6	1.1
Real Estate (531)	5	1.0
Rental and Leasing Services (532)	1	0.2
Professional, Scientific, and Technical Services (54)	6	1.1
Professional, Scientific, and Technical Services (541)	6	1.1
Administrative and Support and Waste Management and Remediation Services (56)	36	6.9
Administrative and Support Services (561)	30	5.7
Waste Management and Remediation Services (562)	6	1.0
Educational Services (61)	8	1.5
Educational Services (611)	8	1.5
Health Care and Social Assistance (62)	15	2.9
Ambulatory Health Care Services (621)	3	0.6
Hospitals (622)	7	1.3
Nursing and Residential Care Facilities (623)	2	0.4
Social Assistance (624)	3	0.6
Arts, Entertainment, and Recreation (71)	9	1.7
Performing Arts, Spectator Sports and Related Industries (711)	5	1.0
Museums, Historical Sites, and Similar Institutions (712)	1	0.2
Amusement, Gambling and Recreation Industries(713)	3	0.6
Accommodation and Food Services (72)	14	2.7
Accommodation (721)	1	0.2
Food Services and Drinking Places (722)	13	2.5
Other Services (except Public Administration) (81)	26	5.0
Repair and Maintenance (811)	13	2.5
Personal and Laundry Services (812)	7	1.3

Industry Sector (NAICS Code)	Number	Percent
Religious, Grantmaking, Civic, Professional, and Similar Organizations (813)	6	1.1
Public Administration (92)	26	5.0
Executive, Legislative and Other General Government Support (921)	1	0.2
Justice, Public Order, and Safety Activities (922)	21	4.0
Administration of Human Resource Programs (923)	1	0.2
Regulation and Administration of Transportation Programs (926)	2	0.4
National Security and International Affairs (928)	1	0.2
Totals	522	

⁺ Industry classification unknown for two individuals.

⁺⁺ Industry classification unknown for one individual.

Table 8. Traumatic Work-Related Fatalities by Means of Death and Industry Sector, Michigan 9/1/2004-8/31/2008

Industry Sector (NAICS Code)	Aircraft (2.7%)	Animal (1.1%)	Asphyxiation (0.6 %)	Drowning (1.0%)	Drug Overdose (1.5%)	Electrocution (4.8%)	Fall (16.7%)	Fire/Explosion (2.5%)	Heat/Cold (0.2%)	Homicide (12.8%)	Machine (12.8%)	Motor Vehicle (21.8%)	Other (0.8%)	Struck By (14.4%)	Suicide (3.6%)	Toxic Exposure (2.7%)	Total
Agriculture, Forestry, Fishing and Hunting (11)		6		2		2	7				22	8		15	2		64
Mining (21)				1			1				3						5
Utilities (22)												1		1			2
Construction (23)				1	1	12	46	3		2	6	14		21	2	4	116
Manufacturing (31-33)	6		1	1	5	1	10	3		4	23	3		8	3	2	70
Wholesale Trade (42)							1				1	10		3		1	16
Retail Trade (44-45)							6			23	1	11	1		1		43
Transportation and Warehousing (48-49)	4		1		1		1	1		6	6	22		12	1		55
Information (51)							1			3							4
Finance/Insurance (52)												1					1
Real Estate and Rental and Leasing (53)							1	1		2		2					6
Professional, Scientific, and Technical Services (54)					1		1			2		1			1		6

Industry Sector (NAICS Code)	Aircraft (2.7%)	Animal (1.1%)	Asphyxiation (0.6 %)	Drowning (1.0%)	Drug Overdose (1.5%)	Electrocution (4.8%)	Fall (16.7%)	Fire/Explosion (2.5%)	Heat/Cold (0.2%)	Homicide (12.8%)	Machine (12.8%)	Motor Vehicle (21.8%)	Other (0.8%)	Struck By (14.4%)	Suicide (3.6%)	Toxic Exposure (2.7%)	Total
Administrative and Support and Waste Management and Remediation Services (56)						5	4			1	2	9		9		6	36
Educational Services (61)	2						1			1		3		1			8
Health Care and Social Assistance (62)			1				2			1		8			2	1	15
Arts, Entertainment, and Recreation (71)							2	1		1	1	3		1			9
Accommodation and Food Services (72)							1			12					1		14
Other Services (except Public Administration) (81)						1	1	3		6	1	7		3	4		26
Public Administration (92)	2						1	1	1	3	1	11	3	1	2		26
Total	14	6	3	5	8	25	87	13	1	67	67	114	4	75	19	14	522

