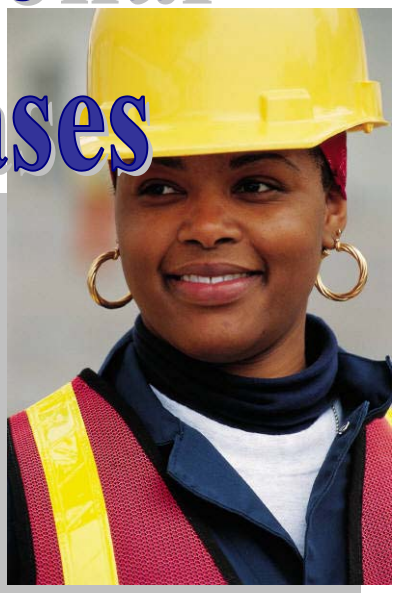
Profiles of Occupational Injuries and Diseases in Michigan



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Division of Environmental and Occupational Epidemiology
Michigan Department of Community Health

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Summary and Recommendations

More than 4.8 million individuals work in the state of Michigan, and some risk of illness or injury attends virtually every job held. Work-related injuries and illnesses cost 1.5 billion dollars annually in workers' compensation claims in Michigan, and the indirect costs of these conditions may be as much as five times greater (7.5 billion dollars). Yet, work-related injuries and illnesses are preventable. Equipment design, ventilation systems, use of personal protective equipment, work practices and many other factors contribute to the control or elimination of workplace hazards.

Since the passage of the federal Occupational Safety and Health Act thirty-five years ago and its adoption in Michigan, workplaces have become safer. The overall decline in occupational injury and illness rates in Michigan and nationally can be attributed to many factors, including strong enforcement of health and safety standards, increased awareness, and support from the private sector.

Identification, quantification and tracking of adverse health outcomes are essential for understanding and preventing occupational injuries and illnesses. Data on the magnitude and trends in occupational injury and illness in Michigan are available from a number of sources. To make these data more accessible, they have been compiled into this single report. The report uses the available data to profile all occupational injuries and diseases and some specific occupational conditions of public health importance in Michigan. Examination of the data has led to the identification of some recommended actions, which could result in significant improvements in occupational health and safety. The key findings of this report and related recommendations are noted below.

Occupational injuries

Findings

- There were 175 fatal occupational injuries in Michigan in 2001; on average, one worker died nearly every two days of an acute, work-related injury. Michigan's fatal injury rate has remained below the federal rate for the 10 years these data have been collected.

- Michigan's non-fatal injury rate declined 32% between 1992 and 2001, from a high of 9.4 per 100 full time workers to 6.4 in 2001. Michigan's rate for private sector employees exceeded the national rate throughout this timeframe, particularly in the manufacturing sector (12.5 per 100 in Michigan; 10.4 in the U.S. in 2001.)

Recommendations

- The Michigan Occupational Safety and Health Administration (MIOSHA) has maintained strong enforcement and education and training programs to ensure effective recordkeeping and reporting of occupational injuries and illnesses by employers, and this may account for the differences between federal and state rates. Additional investigation would help determine how much of the difference is due to better reporting by Michigan employers.

Toxic exposures

Findings

- Over 33,000 adults were tested for blood lead levels between 1998 and 2001; 1,907 of these individuals were exposed to lead at work and had a blood lead level equal or greater than 10 micrograms per deciliter of blood (an indication of exposure to lead greater than background levels). The number of individuals with higher blood lead levels has decreased steadily since 1998.

- Seventy percent of interviewed individuals with elevated blood lead levels experienced symptoms at blood lead levels allowed by the current workplace safety regulations.

- One-third of the interviewed individuals reporting having young children living in their home, who were potentially at risk of exposure to lead taken home on the clothing of the worker. Despite the risk, only 24% of these children had been tested for lead exposure. Of those tested, almost half had an elevated blood lead level.

- Surveillance of occupational lead exposure is effective because laboratories must report all blood lead test results (in children and adults), and because regulations under the Michigan Occupational Safety and Health Act (MIOSHA) require ongoing blood lead monitoring of lead-exposed workers.

Recommendations

- The MIOSHA health standards for lead in general industry and construction should be reassessed in light of evidence that adverse health effects are being experienced even among workers with blood lead levels considered acceptable by these standards.

- Additional efforts are needed to ensure that the children of lead-exposed workers are being tested for lead exposure and are being protected from "take-home" lead.

- Given the effectiveness of the laboratory-based surveillance system for lead, and given concerns in Michigan for exposure to other heavy metals at work and in the environment, consideration should be given to mandating laboratory reporting of mercury, arsenic, and cadmium blood and urine test results.

Occupational diseases

Findings

- Michigan's occupational asthma surveillance system identified over 1,780 individuals with work-related asthma from 1988 through 2001, for an average annual incidence of 3.4 cases per 100,000 workers. The leading causes of occupational asthma were exposures to isocyanates and metalworking fluids.

- Michigan's silicosis surveillance system confirmed silicosis in 857 individuals during the 14-year period from 1988 through 2001. Seventy-seven percent worked in foundries where they were exposed to the silica dust that causes this disabling lung disease. Occupational exposure to mineral dusts other than silica caused pneumoconiosis in 14,148 individuals reported by health care providers and employers between 1992 and 2001. Ninety-one percent of these individuals were reported to have asbestosis, the type of pneumoconiosis caused by asbestos exposure. Because pneumoconioses are diseases of long latency, most individuals currently diagnosed with these conditions were exposed to the causative mineral dusts many years ago.

- Seventy-seven individuals with work-related pesticide poisoning were reported to the occupational pesticide poisoning surveillance system that began in 2001.

- The Michigan work-related noise-induced hearing loss surveillance system, established in 1992, identified 20,731 cases through 2001. These individuals worked in many types of industries but predominantly manufacturing, construction and agriculture. Reduction of noise-induced hearing loss is a goal of MIOSHA's current strategic plan.

- On average, there were about 20 cases annually of work-related infectious diseases in each of the five data systems where these data were available. The amount of overlap between data systems is unknown. More than one-quarter of the cases were for work-related tuberculosis. The number of reported cases is very small given the number of workers potentially exposed in Michigan.

- From 1992-2001, the incidence of disorders due to repeated trauma in the workplace in Michigan was more than double the incidence rate in the United States, although rates for cases associated with days away from work were similar to national rates. The incidence of musculoskeletal disorders declined over that time period, paralleling a decline in the U.S. Reduction of work-related musculoskeletal disorders is a goal of MIOSHA's current strategic plan.

- Mandatory reporting of work-related diseases to the state of Michigan included 706 individuals with work-related cancer between 1991 and 2001. Eighty-three percent had lung cancer.

- The Michigan cancer registry identified 1,377 new cases of malignant mesothelioma between 1985 and 2000. Mesothelioma, a rare type of cancer, is usually caused by exposure to asbestos at work.

- An average of 1,018 cases of work-related skin disease were reported annually to the state of Michigan between 1991 and 2001.

- Underreporting of occupational disease is a significant problem both in Michigan and nationally.

Recommendations

- Additional investigation is needed to understand why the incidence of disorders of repeated trauma is higher in Michigan than in the United States.

- Agencies and organizations should support the current initiative at the Michigan Department of Labor & Economic Growth (DLEG), formerly Consumer and Industry Services, to develop an ergonomics standard, as part of MIOSHA, in order to protect workers from musculoskeletal disorders.

- Ongoing education of health care providers and employers about requirements of the occupational disease reporting law and support for enforcement of its provisions will improve surveillance data.

- The surveillance data should be used to update exposure standards such as those for isocyanates, noise and metalworking fluids.

- There is a need for a multi-agency strategic plan to expand on MIOSHA's strategic plan for work-related noise-induced hearing loss, to address both occupational and environmental causes.

Overall surveillance

Findings

- Michigan occupational injury and illness data are used extensively by the MIOSHA program in DLEG to target enforcement and educational activities to prevent occupational injury and illness.

- BLS data are widely cited because they are collected nationally, but the data are an underestimate of the magnitude of occupational injury and illness. BLS does not collect data on the self-employed, federal workers, and farms with less than eleven employees.

- For a number of reasons, there is no single data source that is adequate to describe the true burden of occupational disease and injury in Michigan.

Recommendations

- The availability of employer information from workers' compensation data provides an opportunity to use data to improve health and safety at Michigan companies. This strategy involves data analysis to identify companies in various industry groups with the lowest rates of claims for work-related injuries and illnesses, assessment of the reasons for the low rates, and marketing of these successes to companies in the same industries with higher rates.

- Improvements in some of the source data systems will strengthen the ability to track and prevent occupational illnesses and injuries, including:

    - Expansion of the emergency department ("MEDCIIN") surveillance system to include all hospital emergency departments in Michigan and to include reporting of all conditions, not just injuries;
    - Expansion of mandatory laboratory reporting of blood lead results to include other heavy metals (arsenic, mercury and cadmium) in blood and urine;
    - Collection of occupational information in communicable disease data systems;
    - Capturing better information about causes of occupational injuries and illnesses in workers' compensation data.

- Periodic analysis and dissemination of Michigan occupational disease and injury data based on multiple data sources are important to describe the true burden of occupational disease and injury in Michigan and to target prevention activities. A comprehensive update of this report should occur at least every five years, with summary data updates annually.

1 Introduction, Organization and Data Systems

Introduction

Occupational injury and illness prevention rests on a comprehensive and integrated approach to the collection and analysis of occupational injury and illness data, and the use of the data to implement and evaluate intervention activity. Occupational disease and injury surveillance data systems have improved greatly over time, although there are still substantial gaps in surveillance information.

Public health surveillance systems, including mandates for the reporting of illness and injury, are generally the responsibility of the state, with support from federal agencies, especially the Centers for Disease Control and Prevention (CDC). In Michigan, occupational health surveillance activities were conducted by the (then-named) Michigan Department of Public Health until a 1996 reorganization of state government transferred these responsibilities to a newly created department, the Michigan Department of Consumer and Industry Services (MDCIS), along with the transfer of responsibilities for the Michigan Occupational Safety and Health Act. In December of 2003, MDCIS became the Michigan Department of Labor & Economic Growth (DLEG), and the MIOSHA program remained within DLEG. Since 1988, Michigan State University (MSU) has carried out many of the state's occupational health surveillance activities under contract, first with the Michigan Department of Public Health, then with MDCIS, and now DLEG.

The Michigan Department of Community Health (MDCH), which was created in 1996 with the state reorganization, became involved with occupational health surveillance in 2000 when it was awarded a four-year grant from the National Institute for Occupational Safety and Health (NIOSH) - CDC to develop the infrastructure to conduct occupational health surveillance. The mission of this project is to integrate occupational health surveillance and the prevention of occupational illness and injury into public health systems in Michigan.

One of the goals of this project has been to prepare a comprehensive report on occupational health surveillance in Michigan. This report fulfills that goal. Although the health statistics program within MIOSHA and its consultant, MSU, have published their data extensively, this is the first report that has compiled and summarized Michigan occupational disease and injury data in one document.

Two documents from the Council of State and Territorial Epidemiologists (CSTE) provide guidance for the development of this report. First, in 1995, CSTE and NIOSH jointly issued a document: "Guidelines for Minimum and Comprehensive State-Based Activities in Occupational Safety and Health".[1] The guidelines propose that, at a minimum, all states should "annually compile and distribute a report on the magnitude of occupational injuries and illnesses identified in existing data sources."

[1] NIOSH. *Guidelines for Minimum and Comprehensive State-Based Activities in Occupational Safety and Health.* DHHS (NIOSH) Publication No. 95-107. 1995.

Second, in 1998, CSTE convened a workgroup of state occupational health surveillance professionals to make recommendations to NIOSH concerning state-based surveillance activities for the coming decade. The workgroup recommended that states place 13 work-related health conditions under surveillance. These priority conditions were selected using criteria such as magnitude, severity, preventability and economic impact. [2] Profiles of 11 of the 13 priority conditions are included in this report.

It is of interest to place the occupational disease and injury surveillance information reported here within the context of the state of Michigan as a whole: the demographics of its workforce and the distribution and types of industries and occupations. The 2000 U.S. Census reports that of the state population of 9.7 million, there are approximately 4.6 million individuals age 16 and older, divided equally between men and women, in the Michigan workforce. The largest income-producing industries are manufacturing (autos, foods, chemicals and pharmaceuticals, lumber), tourism, and agriculture. Michigan's agriculture is very diverse, with over 53,000 farms. The service industry employs approximately 40% of the workforce. Thirty-two percent of the workforce is characterized as managers/professionals.

Links to occupational illness and injury information and resources in Michigan

- Information about reporting occupational diseases may be found at: www.chm.msu.edu/oem or by calling **1-800-446-7805**.
- Information about workers' compensation, including claims forms, is found at: www.michigan.gov/wca.
- To file a complaint about a worksite health or safety issue, call the MIOSHA complaint hotline at **1-800-866-4674.**
- To notify MIOSHA of a worksite fatality or catastrophe, call the MIOSHA Hotline at **1-800-858-0397.**
- To file a complaint about a pesticide exposure call the Michigan Department of Agriculture (MDA) at: **1-800-292-3939**
- MIOSHA health and safety information, standards, and programs are at www.michigan.gov/miosha.
- To search for information about MIOSHA inspections at Michigan companies go to: www.osha.gov/oshstats.
- To find a physician who can evaluate workplace injuries and illnesses, go to the Association of Occupational and Environmental Clinics at www.aoec.org.