**Table 9. Traumatic Work-Related Fatalities by
Standard Occupational Code (SOC), Michigan 9/1/04-8/31/08**

SOC Number	SOC Classification	Number	Percent
11	Management Occupations	89	18.2
11-1000	Top Executives		
11-1011	Chief Executives	2	0.4
11-1021	General and Operations Managers	18	3.5
11-2000	Advertising, Marketing, Promotions, Public Relations and Sales Managers		
11-2022	Sales Managers	3	0.6
11-3000	Operations Specialties Managers		
11-3031	Financial Managers	1	0.2
11-3071	Transportation, Storage and Distribution Managers	1	0.2
11-9000	Other Management Occupations		
11-9012	Farmers and Ranchers	39	7.5
11-9021	Construction Manager	6	0.6
11-9032	Education Administrators, Elementary and Secondary Schools	1	0.2
11-9051	Food Service Managers	3	0.6
11-9081	Lodging Managers	1	0.2
11-9199	Managers, All Other	14	2.7
13	Business and Financial Operations Occupations	4	0.8
13-1000	Business and Operations Specialists		
13-1199	Business Operations Specialists, All Other	1	0.2
13-2000	Financial Specialists		
13-2011	Accountants and Auditors	2	0.4
13-2051	Financial Analysts	1	0.2
15	Computer and Mathematical Occupations	1	0.2
15-2000	Mathematical Science Occupations		
15-2041	Statisticians	1	0.2
17	Architecture and Engineering Occupations	6	1.2
17-2000	Engineers		
17-2141	Chemical Engineers	1	0.2
17-2199	Engineers, All Other	3	0.6
17-3000	Drafters, Engineering and Mapping Technicians		
17-3022	Civil Engineering Technicians	1	0.2
17-3031	Surveying and Mapping Technicians	1	0.2
21	Community and Social Services Occupations	6	1.2
21-1000	Counselors, Social Workers, and Other Community and Social Service Specialists		
21-1093	Social and Human Service Assistants	1	0.2
21-1099	Community and Social Service Specialists, All Other	3	0.6

SOC Number	SOC Classification	Number	Percent
21-2000	Religious Workers		
21-2011	Clergy	2	0.4
23	Legal Occupations	2	0.4
23-1000	Lawyers, Judges, and Related Workers		
23-1011	Lawyers	2	0.4
25	Education, Training, and Library Occupations	4	0.8
25-1000	Postsecondary Teachers		
25-1194	Vocational Education Teachers, Postsecondary	1	0.2
25-1199	Postsecondary Teachers, All Others	1	0.2
25-3000	Other Teachers and Instructors		
25-3021	Self-Enrichment Education Teachers	1	0.2
25-4000	Librarians, Curators, and Archivists		
25-4013	Museum Technicians and Conservators	1	0.2
27	Arts, Design, Entertainment, Sports, and Media Occupations	5	1.0
27-2000	Entertainers and Performers, Sports and Related Workers		
27-2021	Athletes and Sports Competitors	3	0.6
27-2099	Entertainers and Performers, Sports and Related Workers, All Other	1	0.2
27-4000	Media and Communication Equipment Workers		
27-4014	Sound Engineering Technicians	1	0.2
29	Healthcare Practitioners and Technical Occupations	6	1.2
29-1000	Health Diagnosing and Treating Practitioners		
29-1063	Internists, General	1	0.2
29-1111	Registered Nurses	3	0.6
29-1126	Respiratory Therapists	1	0.2
29-2000	Health Technologists and Technicians		
29-2041	Emergency Medical Technicians and Paramedics	1	0.2
31	Healthcare Support Occupations	3	0.6
31-1000	Nursing, Psychiatric, and Home Health Aides		
31-1012	Nursing Aides, Orderlies, and Attendants	1	0.2
31-1013	Psychiatric Aides	1	0.2
31-9000	Other Healthcare Support Occupations		
31-9099	Healthcare Support Workers, All Other	1	0.2
33	Protective Services Occupations	28	5.4
33-1000	First-Line Supervisors/Managers, Protective Service Workers		
33-1012	First-Line Supervisors/Managers of Police and Detectives	1	0.2
33-2000	Fire Fighting and Prevention Workers		
33-2011	Fire Fighters	7	1.4
33-3000	Law Enforcement Workers		
33-3051	Police and Sheriff's Patrol Officers	10	1.9
33-9000	Other Protective Service Workers		
33-9032	Security Guards	9	1.5
33-9099	Protective Service Workers, All Other	1	0.2

SOC Number	SOC Classification	Number	Percent
35	Food Preparation and Serving Related Occupations	6	1.2
35-1000	Supervisors, Food Preparation and Serving Workers		
35-1012	First Line Supervisors/Managers of Food Preparation and Serving Workers	3	0.6
35-2000	Cooks and Food Preparation Workers		
35-2011	Cooks, Fast Food	1	0.2
35-2012	Cooks, Institution and Cafeteria	1	0.2
35-9000	Other Food Preparation and Serving Related Workers		
35-9099	Food Preparation and Serving Related Workers, All Other	1	0.2
37	Building and Grounds Cleaning and Maintenance Occupations	24	4.6
37-1000	Supervisors, Building and Grounds Cleaning and Maintenance Workers		
37-1011	First-Line Supervisors/Managers of Housekeeping and Janitorial Workers	1	0.2
37-1012	First-Line Supervisor/Managers of Landscaping, Lawn Service, and Groundskeeping Workers	1	0.2
37-2000	Building Cleaning and Pest Control Workers		
37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	5	1.0
37-2012	Maids and Housekeeping Cleaners	2	0.4
37-2019	Building Cleaning Workers, All Others	1	0.2
37-3000	Grounds Maintenance Workers		
37-3011	Landscaping and Groundskeeping Workers	4	0.8
37-3013	Tree Trimmers and Pruners	7	1.4
37-3019	Grounds Maintenance Workers, All Others	3	0.6
39	Personal Care and Service Occupations	7	1.4
39-1000	Supervisors, Personal Care and Service Workers		
39-1021	First-Line Supervisors/Managers of Personal Service Workers	1	0.2
39-2000	Animal Care and Service Workers		
39-2011	Animal Trainers	2	0.4
39-6000	Transportation, Tourism, and Lodging Attendants		
39-6011	Baggage Porters and Bellhops	2	0.4
39-9000	Other Personal Care and Service Workers		
39-9011	Child Care Workers	1	0.2
39-9099	Personal Care and Service Workers, All Other	1	0.2
41	Sales and Related Occupations	31	6.0
41-1000	Supervisors, Sales Workers		
41-1011	First Line Supervisors/Managers of Retail Sales Workers	5	1.0
41-1012	First Line Supervisors/Managers of Non-Retail Sales Workers	2	0.4
41-2000	Retail Sales Workers		
41-2011	Cashiers	2	0.4
41-2031	Retail Salespersons	4	0.8