Organization of the report

The 11 conditions addressed in this report include: fatal occupational injuries, non-fatal occupational injuries, elevated blood lead levels among adults, work-related asthma, silicosis and other pneumoconiosis, occupational pesticide-related illnesses and injuries, noise-induced hearing loss, occupationally-acquired infectious diseases, work-related musculoskeletal disorders, occupational cancer and occupational skin diseases. The two of the thirteen CSTE priority conditions are not included because of methodological limitations (cardiovascular disease) and unavailability of data (elevated blood and urine levels of arsenic, cadmium, and mercury).

An overview of each condition is presented, followed by surveillance methods, a presentation of the surveillance data, and a brief discussion of the significance of the findings for occupational disease and injury prevention. Where possible, data are presented at the county and local health jurisdiction level, so that local jurisdictions can use the data for assessing and targeting public health activities. Each chapter also provides information on links to additional resources.

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

Data sources

The data sources used for much of the information in this report are described as follows.

Collection of occupational health data in Michigan, as in other states and nationally, relies on two approaches. The first is the legal mandating of occupational disease and injury reporting and the second is the compilation of health data from data sources that exist for other purposes.

In Michigan, reporting of occupational diseases and adult lead toxicity is mandated under the state Public Health Code, similar to the long-standing mandate for reporting communicable diseases. Under the federal and Michigan Occupational Safety and Health Act, most employers are required to keep logs of work-related illnesses and injuries of their employees, and, if requested, report this information.

Existing health data sources in Michigan that are used in occupational health surveillance include data from death certificates, hospital discharge records, emergency room visits, the cancer registry, communicable disease reports, workers' compensation claims, and calls to poison control centers.

All of these data sources have limitations in terms of completeness, timeliness, and usefulness for occupational health surveillance. Some of the condition-specific occupational disease surveillance systems described in this report use multiple data sources in order to overcome some of the limitations of individual data sources.

Occupational disease (OD) reports: Reporting of occupational disease by physicians, hospitals, clinics, and employers is mandated in the Public Health Code (MCL 333.5601 - 333.5639). Until 1996, all reports were submitted to the then-named Michigan Department of Public Health. As part of a state reorganization in 1996, powers and duties related to this law were transferred to the newly created Michigan Department of Consumer and Industry Services (MDCIS)[3] along with occupational health programs administered under the Michigan Occupational Safety and Health Act. OD reports are required to include name, address, and demographic information about the affected individual, their diagnosis, contact information about the employer, and other related information. Authority for the state to investigate the cause of the disease is included in the law. The surveillance data system is managed for DLEG by the Occupational and Environmental Medicine Division, College of Human Medicine, Michigan State University (MSU). Approximately 20,000 reports are received annually. There is significant underreporting of occupational diseases in spite of the legal mandate to report.

Lead toxicity: Administrative rules enacted under the Public Health Code in 1997 require clinical laboratories to report results of all blood lead tests (R 325.9081-9086), along with the name of the individual tested, and demographic and related information, to MDCH. Approximately 90% of all elevated blood lead tests on adults are related to lead exposure at work. Results from adults are forwarded to the program at MSU that also manages the OD reporting system. Clinical laboratories report approximately 11,000 blood lead test results of adults annually.

[3] As of December 8, 2003, the Michigan Department of Labor and Economic Growth (DLEG).

Reporting of occupational injuries and diseases by employers: Under the federal Occupational Safety and Health Act (OSHA), the U.S. Department of Labor, Bureau of Labor Statistics (BLS), is required to collect and publish data on occupational injuries and illnesses – the "Survey of Occupational Illnesses and Injuries" or "SOII." The data are compiled from an annual survey of employers. Employers are legally required to keep a log of employee work-related illnesses and injuries, and are required to submit this information to the BLS when requested. The BLS collects this employer-generated data annually according to a complex sampling plan designed to generate statistically valid national and state estimates. Excluded from the sample are some employers with less than 11 employees, the self-employed, and federal employees. In Michigan, the Department of Labor & Economic Growth (DLEG), formerly MDCIS, collects SOII data and transmits it to BLS under the authority of the Michigan Occupational Safety and Health Act. Michigan is one of 25 states that have their own OSHA programs, whereby they agree to administer the provisions of federal OSHA at a minimum, and have the authority to include broader and more stringent requirements. Unlike the federal OSHA law, which applies only to private sector employers, MIOSHA covers the public sector as well.

Identifying information related to the employer or employee is not available in SOII. Available information includes numbers and incidence rates by employer industry groupings and by whether illness/injury resulted in restricted or lost work time. This information is also available for six illness categories: disorders associated with repeated trauma, occupational skin disorders, dust diseases of the lung, respiratory conditions due to toxic agents, poisoning, and disorders due to physical agents. Detailed case data on more specific types of injuries and illnesses are compiled only on individuals with lost work time due to the condition. Additional case data include age, occupation, number of days away from work, specific "nature of injury/illness," "event or exposure" associated with the condition (e.g., repetitive motion), affected "body part," and "source" (e.g., equipment, chemical).

SOII data have many limitations due to methods for data collection and coverage, which result in considerable underestimation of the true amount of occupational disease and injury in the U.S.[4] One study has estimated that SOII data miss over 50% of all work-related injuries.[5]

Death certificates: Data from all deaths in Michigan and for Michigan residents who die in other states are compiled by the MDCH into a Master Death File. Underlying and contributing causes of death are coded according to the International Classification of Diseases (ICD) nomenclature system, which identifies the disease or injury type. Work-relatedness of diseases or injuries cannot be identified by the ICD code. Work-relatedness of injuries is captured by an item on the death certificate that asks if the injury "occurred at work." The usual occupation and industry of the decedent is collected and coded; this information can be used to identify individuals with potentially work-related diseases (e.g., insulation worker as the occupation and lung cancer as the cause of death, suggesting asbestos exposure as a possible cause of the lung cancer.) In addition, there are a few unique ICD codes for diseases that are almost always associated with work (e.g., pneumoconiosis). Computerized death data also include demographic information about the decedent. There are about 86,000 deaths of Michigan residents per year.

[4] National Research Council. *Counting Injuries and Illnesses in the Workplace, Proposals for a Better System.* ES Pollack and DG Keimig, eds. National Academy Press, Washington DC 1987.
[5] Leigh JP, Markowitz S, Fahs M, Landrigan P. Costs of Occupational Injuries and Illnesses. University of Michigan Press. Ann Arbor. 2000. p. 2.

Michigan Inpatient Database (MIDB): All acute care hospitals in Michigan submit data on their inpatient discharges to the Michigan Health and Hospital Association (MHA), which compiles the data annually and makes it available to researchers and others. MDCH purchases the MIDB data set. No personal identifiers are available. The data system can capture up to 62 discharge diagnoses for each hospitalization; these are coded according to the ICD-9-CM system, but, again, work-relatedness cannot be identified by the ICD-9-CM code. Available demographic information includes age, race, sex, place of residence, and insurance coverage. Workers' compensation insurance as the payer can be used as a proxy for work-relatedness of the hospitalization. This is undoubtedly more sensitive for injuries, which would usually be known to have occurred at work, than illnesses, which are much harder to associate with a work condition due to the non-specificity of many occupational diseases and/or the latency between exposure and onset of overt disease. There are about 1.3 million patient discharges recorded yearly in MIDB. In 2001, 0.5% of the 1.2 million discharges of individuals age 16 and older had workers' compensation as the primary payer.

Michigan Emergency Department Community Injury Information Network (MEDCIIN): Unlike inpatient data, there is no statewide system for compiling all hospital emergency department (ED) encounter data. There is, however, a system of 23 hospitals selected to represent the state that voluntarily provide demographic and diagnostic data on emergency department injury visits to MDCH. The first year of data collection was 1999. Statistical methods to generate statewide injury estimates from this sample are under development. Injuries are coded according to the ICD-9 system. As with MIDB, work-relatedness can be identified by workers' compensation as the primary insurer. In 2000, 21 hospitals reported almost 148,000 patient encounters for injuries, which have been crudely estimated to represent 13.7% of all ED injury encounters in Michigan. Seven percent of the 148,000 reported patient encounters were covered by workers' compensation.

Cancer Registry: The Cancer Registry, which is maintained by MDCH, contains demographic, diagnostic, and treatment information on all incident cancer cases in Michigan. Reporting of this information is mandatory under the Public Health Code. Diagnosis is coded according to the ICD oncology system, which, although more detailed than the ICD system used for deaths and hospital discharges, has the same limitations in that the codes do not explicitly identify work as a cause. Usual occupation and industry on incident cases are collected and coded when that information is provided in the case report, but reporting of this information is incomplete. It is also available for deceased cancer cases by linking that information from the Master Death File to the Cancer Registry. There are approximately 48,000 incident cancer cases recorded in the Cancer Registry annually.

Communicable diseases: Reporting of communicable diseases is mandated by the Public Health Code (MCL 333.5111 and 333.5114) and administrative rules (R 325.60 and R 325.9001 et seq). There are approximately 70 reportable communicable diseases and conditions. Procedures for data collection vary, depending on the disease. Data collection procedures for some diseases (hepatitis, HIV/AIDS, tuberculosis) include collection of information about a patient's occupation because workers are known to be at risk due to exposure to the pathogen at work, but often this information is not provided. Reports are made by health care providers to local health departments, which in turn transmit data to the Division of Communicable Disease and Immunization, MDCH. Clinical laboratories are also required to report laboratory evidence of some infectious diseases. The data are managed in separate data systems for HIV/AIDS, TB, STDs, and all other communicable disease reports. There were over 19,000 communicable disease reports, excluding STDs, in 2001.

Workers' compensation: Employers who are required to provide workers' compensation insurance (all public employers and private employers with three or more full-time employees) are required to file reports of employees' work-related injuries and illnesses to the Workers' Compensation Agency at DLEG (formerly the Bureau of Workers' Disability and Compensation at MDCIS), which has oversight over the workers' compensation insurance system. The self-employed, federal employees, and railroad and maritime workers are not included. Workers' compensation insurance reimburses employees for medical costs. In addition, it provides wage compensation for those with a work-related injury or illness that results in death, specific losses (e.g., amputation), or more than seven consecutive days off work. Data are available on cases that have filed for wage compensation or certain types of injury (e.g. amputations). Data items include demographics, nature of illness or injury, part of body affected, and whether the employee died. Information on cause of injury and the object or substance causing the injury or illness is collected but not entered into the database. As with BLS SOII data, workers' compensation data are more complete for occupational injuries than illnesses, because of a more obvious association between an event or exposure at work and outcome. About 50,000 reports are submitted annually.

Poison Control Centers: Information related to all calls received by the two poison control centers in Michigan (Detroit and Grand Rapids) are compiled in a data management system used by most poison control centers in the United States called Toxicall®. The caller may be from the public or a health care provider. Information collected on the person who was exposed or has concerns about exposure includes: some demographics, reported signs, symptoms, clinical findings, severity of symptoms, medical outcome, substance exposed to, whether the exposure was intentional, unintentional or an adverse reaction, reason for exposure (including occupational), and if a visit was made to a health care facility. Combined, the two centers receive about 115,000 calls annually, of which approximately 1,800 are coded "occupational." Recently both poison control centers have begun to report all occupational exposure calls as "occupational disease" (OD) events under the Public Health Code.

2 Fatal Work-Related Injuries

Background

The Occupational Safety and Health Act of 1970 was passed to ensure "…so far as possible every working man and woman in the nation safe and healthful working conditions …" (P.L. 91-596, 1970). Yet thirty years later workers in the U.S. are dying of work-related injuries every day – about 16 deaths a day nationally and, on average, one every two days in Michigan. Behind these numbers are heartrending stories of individuals, their families and their co-workers. More often than not, these are stories of events that could have been prevented.

The Bureau of Labor Statistics (BLS), U.S. Department of Labor, established a comprehensive national census of workplace fatal injuries in the early 1990s (the "Census of Fatal Occupational Injuries," or CFOI). This data system indicated that between 1992 and 2001, an average of 6,182 workers were killed on the job annually. Nationally, transportation incidents were the leading cause of work-related fatal injuries (43% of all fatalities).

Investigations of work-related fatalities are required by OSHA (MIOSHA in Michigan) and other agencies, such as the federal Coast Guard and National Safety Transportation Board, when appropriate. Unfortunately, some working individuals (e.g., the self-employed, some contract workers) are not covered by regulatory agencies.

Research on fatal occupational injuries through worksite investigations has been conducted by the Michigan Fatality Assessment and Control Evaluation (MIFACE) program since 2001, with funding from NIOSH. MIFACE is a joint project of the Michigan Department of Labor & Economic Growth (DLEG ─ formerly the Michigan Department of Consumer and Industry Services [MDCIS]), Michigan State University (MSU) and Wayne State University. The purpose of MIFACE is to develop and disseminate strategies to prevent work-related fatalities. MIFACE has made particular efforts to investigate fatal occupational injuries that fall outside the jurisdiction of regulatory agencies such as MIOSHA.

Surveillance Methods

CFOI is a collaborative data system between the BLS and each state. In Michigan, data are ascertained by DLEG, MIOSHA Information Division. CFOI utilizes multiple sources (e.g., death certificates, police reports, newspaper accounts, workers' compensation claims) to identify work-related injury deaths. Multiple sources are used because studies have found that no single source captures all events. Source documents are matched so that each fatality is counted only once. To ensure that the death occurred while the decedent was working, information is verified from two or more independent source documents, or from a source document and a follow-up questionnaire.