SOC Number	SOC Classification	Number	Percent
41-3000	Sales Representatives, Services		
41-3011	Advertising Sales Agents	1	0.2
41-3041	Travel Agents	1	0.2
41-3099	Sales Representatives, Services, All Other	1	0.2
41-4000	Sales Representatives, Wholesale and Manufacturing		
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	1	0.2
41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	2	0.4
41-9000	Other Sales and Related Workers		
41-9021	Real Estate Brokers	1	0.2
41-9022	Real Estate Agents	1	0.2
41-9091	Door-To-Door Sales Workers, News and Street Vendors, and Related Workers	6	1.2
41-9099	Sales and Related Workers, All Other	4	0.8
43	Office and Administrative Support Occupations	9	1.7
43-1000	Supervisors, Office and Administrative Support Workers		
43-1011	First-Line Supervisors/Managers of Office and Administrative Support Workers	3	0.6
43-4000	Information and Record Clerks		
43-4111	Brokerage Clerks	1	0.2
43-4171	Receptionists and Information Clerks	1	0.2
43-5000	Material Recording, Scheduling, Dispatching, and Distributing Workers		
43-5021	Couriers and Messengers	2	0.4
43-5081	Stock Clerks and Order Fillers	1	0.2
43-9000	Other Office and Administrative Support Workers		
43-9199	Office and Administrative Support Workers, All Other	1	0.2
45	Farming, Fishing, and Forestry Occupations	23	4.4
45-2000	Agricultural Workers		
45-2021	Animal Breeders	1	0.2
45-2041	Graders and Sorters, Agricultural Products	1	0.2
45-2091	Agricultural Equipment Operators	3	0.6
45-2092	Farm Workers and Laborers, Crop, Nursery, and Greenhouse	5	1.0
45-2093	Farm Workers, Farm and Ranch Animals	5	1.0
45-4000	Forest, Conservation, and Logging Workers		
45-4021	Fallers	5	1.0
45-4022	Logging Equipment Operators	1	0.2
45-4029	Logging Workers, All Others	2	0.4
47	Construction and Extraction Occupations	95	18.4
47-1000	Supervisors, Construction and Extraction Workers		
47-1011	First-Line Supervisors/Managers of Construction Trades and Extraction Workers	6	1.2

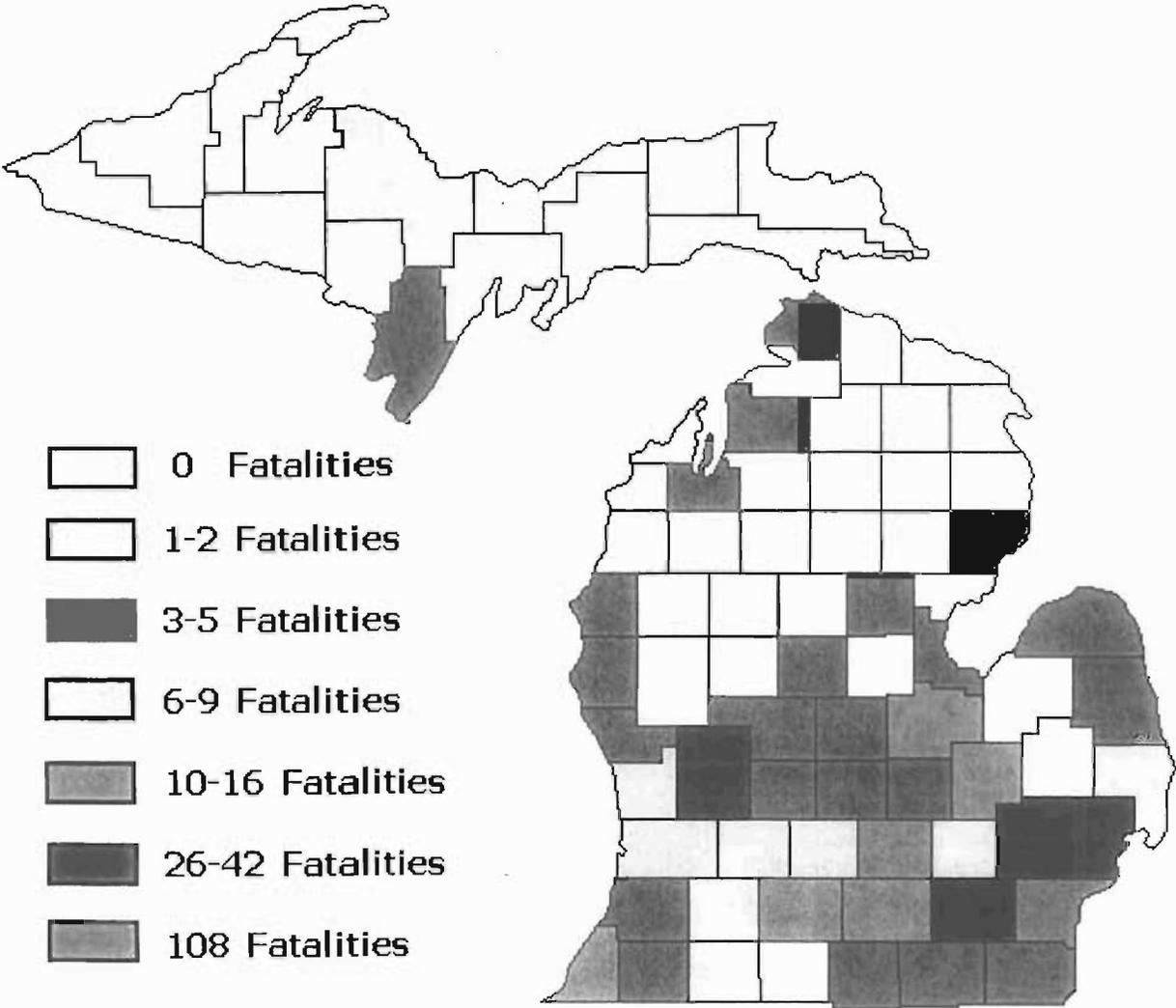
SOC Number	SOC Classification	Number	Percent
47-2000	Construction Trade Workers		
47-2021	Brickmasons, Blockmasons, and Stonemasons	6	1.2
47-2031	Carpenters	9	1.7
47-2061	Construction Laborers	15	2.9
47-2071	Paving, Surfacing, and Tamping Equipment Operators	1	0.2
47-2073	Operating Engineers and Other Construction Equipment Operators	3	0.6
47-2081	Drywall and Ceiling Tile Installers	2	0.4
47-2111	Electricians	7	1.4
47-2141	Painters, Construction and Maintenance	5	1.0
47-2152	Plumbers, Pipefitters, and Steamfitters	5	1.0
47-2181	Roofers	14	2.7
47-2211	Sheet Metal Workers	1	0.2
47-2221	Structural Iron and Steel Workers	5	1.0
47-3000	Helpers, Construction Trades		
47-3014	Helpers -- Painters, Paperhangers, Plasterers, and Stucco Masons	1	0.2
47-3016	Helpers -- Roofers	3	0.6
47-3019	Helpers – Construction Trades, All Other	2	0.4
47-4000	Other Construction and Related Workers		
47-4021	Elevator Installers and Repairers	1	0.2
47-4041	Hazardous Materials Removal Workers	1	0.2
47-4051	Highway Maintenance Workers	1	0.2
47-4071	Septic Tank Servicers and Sewer Pipe Cleaners	1	0.2
47-4099	Construction and Related Workers, All Other	1	0.2
47-5000	Extraction Workers		
47-5049	Mining Machine Operators, All Other	2	0.4
47-5081	Helpers – Extraction Workers	2	0.4
47-5099	Extraction Workers. All Other	1	0.2
49	Installation, Maintenance, and Repair Occupations	33	
49-1000	Supervisors of Installation, Maintenance, and Repair Workers		
49-1011	First Line Supervisors/Managers of Mechanics, Installers, and Repairers	4	0.8
49-2000	Electrical and Electronic Equipment Mechanics, Installers, and Repairers		
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	1	0.2
49-3000	Vehicle and Mobile Equipment Mechanics, Installers, and Repairers		
49-3021	Automotive Body and Related Repairers	1	0.2
49-3023	Automotive Service Technicians and Mechanics	5	1.0
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	2	0.4
49-3041	Farm Equipment Mechanics	1	0.2