For an incident to be counted as an occupational injury fatality, the decedent must have been employed (i.e., working for pay, compensation, or profit) at the time of the event, engaged in a legal work activity, or present at the site of the incident as a requirement of his/her job. Under this definition, both intentional (homicide and suicide) and unintentional fatal injuries are counted. It also includes the self-employed and others who are outside the scope of regulatory coverage.[1] Michigan CFOI counts represent the number of deaths occurring in the state from work-related injuries (regardless of the state of incident). Excluded are fatalities that occur during a person's commute to or from work.

The CFOI protocol includes collection of detailed information about the individual and the circumstances of the fatality, including the nature of the injury, body part affected, the event or exposure that caused the injury, equipment used, and occupation and industry of the decedent at the time of injury. The information is collected and coded according to a standardized protocol used by all participating states.

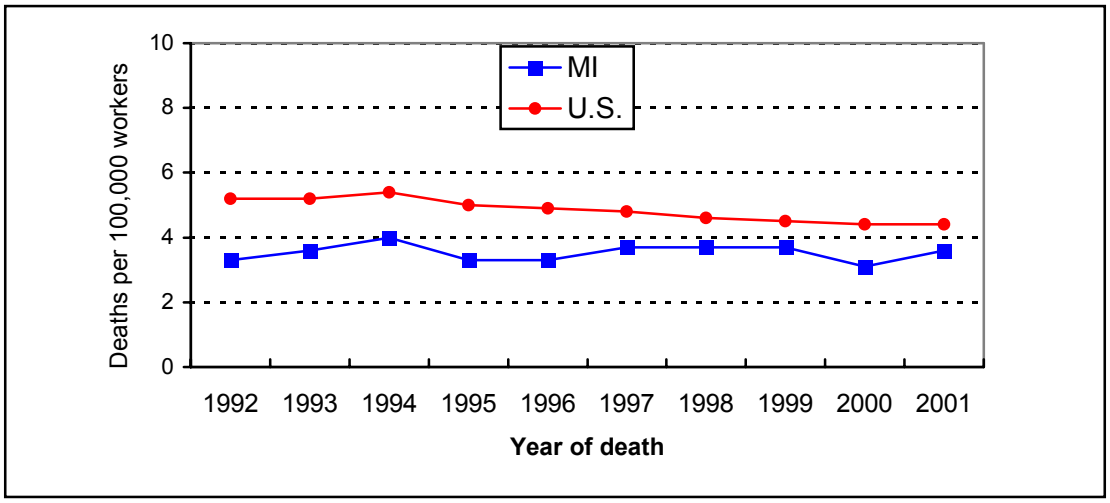
Fatality rates were calculated for this report by dividing the number of annual deaths by the appropriate employment levels and multiplying the result by 100,000 to yield a death rate per 100,000 workers. Employment levels were provided by the Current Population Survey (CPS).[2] The CPS, conducted by the Bureau of Labor Statistics, U.S. Department of Labor, provides monthly estimates of the number of workers aged 16 and older. This information allowed the calculation of death rates at the state and national levels. Rates were not calculated at the local level due to the unreliability of rates when based on very small numbers.

[1]MIOSHA Information Division, MI Department of Consumer and Industry Services (now MI Department of Labor & Economic Growth). *Census of Fatal Occupational Injuries, Michigan, 2001*. Lansing, MI. October, 2002.
[2] United States Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics. Data obtained using the following website: http://www.bls.gov/lau/.

Results

In 2001, 175 people died in Michigan following an injury at work[3]. This corresponds to a fatality rate of 3.6 per 100,000 workers. Figure 1 illustrates Michigan and national work-related injury death rates over the most recent ten-year period, 1992-2001. The rate remained stable in Michigan. Nationally, the rate has been consistently decreasing, albeit slightly, since 1994. Michigan's rates were lower than national rates throughout the period.

FIGURE 1
Rate of fatal occupational injuries,
Michigan and U.S. workers, by year, 1992-2001[4]

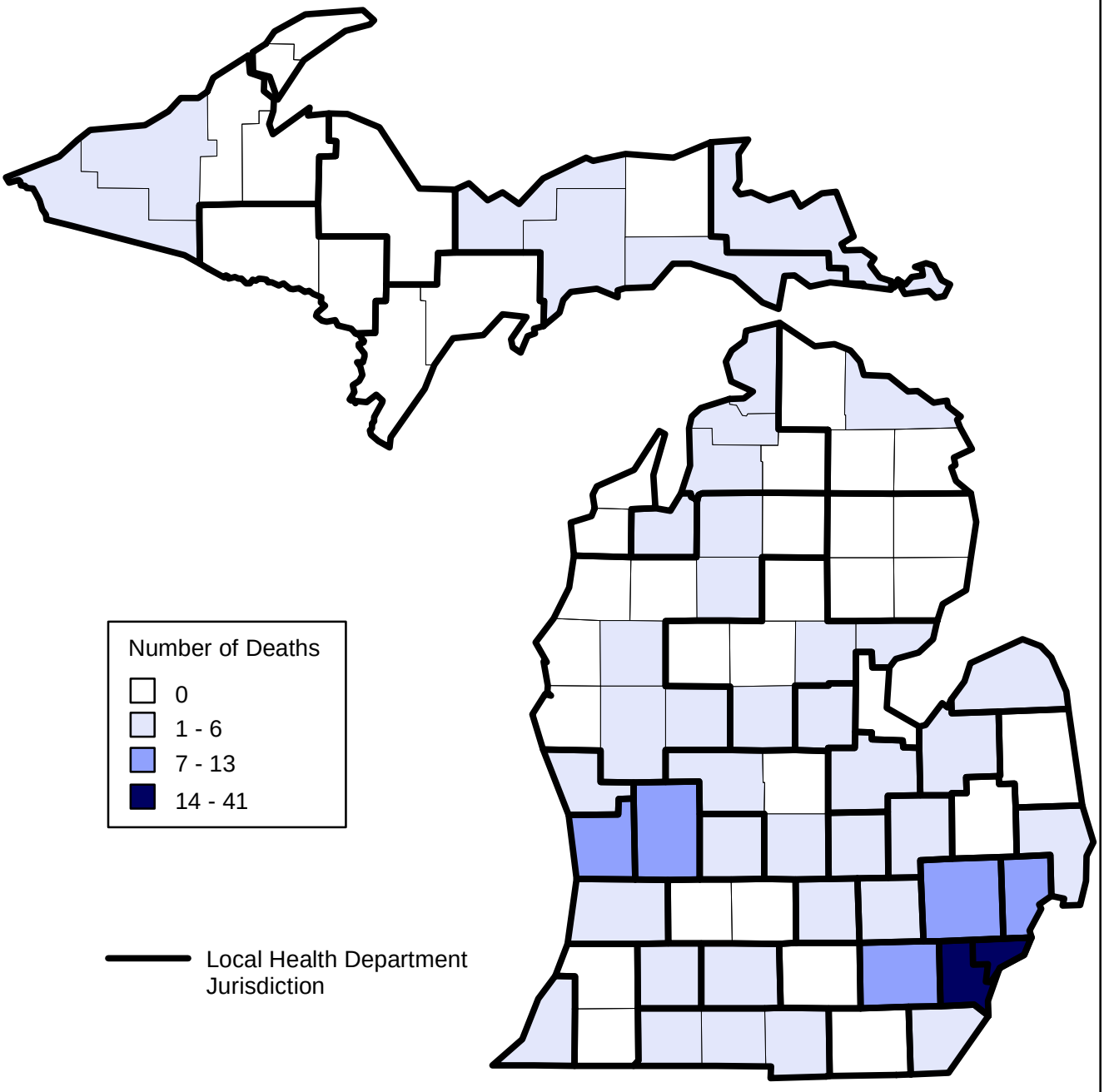


Source: CFOI

Figure 2 illustrates the number of work-related injury deaths by county of occurrence.[5] The local health department jurisdictions are also indicated. The greatest number of deaths (N=41) occurred in Wayne County. This represents 24% of the deaths for 2001. Note that Wayne County workers comprise about 11% of the state's workers. Other counties with a relatively large number of incidents were Washtenaw (13), and Oakland (11).

[3] This includes one Michigan resident who sustained the injury out-of-state but died in Michigan.
[4] Excluding the 2,886 people who were killed while at work during the September 11, 2001 terrorist attacks in New York City, Virginia, and Pennsylvania.
[5] These data were provided by the MIFACE program. CFOI data indicate county of death, which is not necessarily the county of occurrence.

FIGURE 2
Fatal occupational injuries by county of occurrence
Michigan, 2001



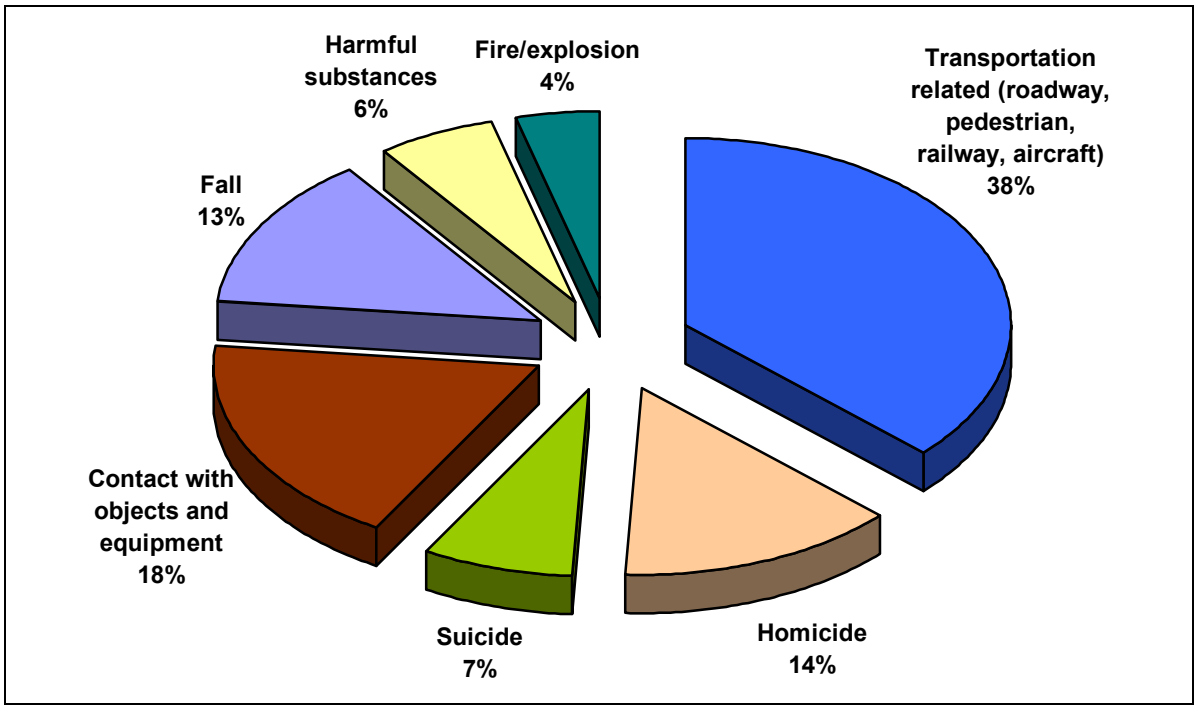
Total Michigan Deaths: 175

One incident occurred out of state. For two deaths, the county of occurrence was unknown. Detroit cases and Wayne out-county cases were combined.

Source: Michigan Fatality Assessment and Control Evaluation (MIFACE)

The events or exposures that caused the injury are illustrated in Figure 3. Transportation incidents comprised more than one-third of the deaths. This category includes highway (N=28), non-highway (17), pedestrian (9), railway (3) and aircraft (5) incidents.

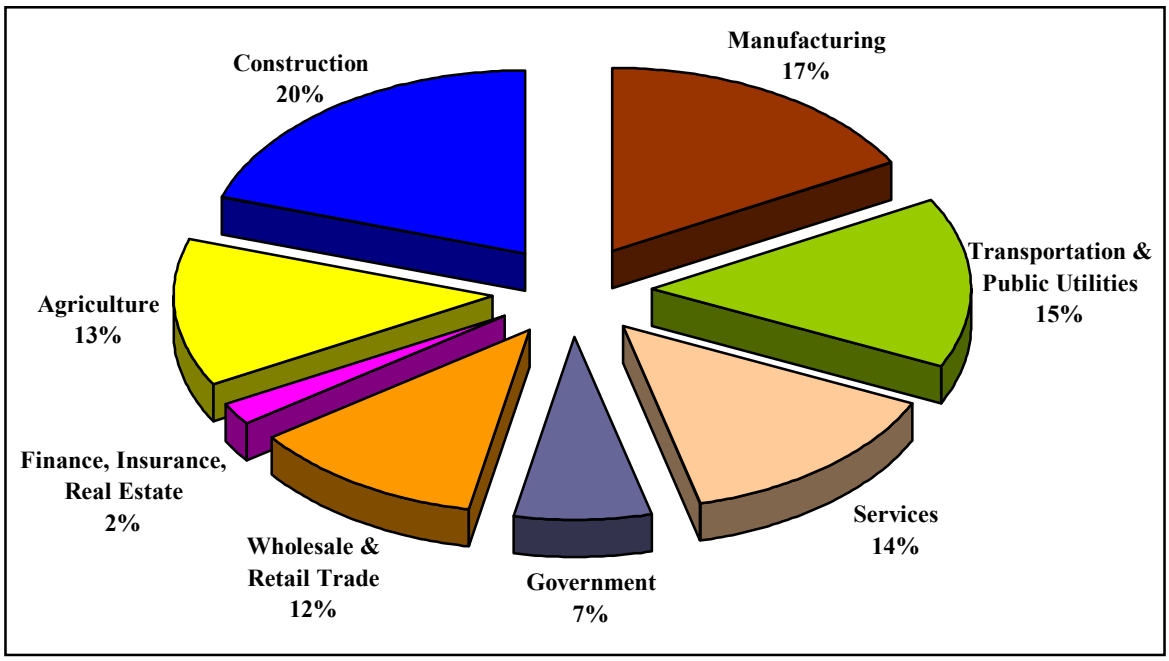
FIGURE 3
Fatal occupational injuries by event or exposure, Michigan, 2001 (N=175)



Source: CFOI

Figure 4 illustrates the industries associated with the fatal injuries. The leading industry for work-related deaths was construction (20%), followed by manufacturing (17%), and transportation/public utilities (15%).