SOC Number	SOC Classification	Number	Percent
49-9000	Other Installation, Maintenance, and Repair Occupations		
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	2	0.4
49-9041	Industrial Machinery Mechanics	2	0.4
49-9042	Maintenance and Repair Workers, General	2	0.4
49-9043	Maintenance Workers, Machinery	1	0.2
49-9044	Millwrights	1	0.2
49-9051	Electrical Power Line Installers and Repairers	4	0.8
49-9052	Telecommunications Line Installers and Repairers	2	0.4
49-9099	Installation, Maintenance, and Repair Workers, All Other	5	1.0
51	Production Operations	33	6.4
51-1000	Supervisors, Production Workers		
51-1011	First-Line Supervisors/Managers of Production and Operating Workers	4	0.8
51-2000	Assemblers and Fabricators		
51-2099	Assemblers and Fabricators, All Other	1	0.2
51-3000	Food Processing Workers		
51-3093	Food Cooking Machine Operators and Tenders	1	0.2
51-4000	Metal Workers and Plastic Workers		
51-4030	Machine Tool Cutting Setters, Operators, and Tenders, Metal and Plastic	1	0.2
51-4032	Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	2	0.4
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	3	0.6
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	1	0.2
51-4041	Machinists	1	0.2
51-4072	Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	1	0.2
51-4111	Tool and Die Makers	2	0.4
51-4121	Welders, Cutters, Solderers, and Brazers	3	0.6
51-4199	Metal Workers and Plastic Workers, All Other	3	0.6
51-5000	Printing Workers		
51-5011	Bindery Workers	2	0.4
51-7000	Woodworkers		
51-7041	Sawing Machine Setters, Operators, and Tenders, Wood	1	0.2
51-9000	Other Production Occupations		
51-9023	Mixing and Blending Machine Setters, Operators, and Tenders	1	0.2
51-9051	Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders	1	0.2
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	2	0.4
51-9198	Helpers – Production Workers	2	0.4
51-9199	Production Workers, All Other	1	0.2

SOC Number	SOC Classification	Number	Percent
53	Transportation and Material Moving Occupations	102	19.7
53-1000	Supervisors, Transportation and Material Moving Workers		
53-1021	First-Line Supervisors/Managers of Helpers, Laborers, and Material Hand	1	0.2
53-2000	Air Transportation Workers		
53-2011	Airline Pilots, Copilots, and Flight Engineers	3	0.6
53-2012	Commercial Pilots	2	0.4
53-3000	Motor Vehicle Operators		
53-3022	Bus Drivers, School	2	0.4
53-3031	Drivers/Sales Workers	1	0.2
53-3032	Truck Drivers, Heavy and Tractor-Trailer	47	9.1
53-3033	Truck Drivers, Light or Delivery Services	8	1.5
53-3041	Taxi Drivers and Chauffeurs	5	1.0
53-3099	Motor Vehicle Operators, All Other	4	0.8
53-4000	Rail Transportation Workers		
53-4011	Locomotive Engineers	1	0.2
53-4021	Railroad Brake, Signal, and Switch Operators	1	0.2
53-4031	Railroad Conductors and Yardmasters	1	0.2
53-5000	Water Transportation Workers		
53-5011	Sailors and Marine Oilers	1	0.2
53-6000	Other Transportation Workers		
53-6031	Service Station Attendants	2	0.4
53-7000	Material Moving Workers		
53-7032	Excavating and Loading Machine and Dragline Operators	2	0.4
53-7051	Industrial Truck and Tractor Operators	14	2.7
53-7061	Cleaners of Vehicles and Equipment	1	0.2
53-7062	Laborers and Freight, Stock and Material Movers, Hand	4	0.8
53-7081	Refuse and Recyclable Material Collectors	1	0.2
53-7121	Tank Car, Truck, and Ship Loaders	1	0.2
Total		517*	

* Standard Occupational Code unknown for 5 individuals.

Figure 1. Traumatic Work-Related Fatalities by County of Injury, Michigan, 9/1/04-8/31/08



County of Incident Unknown for 2 counties