FIGURE 4
Fatal occupational injuries by industry,
Michigan, 2001 (N=175)

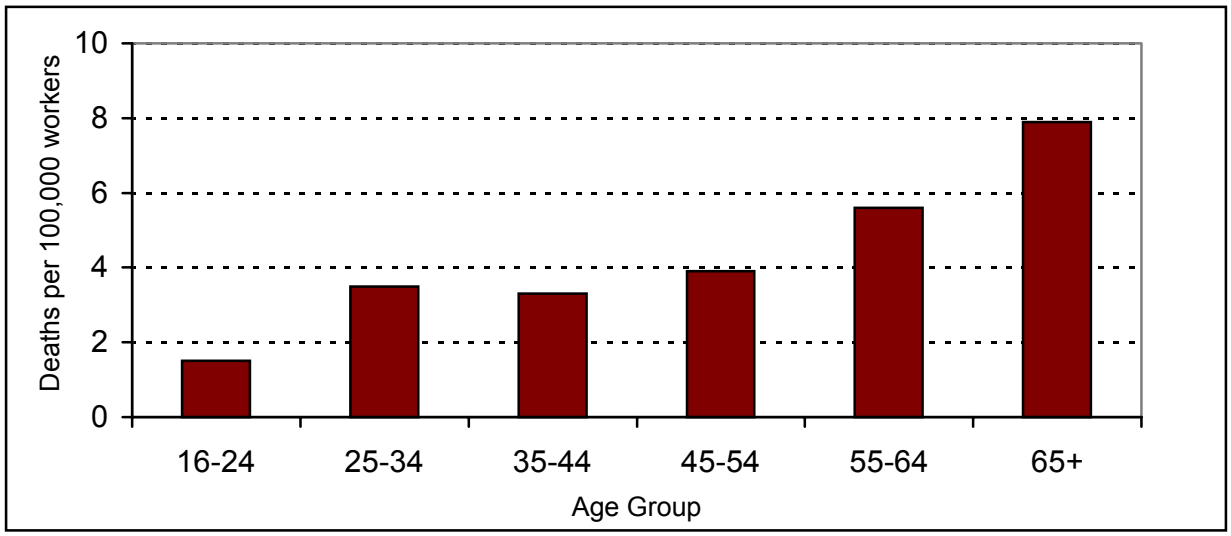


Source: CFOI

Some demographic information of interest includes: 93% of the fatally injured individuals were men; 21% non-white; six percent were among workers over the age of 65, and one percent were under age 16.

Michigan death rates by age group are illustrated in Figure 5. After the 35-44 year old age group, rates increased with increasing age and were highest for those aged 65 and older. (A rate was not calculated for the two decedents under age 16.)

FIGURE 5
Occupational injury death rates, by age group, Michigan, 2001



Source: CFOI

Discussion

In 2001, 175 people died in Michigan from a work-related injury, for a rate of 3.6 per 100,000 workers. This rate has not fluctuated significantly in the ten years the data have been collected in the standardized national format of CFOI. Michigan's rate is slightly lower than the national rate. Data about high-risk groups identified in Michigan CFOI — e.g., working seniors, workers in agriculture, workers engaged in transportation — are consistent with data in other studies.

Regulatory agencies are not able or authorized to investigate all workplace fatal injuries. The MIFACE program, with its non-regulatory research approach, is thus a critical component of a comprehensive work-related fatality prevention and intervention program. Continued efforts are needed to identify root causes of these fatalities and implement primary prevention measures, ideally, by engineering safety into equipment and job specifications.

Incident descriptions of each work-related fatality in 2001 can be found in Appendix 1 of the *2001 Annual Report on Traumatic Work-Related Fatalities in Michigan, MIFACE.*[6] One of these, an electrocution, has resulted in criminal charges against the foreman/owner of the company; this is the first time in Michigan that an individual has been charged criminally for a workplace fatality.

Additional Resources

Annual reports with detailed data on the MIFACE (Michigan fatal injuries) program: www.chm.msu.edu/oem

Data from the Census of Fatal Occupational Injuries (CFOI) for Michigan may be found at www.michigan.gov/miosha. Click on "Statistics, Publications and Media;" then "Statistics and Data."

National CFOI data from the Bureau of Labor Statistics: www.bls.gov/iif

[6] http://web2.chm.msu.edu/oem/miface/01miface.pdf

3 Non-Fatal Work-Related Injuries

Background

Workplace injuries affect the health and livelihood of thousands of workers each year in Michigan and nationally. Injuries are not random, unavoidable events; they are preventable occurrences.

Job-related injury is usually defined as any wound or damage to the body caused by events occurring within a single workday or shift and which is work-related, regardless of whether it occurred on or off the employer's premises.

The Bureau of Labor Statistics (BLS), U.S. Department of Labor, is responsible for collecting data on occupational safety and health, including non-fatal and fatal injuries nationwide. According to the BLS Survey of Occupational Injuries and Illnesses (SOII), nationally the rate of injuries in the private sector declined from 8.3 per 100 full-time workers in 1992 to 5.4 in 2001. The leading causes of these work-related injuries were falls, traffic crashes, burns, machinery, electric shocks, and assaults.

Although widely cited, the SOII data are an underestimate of the number of work-related injuries because of the scope and methods of the survey. Hospital patient encounter data (inpatient and emergency department [ED]) provide important additional information. A survey conducted by the National Center for Health Statistics found that in 2000, 16% of injuries treated in EDs were work-related among those aged 18-64 years.[1] Another study has estimated that nearly one-third of all injury inpatient hospitalizations among individuals of working age are work-related.[2] Work-related injuries that are treated in EDs or that require inpatient care are only a portion of the total number of work-related injuries, most of which are treated in an outpatient setting. Workers' compensation data include outpatient cases; they are another useful source of information on work-related injury. Additional discussion of the uses and limitations of these data sources is in Chapter 1.

Occupational injury data are used by OSHA to set strategic goals for improvements in workplace safety. For example, federal OSHA and MIOSHA have been targeting amputations as a special initiative because of the data on occupational amputations. Other agencies use occupational injury data to prioritize prevention activities, including NIOSH, the Mine Safety and Health Administration, and the National Safety Council. *Healthy People 2010* includes an objective for the reduction of work-related injuries.[3]

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[1] McCaig LF, Ly N. National Hospital Ambulatory Medical Care Survey: 2000 emergency department summary. Advance data from vital and health statistics; no. 326. Hyattsville, Maryland: National Center for Health Statistics. 2002.

[2] Hensler, D, et. al. *Compensation for Accidental Injuries in the United States*. R-3999-HHS-ICJ. Santa Monica: Rand Institute for Civil Justice. 1991.

[3] U.S. Department of Health and Human Services. *Healthy People 2010.* 2nd edition. Washington DC. US. Government Printing Office. November 2000. Objective 20-2 .

Surveillance Methods

Data sources for non-fatal occupational injuries in Michigan include data from the BLS SOII, the Michigan Inpatient Database (MIDB), the Michigan Emergency Department Community Injury Information Network (MEDCIIN), and workers' compensation claims. Chapter 1 describes the data collection methods for each of these systems. None of these data systems allow for identification of individuals; therefore the number of individuals who are counted more than once cannot be determined. The data from each of these sources are presented separately.

Data from the SOII are for 1992-2001. All rate calculations from this survey were performed by BLS. The BLS survey sample was not designed to allow for the generation of county-specific injury rate estimates. Comparisons between Michigan and national BLS data are provided.

MIDB data are for 2001. (The map of county-specific hospitalization rates utilized 1999-2001 MIDB data. Using three years of data substantially increased the number of counties that could be illustrated.) MEDCIIN data are for 2000, the most recent year available. Occupational injury cases were identified using the primary diagnosis (ICD-9-CM codes included 800.0-904.9, 910.0-957.9, 959.0-994.9, 995.50-995.59, and 995.80-995.85) and the principal payer (workers' compensation). Patients under age 16 and those who died during their hospital stay were excluded. Statewide and age/gender rates were calculated from MIDB data by dividing hospitalizations by the appropriate employment levels (2001 annual average).[4] County rates for 1999-2001 were calculated by dividing the number of hospitalizations by the total employment levels, both summed over the three years. No ED rates were calculated because statewide estimates based on MEDCIIN data have not yet been generated.

Injury cases occurring in 2001 were selected from the Michigan workers' compensation database using that system's diagnostic coding system.

A separate section on amputations presents results of a study of inpatient and ED case reports from 1997. All Michigan hospitals were contacted and requested to provide discharge/ED summaries of patients hospitalized or seen in the ED with work-related amputations in 1997, under the authority of the occupational disease reporting statute. Information was abstracted from the patient records, including patient demographics, anatomic site of the amputation, source of amputation (e.g., machine type), name and address of employer, and primary insurance payer. Work-relatedness was determined by reviewing the medical record as well as reviewing the insurance information. The study compared these data with SOII and workers' compensation data. Names of selected employers, based on criteria provided by MIOSHA, were provided to MIOSHA, and results on MIOSHA follow-up inspections were recorded. A case study of one incident is provided.

[4] United States Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics. Data obtained using the following website: http://www.bls.gov/lau/

Results

BLS SOII: In 2001, an estimated 226,300 injury cases were reported by private industry and state/local government employers in Michigan (includes cases with and without lost workdays). This corresponds to a rate of 6.4 injury cases per 100 full-time workers (Table 1). As the table illustrates, the overall work-related injury rate declined between 1992 and 2001.

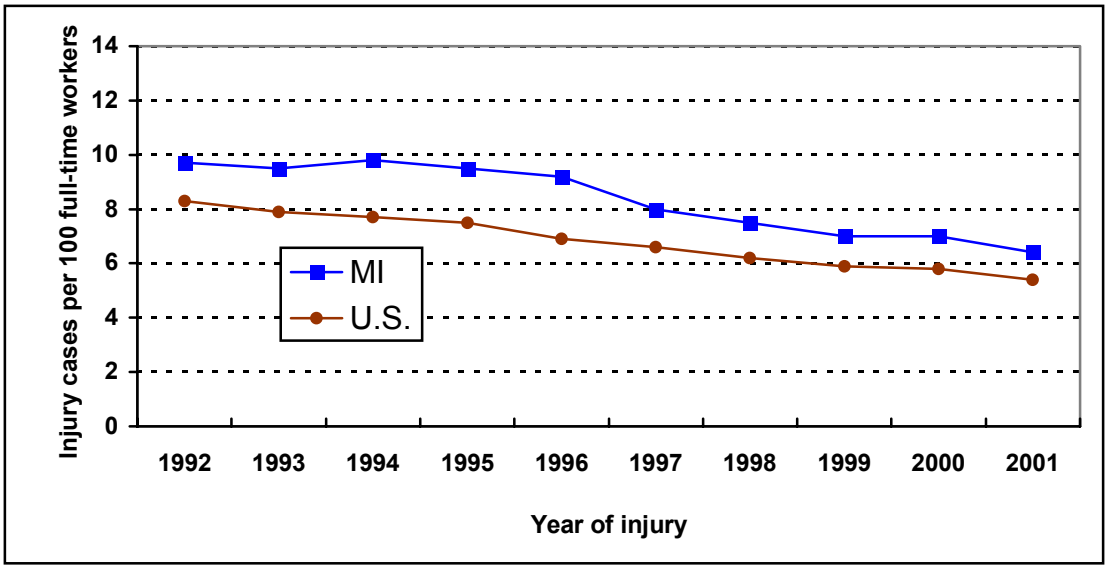
TABLE 1
Estimated number and rate of non-fatal occupational injuries occurring in Michigan among private industry and state/local government, by year, 1992-2001

Year	Private Industry		State/Local Gvt		Total	
	Number	Rate*	Number	Rate*	Number**	Rate*
1992	261,200	9.7	26,200	7.3	287,400	9.4
1993	270,500	9.5	32,600	8.4	303,100	9.3
1994	286,800	9.8	32,500	8.1	319,200	9.6
1995	287,300	9.5	28,200	7.1	315,500	9.2
1996	284,300	9.2	28,600	6.8	312,900	8.9
1997	260,100	8.0	31,900	7.4	292,000	7.9
1998	245,600	7.5	29,000	6.7	274,600	7.4
1999	234,100	7.0	25,300	5.7	259,300	6.9
2000	225,800	7.0	26,800	5.7	252,600	6.8
2001	196,700	6.4	29,600	6.4	226,300	6.4

Data represent estimates as they are based on a sample.
* Number of injury cases per 100 full-time workers.
** Row totals may not equal the sum of columns due to rounding.
Source: BLS SOII

Because national data exclude incidents involving government employees, valid comparisons between Michigan and the U.S. are limited to private industry only. As illustrated in Figure 1, injury rates among private industry employees declined between 1992 and 2001 both in Michigan and nationally. Michigan rates exceeded national rates throughout this timeframe.

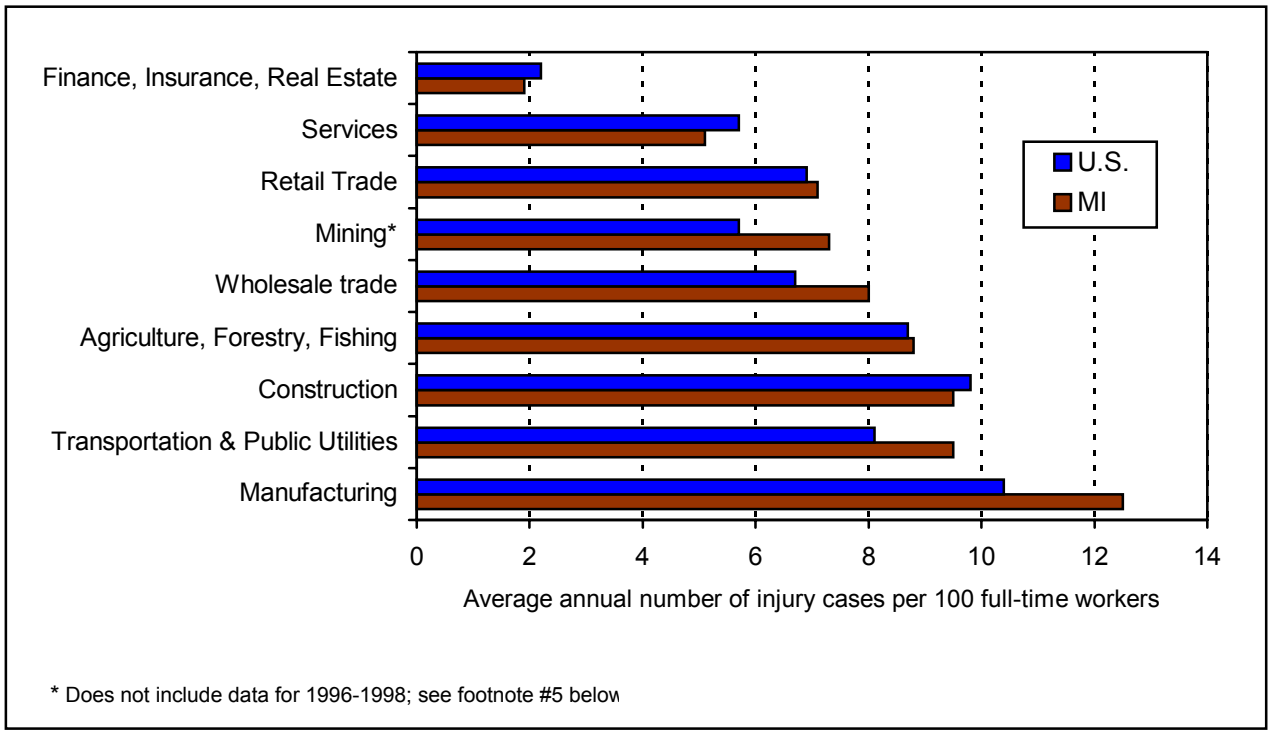
FIGURE 1
Rate of non-fatal occupational injuries among private industry, Michigan and U.S. workers, by year, 1992-2001



Source: BLS SOII

Figure 2 illustrates average annual injury rates for Michigan and the U.S. for the major industry categories for 1992-2001. In Michigan, manufacturing had the highest injury rate by a substantial margin (three injury cases more per 100 full time workers per year than the next highest industries, transportation and construction). Over this ten-year period, injury rates were substantially higher in Michigan than in the U.S. for mining (28% higher),[5] manufacturing (20%), wholesale trade (19%), and transportation and public utilities (17%).

FIGURE 2
Average annual rate of non-fatal occupational injuries among private industry, Michigan and U.S. workers, by industry, 1992-2001



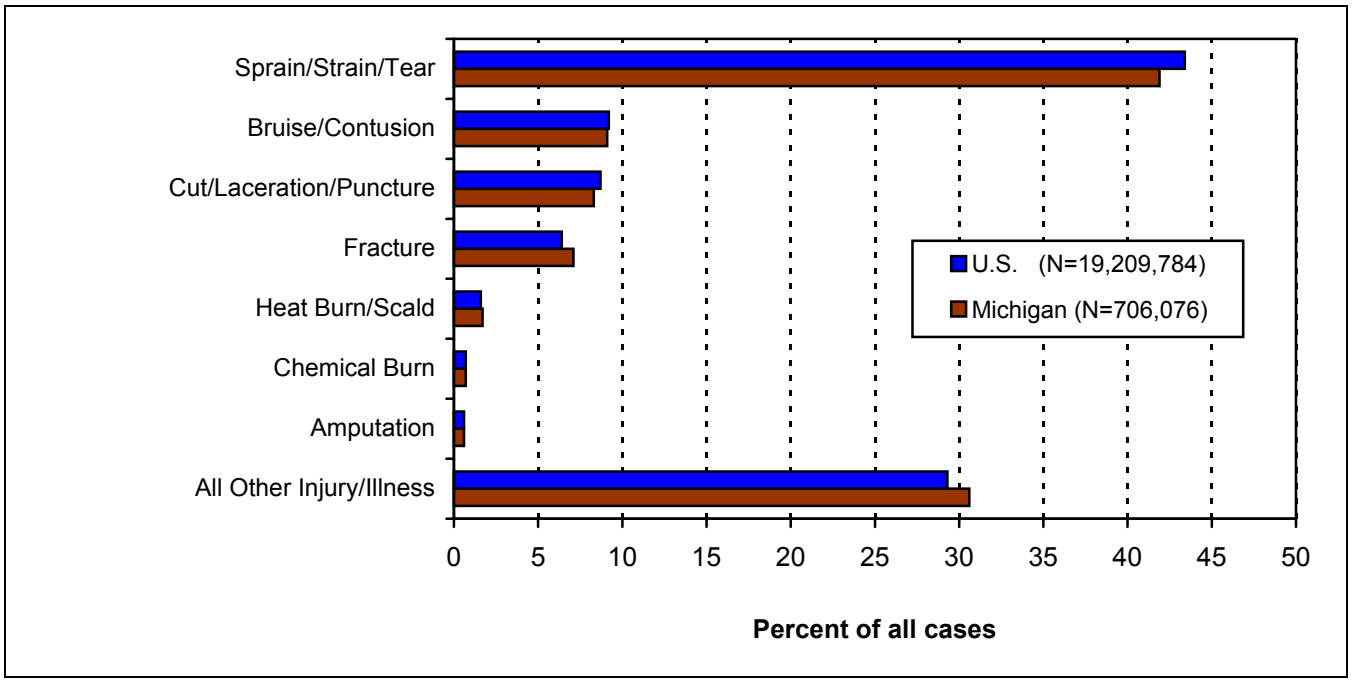
Source: BLS SOII

[5] Data for the Michigan mining industry were unavailable for 1996-1998 because the Bureau of Labor Statistics requires a minimum level of employment (4,500 average annual workers) for data to be included in statistical reports. Data for the U.S. for these three years were therefore also excluded to allow a valid comparison.

Injuries requiring days away from work

The types of injuries requiring days away from work within private industry during 1992-2001 for Michigan and the U.S. are presented in Figure 3.[6] The types of injuries sustained by Michigan workers and U.S. workers were nearly equivalent in distribution. Sprains and strains were by far the most common cause of lost work.

FIGURE 3
Distribution of types of injuries associated with worker days away from work (percent of cases), Michigan and United States workers, private industry, 1992-2001



Source: BLS SOII

[6] Michigan data do not separate injuries from illnesses, so illnesses are included in the figure under "All Other Injury/Illness." Note that injuries outnumber illnesses nine to one.

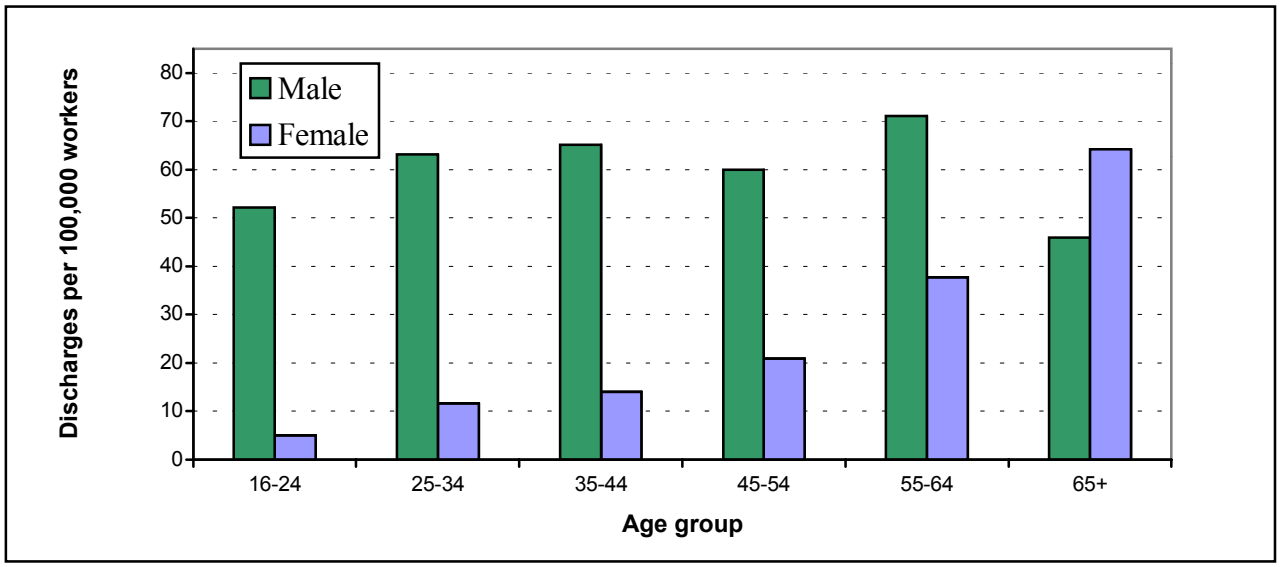
Hospitalizations

In 2001, 1,861 (3.8%) of the 49,480 Michigan residents aged 16 and older who were hospitalized with a non-fatal injury had workers' compensation listed as the principal payment source. The corresponding hospitalization rate was 38.0 per 100,000 workers.

Falls were the leading cause of work-related injury. They comprised 39% of the cases for which cause was specified. Hospitalization rates were substantially higher for males than females for every age group between 16 and 64. For those aged 65 and older, however, the rate for females was greater than for males (Figure 4).

Forty-one percent (41%) of work-related injury hospitalizations were due to fracture of an upper or lower extremity. Strains/sprains were next in order of frequency (11%). Hospital stays ranged from one to 103 days; 88% of the patients were discharged within one week of admission.

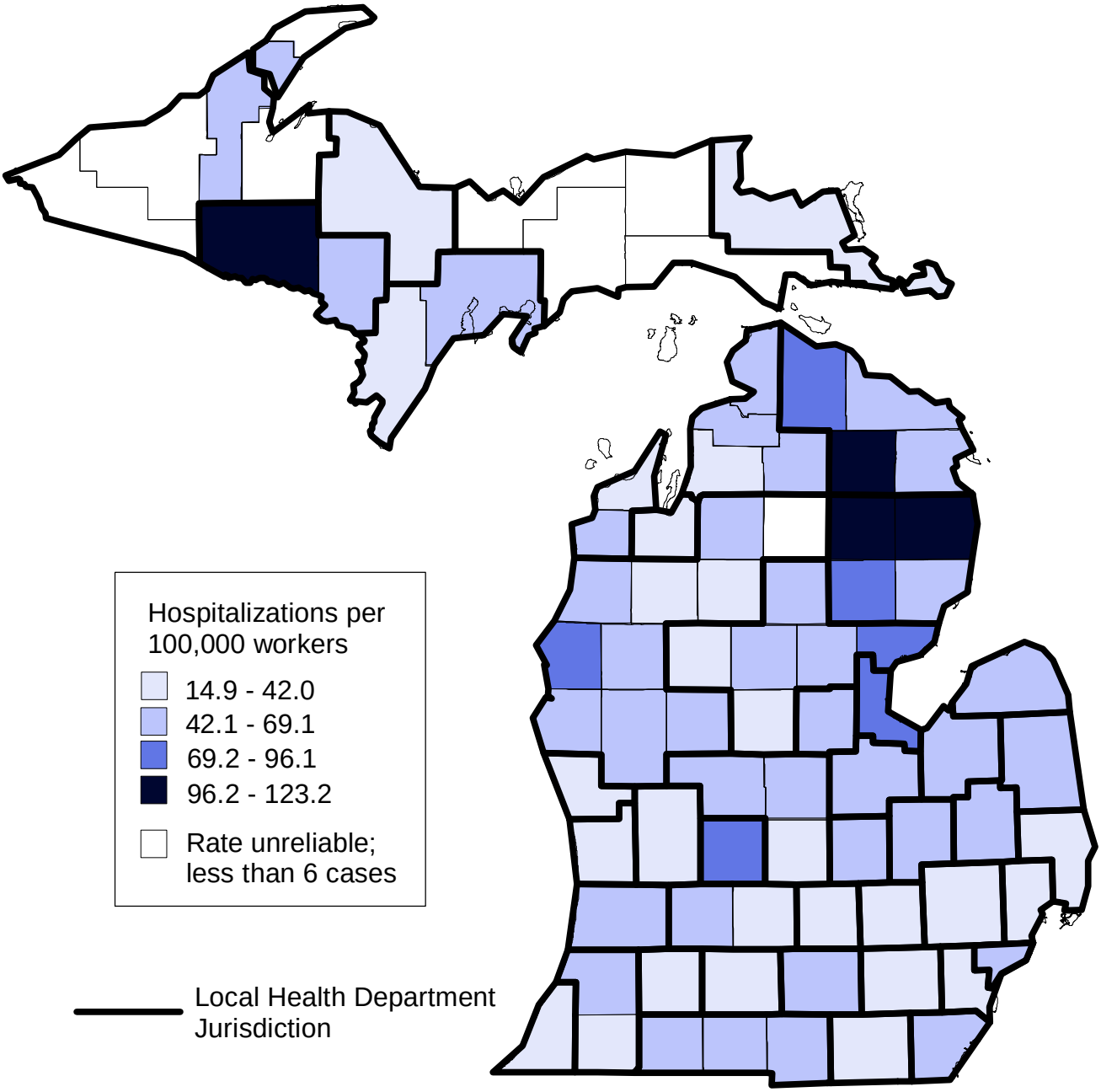
FIGURE 4
Rate of Michigan resident work-related non-fatal injury hospitalizations, by age and sex, ages 16 and older, 2001



Occupational injury hospitalizations were defined as those for which payment source was workers' compensation.
Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

The average annual work-related injury hospitalization rate during 1999-2001 varied widely by county – from 14.9 per 100,000 workers (Washtenaw County) to 123.2 (Oscoda County). The average annual statewide rate during the three-year period was 38.7. The northeast section of the Lower Peninsula had several counties with high rates (Figure 5).

FIGURE 5
Average annual hospitalization rates for work-related injuries
by county of residence, ages 16 and older, Michigan, 1999-2001



Excludes in-hospital deaths

Rates for the two health department jurisdictions in Wayne County are shown separately. The overall Wayne County rate was 42.5.

Work-related hospitalizations were defined as those for which the payment source was workers' compensation.

Sources: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH
Bureau of Labor Statistics, U.S. Department of Labor

Emergency department visits

In 2000, 14,256 visits were made to 21 of the 23 MEDCIIN hospitals[7] by those aged 16 and older (excluding deaths and admissions) where workers' compensation was the principal payment source. These visits comprised 10.5% of the 135,928 injury visits by those aged 16 and older in the MEDCIIN sample in which payment source was known.

Statewide estimates based on data submitted by MEDCIIN hospitals were not available as of this writing because the appropriate statistical weights have not yet been developed. However, survey data from the Michigan Health and Hospital Association[8] on the number of ED visits for all conditions in Michigan and information from the National Center for Health Statistics[9] on the proportion of all ED visits that are for injury allow a rough estimate to be made. Based on these two surveys, it can be estimated that MEDCIIN captured 13.7%[10] of all injury visits to Michigan emergency departments in 2000. Thus, the estimated number of injury ED visits for which workers' compensation was the payment source for those aged 16 and older is 104,000.[11]

The distribution of types of work-related injuries treated in EDs was different from the distribution of injuries seen among inpatients: upper/lower extremity fractures comprised only 6% of the ED visits while open wounds (32%), sprains/strains (26%) and abrasions/contusions (20%) comprised a total of 78% of the injuries. The most prevalent ED injury types were similar to those in the BLS SOII data.

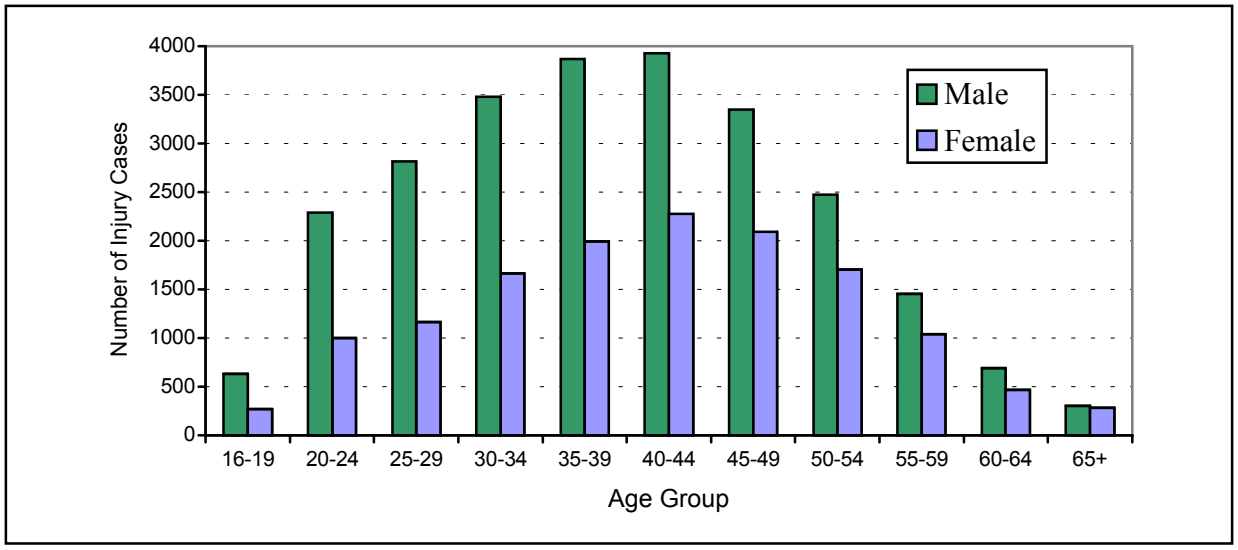
Workers' compensation

There were 39,762 claims of work-related injuries filed with workers' compensation in 2001 (919 per 100,000 workers covered by workers' compensation).[12] This excludes deaths and claims that did not result in a disability for eight or more consecutive days. (Workers' compensation insurance covers medical expenses for cases involving less than eight consecutive no-work days, but the data system does not collect information on them.) According to the BLS SOII data for Michigan for 2001, about 50% of injuries resulted in less than seven days away from work.[13]

[7] Two hospitals did not report 2000 data to the system. Data from three other hospitals were incomplete.
[8] Data on the number of Michigan hospital emergency department visits provided by Mark Sonneborn of the Michigan Health and Hospital Association.
[9] McCaig LF, Ly N. National Hospital Ambulatory Medical Care Survey: 2000 emergency department summary. Advance data from vital and health statistics; no. 326. Hyattsville, MD: National Center for Health Statistics, 2002.
[10] The Michigan Public Health Institute, which manages MEDCIIN, obtained more complete data for 2000 subsequent to these calculations. However, these data were not available in time for inclusion in the report.
[11] Assuming the 14,256 ED visits with workers' compensation as the pay source identified in the MEDCIIN sample represented 13.7% of all such visits in the state, the total number of cases would be 104,000.
[12] National Academy of Social Insurance. *Workers' Compensation: Benefits, Coverage, and Costs, 2001*. Washington, DC, National Academy of Social Insurance. July 2003.
[13] SOII data categories include less than seven days away from work, not eight.

The age and sex distribution of injured workers age 16 and older is illustrated in Figure 6. Twenty-three additional individuals were under age 16 when the injury occurred. For both men and women, the greatest number of injuries occurred among those aged 40-44. While there were more injuries to men than women within each age group, the difference diminished with increasing age.

FIGURE 6
Number of Michigan workers' compensation injury claims*
by age and sex,
ages 16 and older, 2001



Age or sex was unknown for 510 cases. These are not illustrated in the figure.
* Excluding deaths and disabilities resulting in less than eight consecutive days away from work.
Source: Workers' compensation database; "Employer's Basic Report of Injury" (Form 100)

By far, the leading type of injury was sprain/strain/torn cartilage/pinched nerve (56%; all of these were categorized into one group and could not be separated in the analysis). More than one-third (34%) of these injuries were to the back.

Amputation study

Three hundred thirty-nine work-related amputations were identified from hospital inpatient and ED records in 1997, including 110 (32%) that involved an overnight hospitalization. Eighty-six percent were male and 82% of the 265 patients with race specified were white. Two hundred seventy-six (89.3%) of the 309 work-related amputations where insurance coverage was known were covered by workers' compensation.

Ninety-three percent of the amputations involved fingers. Three of the amputations were among workers under the age of 18, including a sixteen year old who lost an arm in a meat grinder, a machine which working minors are prohibited by law from using. Power presses were the source of injury in 37 (12%) of the 298 cases where source was determined, power saws were the source in 14%, and food processing machines were the source in 7% of the amputations. The industry with the highest incidence rate of amputations was agriculture (29 per 100,000 workers),

followed by manufacturing (20.8). Within manufacturing, the group "lumber and wood products" had an incidence rate of 100 per 100,000 workers.

There were 619 amputations reported in Michigan workers' compensation data for 1997.[14] Assuming workers' compensation covered 89% of all work-related amputations (as stated above, it covered 89% of amputations treated at hospitals), the total number of work-related amputations in 1997 can be estimated at 693. In contrast, the BLS survey estimated that there were 440 amputations in Michigan in 1997.

MIOSHA completed enforcement inspections at 30 companies as a result of referrals of cases identified in the 1997 hospital and ED data. The following illustrates one incident and the outcome of the MIOSHA inspection: A nineteen year old general laborer who had been working for over one year at a saw mill had his left hand amputated as he reached under a saw to position a piece of lumber. The saw blade caught the cuff of his glove, which then pulled his hand into the saw. He sustained a significant blood loss and was airlifted to a major hospital where his four fingers and thumb were successfully reattached. The patient still works at the sawmill. The company was cited for inadequate guarding of the saws and for one employee not wearing safety glasses at the time of the inspector's visit. Proper guards were installed and employees were reminded of the requirement to wear safety glasses at all times.

Discussion

BLS SOII, hospitalization, and MEDCIIN data all show that occupational injuries are a major public health problem. MIOSHA has utilized the SOII data to develop strategic plans for FY99 - FY03 and FY04 - 2008.[15] The most recent plan quantifies targeted injury rate reductions for certain industries (e.g., primary metal industries, industrial machines and equipment), types of injury/illness (amputations, overexertion or repetitive strain syndrome, noise-induced hearing loss), and causes of injury in the construction industry (falls, electrocution, struck by an object, crushed by/caught between objects). The current plan also has a strategic goal of promoting employer and worker involvement with safety and health through such strategies as MIOSHA's Voluntary Protection Program, special targeted outreach services when new standards or emphasis programs are initiated, and development of partnerships to promote employee safety and health.

According to the BLS survey data, the rate of non-fatal occupational injury in Michigan decreased 32% between 1992 and 2001. However, the state's rates consistently exceeded national rates during that timeframe. The Michigan Occupational Safety and Health Administration (MIOSHA) has maintained strong enforcement and education and training programs to ensure effective recordkeeping and reporting of occupational injuries and illnesses by employers, and this may account for the differences between federal and state rates. Additional investigation would help determine how much of the difference is due to better reporting by Michigan employers.

[14] Amputations result in benefit compensation (and are thus reportable to the Michigan Department of Labor & Economic Growth [DLEG], formerly MDCIS) regardless of the length of time lost from work (as noted previously, an injury generally must cause a disability of more than seven days to qualify).

[15] Strategic Plan Fiscal Years 1999-2003 and Strategic Plan Fiscal Years 2004 - 2008, Bureau of Safety and Regulation, Michigan Occupational Safety and Health Act, Michigan Department of Labor & Economic Growth are at: www.michigan.gov/miosha; click on "Inside MIOSHA."

Falls caused approximately one-third of hospitalized non-fatal work-related injuries in 2001. ICD-9-CM cause of injury codes provide general information on the type of falls that occurred (e.g., fall from one level to another; fall on same level from slipping or tripping). In order to design effective prevention programs, further work is needed to gather more detail about the circumstances in which falls occur. The types of less serious injuries, such as those treated in emergency departments, differed from the types of the more serious hospitalized injuries.

MDCH is currently developing weighted data from the MEDCIIN sample of hospitals to generate a more reliable estimate of the number of work-related injuries treated in Michigan emergency departments. In addition, these data will allow age/sex rates to be calculated and compared to inpatient data.

Overall, men were at higher risk of sustaining a work-related injury than women. However, as seen in the hospitalization and workers' compensation data, the difference between the sexes diminished with increasing age.

Several counties in the northeastern lower peninsula had work-related injury hospitalization rates that were at least twice the state rate. The number of hospitalizations upon which these rates were based was small (e.g., taken together, the counties with the highest rates – Alcona, Montmorency, and Oscoda – averaged a combination of only 13 hospitalizations per year). Since falls are a leading cause of work-related injury hospitalization and those aged 65 and older are most likely to be injured by a fall than any other cause, rate differences between counties could be due in part to differing age distributions.

Attempts to quantify and characterize non-fatal occupational injuries tend to rely upon the Bureau of Labor Statistics' Survey of Occupational Injuries and Illnesses. While this is an important data source that is standardized nationally, other sources in Michigan have valuable information to provide more complete estimates and to provide data not available in the SOII (e.g., county of residence from hospital discharge data). The 1997 amputation study highlights the significant underestimate of occupational injury if one relies solely on SOII. Multiple data sources should be utilized to develop the most comprehensive information on non-fatal work-related injuries.

Additional Resources

SOII data for Michigan are found at: www.michigan.gov/miosha; click on "Statistics, Publications and Media," then "Statistics and Data."

National SOII data from the Bureau of Labor Statistics: www.bls.gov/iif

MIOSHA web site, including information about employer record keeping and reporting requirements for SOII: www.michigan.gov/miosha

4 Work-Related Asthma

Background

Work-related asthma is asthma that is caused by or exacerbated by exposures to chemicals or other substances at work. Work exposures may cause new onset asthma from exposure to an allergen or an irritant that precipitates inflammatory changes, or work exposures may exacerbate pre-existing asthma. Work-related asthma can be a serious and disabling lung disease, causing death, hospitalization and disability.

Some of the more commonly recognized agents associated with work-related asthma include isocyanates, metalworking fluids, laboratory animal dander, wood dust, and flour ("baker's asthma"). There are approximately 380 documented agents associated with work-related asthma. Prevention of work-related asthma is accomplished by limiting and preventing exposure through engineering controls, personal protective equipment and education. Unfortunately, some individuals who become sensitized to an asthma-causing agent must completely avoid working with or around the agent.

There is no national surveillance system for work-related asthma. A small number of states, including Michigan, have developed state surveillance systems based on mandatory public health reporting requirements. It is estimated that 15% of adults with asthma have acquired asthma from a work exposure.[1]

Surveillance Methods

Michigan has had a case-based surveillance system for work-related asthma since 1988. The goal of the surveillance program is the prevention of work-related asthma through the reporting of patients with known or suspected work-related asthma. The reporting of the patient is regarded as a sentinel health event that may lead to the identification of other employees from the same facility who are at risk of developing asthma or who have developed similar breathing problems.

The OD reporting system, described in Chapter 1, is the source of data and case identification for Michigan's occupational asthma surveillance system. Cases reported to the surveillance system are likely to under count the true number of cases of work-related asthma, both because health care providers generally do not comply with public health reporting requirements and because the role of work exposures in asthma is often unrecognized.

The reported patient is interviewed to collect diagnostic and exposure information in order to evaluate the work-relatedness of the condition. If warranted, industrial hygiene evaluation of the patient's workplace may then be conducted. The industrial hygienist from the Michigan Department of Consumer and Industry Services' MIOSHA program conducts air monitoring for any suspected allergens and reviews the company's health and safety program. Additionally, co-workers are interviewed to determine if others are experiencing similar breathing problems from

[1] Balmes J et al. American Thoracic Society: Occupational Contribution to the Burden of Airway Disease. Am J Respir Crit Care Med. 2003; 167:787-97.

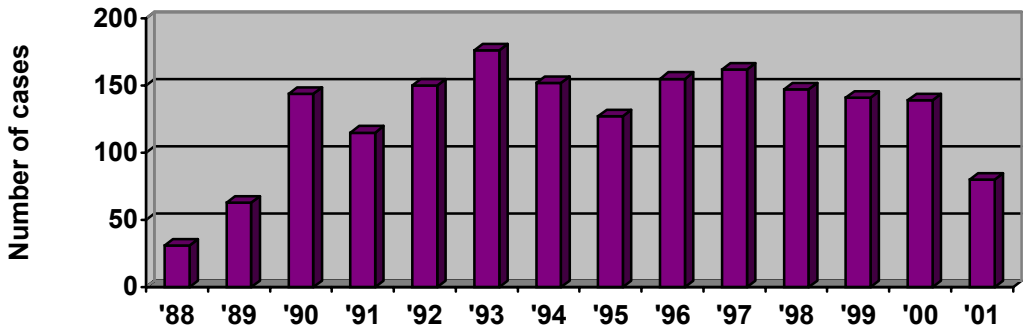
exposure to the suspected allergen. A report is sent to the company and union or designated labor representative that includes air sampling results and recommendations to prevent exposure among co-workers, as well as findings that are violations of health and safety regulations. In some instances, letters about potential problems with exposures are sent to companies where the reported cases were exposed to an allergen, in lieu of a formal MIOSHA inspection.

The Michigan surveillance system categorizes reports of work-related asthma according to published guidelines.[2] A person is considered to have work-related asthma if they have a health care provider's diagnosis of asthma and an association between symptoms of asthma and work. Confirmed work-related asthma cases are classified to distinguish between work-related exacerbation of a preexisting asthma condition ("work-aggravated asthma") and new onset asthma that is induced by workplace exposures. New onset asthma is categorized into classic allergen-induced asthma ("occupational asthma") and reactive airways dysfunction syndrome ("RADS"), which is persistent asthma symptoms induced by a one-time, high level irritant exposure at work. New onset asthma without pulmonary function testing to document association between symptoms and work exposures, or documentation of exposure to a known allergen, is classified as "possible occupational asthma."

Results

Between 1988 and 2001 there were 1,782 confirmed cases of work-related asthma in the Michigan occupational asthma surveillance system. Figure 1 indicates the numbers of cases by year of report.

FIGURE 1
Number of confirmed occupational asthma cases by year reported, Michigan, 1988-2001 (data are incomplete for 1988 and 2001)



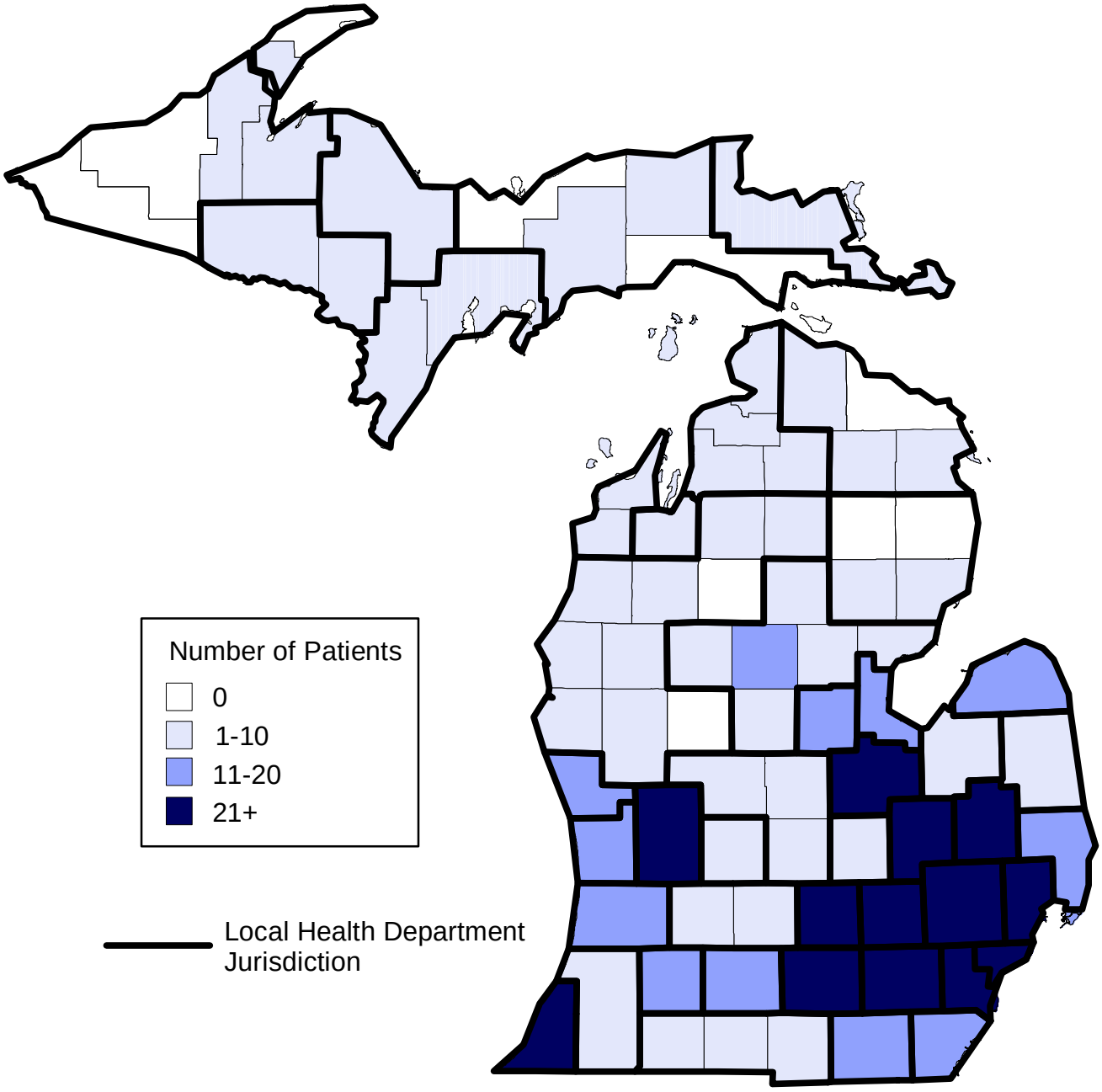
Source: Michigan occupational asthma surveillance system

The average annual incidence rate was 3.4 cases per 100,000 workers. The incidence rate of work-related asthma among African-Americans (5.4/100,000) was twice that of whites (2.6/100,000).

Figure 2 is a map of the numbers of cases by Michigan county of exposure.

[2] Jajosky RA et al. Surveillance of work-related asthma in selected U.S. states using surveillance guidelines for state health departments – California, Massachusetts, Michigan, and New Jersey, 1993-1995. In: *CDC Surveillance Summaries*, June 25, 1999. MMWR 1999; 48(SS-3):1-20.

FIGURE 2
Confirmed work-related asthma patients
by county of exposure, 1988-2001



Total Michigan Patients: 1,750

County of exposure was unknown for ten patients. Twenty-two patients were exposed out-of-state to an allergen. Detroit cases and Wayne out-county cases were combined.

Sources: Michigan State University, Department of Medicine
Michigan Department of Consumer and Industry Services

The two industries that predominated as the sources of exposure were the automobile industry (44% of the cases), and the health field (9% of cases). Incidence rates were highest in the automobile manufacturing industry (20.7/100,000 workers), food and kindred products (12.5/100,000) and other non-durable goods (11.2/100,000).

The top ten substances most frequently associated with occupational asthma among confirmed cases are listed in Table 1.

TABLE 1
The ten leading causes of asthma among the 1,782 confirmed occupational asthma cases (Michigan, 1988-2001)

Agent	Percent of cases
Isocyanates	17.1
Metal-working fluids	12.1
Cleaning solutions	5.8
Exhaust, smoke, fumes	5.7
Welding fumes	5.1
Solvents	3.0
Latex/rubber	2.9
Formaldehyde	2.4
Epoxy	2.4
Paint fumes	2.3

Source: Michigan occupational asthma surveillance system

Five hundred thirty-seven MIOSHA inspections were conducted at 475 different facilities identified by case reports as the source of their exposure. Seven thousand three hundred thirty-seven co-workers at 278 of these facilities were interviewed, and 17% reported symptoms consistent with work-related asthma even though measured air levels of the allergens often did not exceed OSHA legal limits.

Exposures to cleaning agents and welding fumes are two common causes of work-related asthma that are being targeted for educational programs because of the data in the surveillance system.

Discussion

Over 1,780 case reports of work-related asthma have been confirmed in the surveillance system from 1988 through 2001, with an annual average incidence of 3.4 cases per 100,000 workers in Michigan. Even so, estimates based on a number of studies and surveys indicate that this system does not capture all cases in the state. Data on the prevalence of asthma from the Behavioral Risk Factor Survey can be used to estimate the prevalence of occupational asthma. Using the estimate that 15% of adults with asthma have acquired asthma from a work exposure, and applying this estimate to Michigan BRFS data (650,000 adults with asthma) would suggest that there are 97,500 adults in Michigan with work-related asthma.

These data show a two-fold difference in incidence rates between African-Americans and whites. This disparity needs additional investigation.

The surveillance system has led to the identification and amelioration of potentially hazardous exposures in many worksites in Michigan. Follow-up surveys of co-workers have found large numbers with work-related asthma symptoms, despite the fact that relatively few facilities where these individuals worked were found to have air levels of exposures that exceeded legal limits. Occupational exposure standards for known allergens such as isocyanates and metalworking fluids need to be reevaluated in light of these data.

Three initiatives are underway related to the surveillance system. First, Michigan is nearing completion of an in-depth analysis of the data on work-related asthma and cleaning agent exposures, in collaboration with three other states that track work-related asthma. Second, the four states are collaborating on a study of work-related asthma among health care workers. Finally, information is being collected during MIOSHA enforcement inspections to better understand the types of welding fume exposures and work practices associated with work-related asthma. All three initiatives were undertaken specifically because these exposures account for a significant number of the work-related asthma cases identified through the surveillance system.

Additional Resources

Annual reports with detailed data on occupational asthma:
www.chm.msu.edu/oem

Information about occupational asthma from the Asthma Initiative of Michigan:
www.getasthmahelp.org/Occupational_asthma_main.asp.

For a comprehensive list of known causes of work-related asthma:
www.remcomp.com/asmanet/asmapro/asmawork.htm#star

OSHA's guide to occupational asthma and related issues:
www.osha.gov/SLTC/occupationalasthma

5 Occupational Lead Poisoning and Elevated Blood Lead Levels

Background

Lead, a human health hazard, has a long history of industrial uses. Despite comprehensive standards requiring the control of airborne lead in the workplace, that have been in place since the 1980s in the United States, cases of occupational lead intoxication continue to occur. Occupations known to expose workers to lead include radiator repair, battery manufacture and recycling, brass and bronze manufacturing, and construction or remodeling of items previously painted with lead-based paint. Workers' exposure to lead can damage the central nervous system, cardiovascular system, reproductive system, blood-forming system, and the kidney. Lead poisoning often goes undetected because many of the symptoms, such as stomach pain, headaches, anxiety, irritability and poor appetite, are nonspecific. Lead exposure can be prevented by engineering controls, housekeeping, personal protective equipment, and good hygiene.

The blood lead level (BLL) is the best biological indicator of recent lead exposure in adults and children. The federal Occupational Safety and Health Administration (OSHA) requires that employers monitor the BLLs of workers where airborne lead exceeds certain levels in the work site. The OSHA standards are based on the assumption that a BLL greater than 50 µg/dL (micrograms per deciliter) indicates that the individual is at risk of adverse health effects, but studies performed since the promulgation of the OSHA lead standard indicate that BLLs appreciably lower than 50 µg/dL can have adverse effects.[1] Workers bringing lead dust home on their clothing can expose their children at home.

Currently, thirty-five states, accounting for more than half of the U.S. population, compile reports of laboratory blood lead levels in adults for the federally funded Adult Blood Lead Epidemiology and Surveillance (ABLES) program. Reporting by laboratories is mandatory in these states, usually in conjunction with reporting of BLLs in children. Surveillance systems for ABLES are usually linked to public health interventions, including education of employers and workers, and enforcement actions at worksites where there are violations of OSHA health standards.

In 2002, CDC published adult lead data from 25 of the 35 ABLES programs. These 25 states reported 41,984 adults with BLLs of 25 µg/dL or greater for the four year period 1998 - 2001, for a mean annual prevalence rate of 13.4/100,000 employed adults.[2] The National Institute for Occupational Safety and Health (NIOSH) has estimated that approximately 800,000 workers are exposed to lead at work in the United States.

[1] Rosenman KD, Sims A, Luo Z, Gardiner J. Occurrence of lead-related symptoms below the current Occupational Safety and Health Act allowable blood lead levels. J Occup Environ Med. 2003; 45:546-555.
[2] Roscoe R et al. Adult blood lead epidemiology and surveillance -- United States, 1998 - 2001. MMWR December 13, 2002. Vol 51, No. SS11; 1-10

Surveillance Methods

Michigan has been conducting surveillance of adult blood lead levels since October 1997, when blood lead test results from laboratories became reportable, and, during the same year, funding was received from NIOSH to establish an ABLES program. (Reporting by health care providers and employers of individuals with known or suspected occupational disease, including lead poisoning, has been mandatory since 1978, but occupational lead poisoning surveillance did not begin until the laboratory reporting rule went into effect.) Laboratories submit all blood lead test results to the MDCH Childhood Lead Poisoning Prevention Program (CLPPP). CLPPP forwards all reports of adults to the Michigan Department of Labor & Economic Growth (DLEG), formerly Consumer and Industry Services (MDCIS), for data management and case follow-up, because more than 90% of these reports are of lead-exposed workers and MDCIS is responsible for enforcement of occupational health and safety standards. Michigan State University (MSU) administers the surveillance system under contract with DLEG.

All adults with BLLs 25µg/dL and greater and selected adults whose BLLs are between 10 and 24[3] are contacted. The interview determines if the lead exposure was work-related and collects information on demographics, work exposure and history, symptoms related to lead exposure, potential lead-using hobbies, and the presence of young children in the household, to assess possible take-home lead exposures among these children.

Lead surveillance data are shared with NIOSH. As noted above, NIOSH publishes them in combination with other states' data.

The Michigan Occupational Safety and Health Administration (MIOSHA), which is part of DLEG, determines whether a worksite inspection is warranted based on information obtained about reported cases. A MIOSHA worksite inspection typically involves evaluating the employer's compliance with the applicable lead standard. The lead standards for general industry and construction have separate requirements for biological monitoring and medical removal when BLLs exceed certain levels. Because biological monitoring requirements are ongoing, many lead-exposed workers have blood lead tests several times a year.

Results

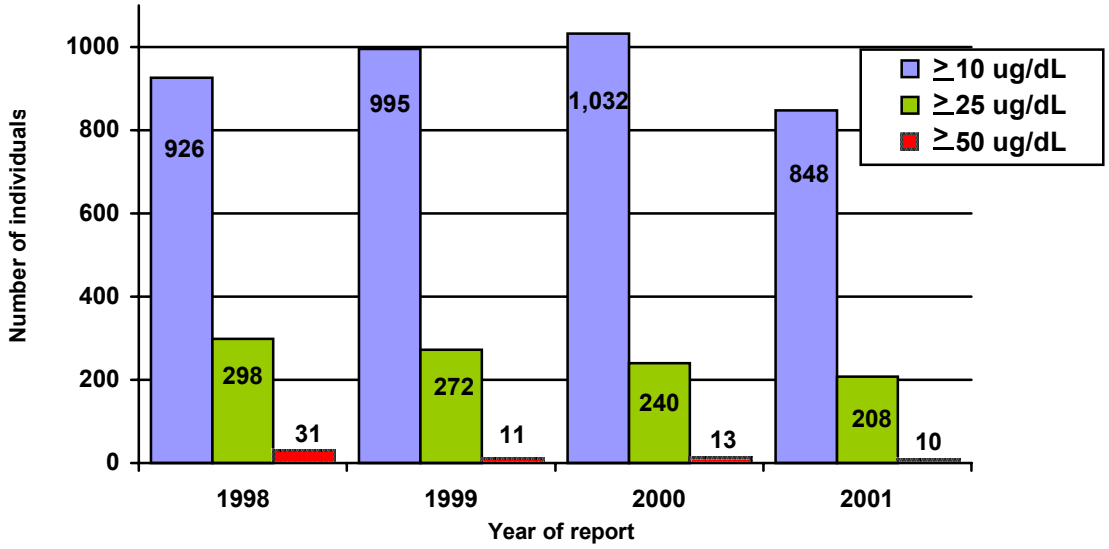
In the first four full years of laboratory reporting in Michigan, 1998-2001, 53,706 blood lead test reports were received on 33,331 individuals.[4] Two thousand six hundred thirteen (8%) of these individuals had at least one blood lead test result equal or greater than 10 µg/dL and 675 (2%) had at least one blood lead test result equal or greater than 25 µg/dL.

[3] Individuals with BLLs between 10 and 24 µg/dL are interviewed if they are reported with an employer that has not previously been identified or where the source of lead is not known.

[4] It should be noted that numbers in the adult blood lead surveillance system change over time because the data are always being updated as better information is obtained from reported cases and reporting sources, thus cited numbers may differ slightly across publications.

Figure 1 shows the numbers of individuals reported *each year* where the individual's highest BLL in that year was equal or greater than 10, 25 and 50 µg/dL. For each year, the first bar represents all individuals with BLL of 10 µg/dL and greater, and the second and third bars are subsets of the first. (An individual was counted once each year a report was received in each blood lead category, and, because some individuals are reported in more than one year, the total number of individuals across years is greater than the total with all years combined.)

FIGURE 1
Number of adults with highest blood lead levels ≥ 10, 25, and 50 µg/dL per year, Michigan, 1998-2001



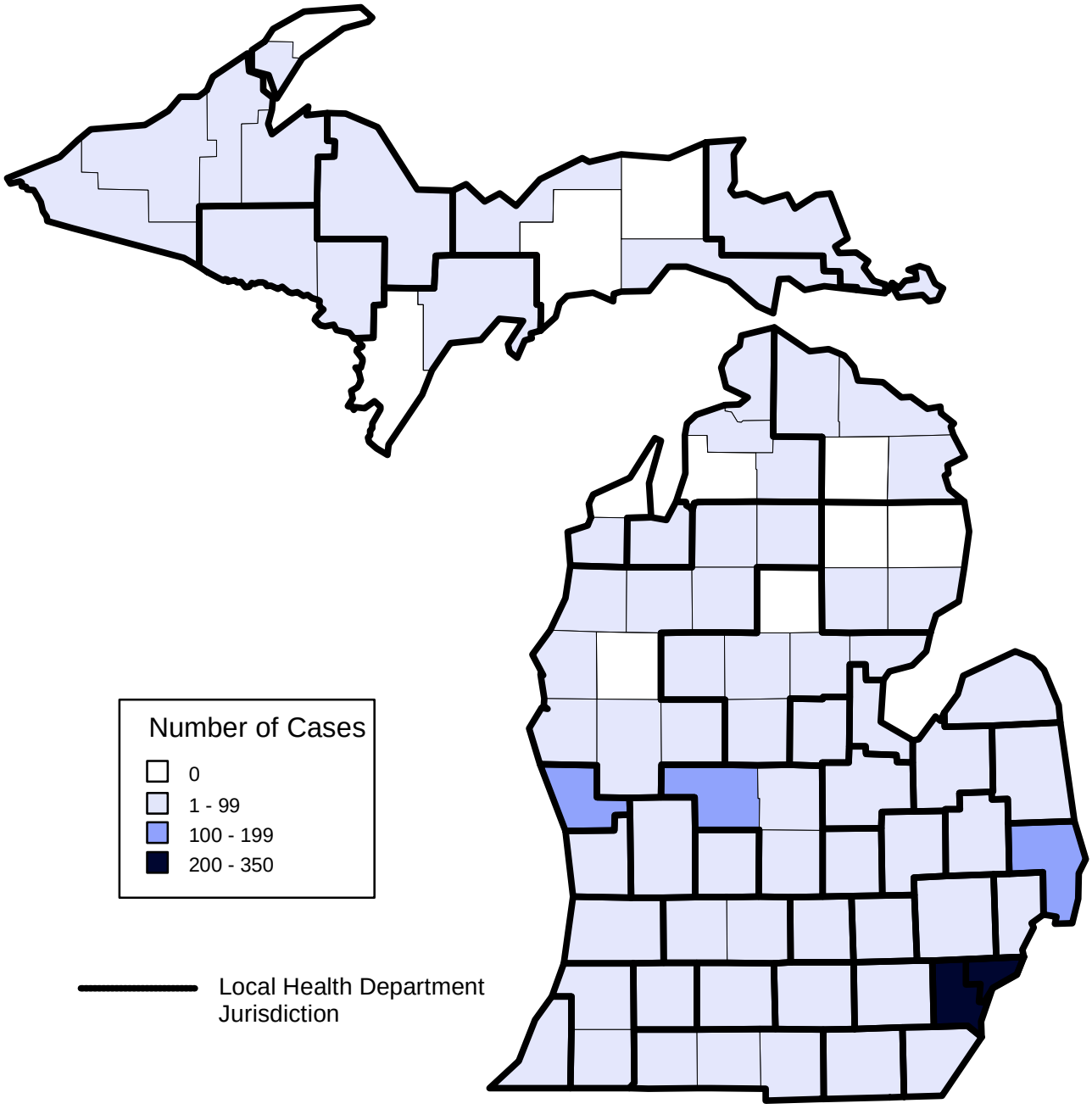
Source: Michigan ABLES

There were, on average, 950 individuals per year with a peak blood level of 10 µg/dL or greater, for an incidence rate of 18.9 per 100,000 employed persons[5] in Michigan.

Of the 2,613 individuals ever reported with BLL of 10 µg/dL or greater across all four years, source of lead exposure was determined for 2084 (80%). One thousand nine hundred seven (92%) of these 2084 individuals were known or presumed to have been exposed to lead at work. Non-occupational sources of exposure included hobbies such as target shooting and home remodeling. The ages of these lead-exposed workers ranged from 19 to 74. Figure 2 is a map by county identifying where these individuals lived.

[5] The number of employed persons is from the Bureau of Labor Statistics *Geographic Profile of Employment and Unemployment* (http://www.bls.gov/opub/gp/laugp.htm)

FIGURE 2
Number of elevated blood lead level (≥10 ug/dL) cases
due to exposure at work, by county of residence
Michigan, 1998-2001



Total Michigan Cases: 1,907

County of residence was unknown for 121 cases.
Detroit cases and Wayne out-county cases were combined.
Source: Michigan State University, Department of Medicine

The major industry groups where individuals with BLLs 10 µg/dL and greater were exposed to lead are listed in Table 1. Selected industry subgroups where large numbers of cases worked are also listed. Work in the subgroups of primary metals manufacturing (predominantly nonferrous foundries) and special construction trades (painting) contributed to the greatest numbers of lead-exposed workers. The construction industry was associated with particularly high BLLs, where workers are less likely to have access to hygiene facilities or be protected from lead by engineering controls. Forty percent of all individuals with a BLL of 50 µg/dL or greater were exposed to lead during construction work.

TABLE 1
Industries where individuals with BLL ≥ 10 µg/dL were exposed to lead, Michigan, 1998-2001

Industry by major groups and selected subgroups	Number of work-exposed individuals; BLL ≥ 10	
Construction	**579**	**(30%)**
Painting	275	
Manufacturing	**892**	**(47%)**
Primary Metals	457	
Fabricated Metals Product	230	
Industrial machinery and equipment	29	
Transportation equipment	96	
Transportation and Public Utilities	**58**	**(3%)**
Wholesale and Retail Trade; and Finance, Insurance and Real Estate	**37**	**(2%)**
Services	**110**	**(6%)**
Auto repair services	43	
Public Administration	**60**	**(3%)**
Police protection	40	
Unknown type of industry	**171**	**(9%)**
Total	**1907**	**(100%)**

Source: Michigan ABLES

One-third of the adults who were interviewed reported young children living or spending time in the home. Children in twenty percent of these households had been tested for lead and almost half reported a child with an elevated BLL. All those interviewed with young children were sent letters encouraging them to have their children tested for lead.

Workers with lower BLLs were more likely than workers with higher levels to report having their work clothing laundered at work, having a showering facility and having a separate lunch room. Lead-related health symptoms reported by interviewed workers were associated with increasingly higher levels of blood lead.

In this four-year period, the statewide surveillance system referred 118 companies to MIOSHA for follow-up. To date, MIOSHA has completed inspections at 81 companies and is planning on completing another 12. There are a variety of reasons why the remaining 25 companies were not inspected, including company closure and completion of the job, such as bridge painting. Sixty-four (79%) of these inspected companies were cited for violations of MIOSHA standards, including 58 (72%) that were cited for violations of lead standards. A comparison of the numbers of citations and amounts of penalties between a group of inspections conducted as a result of elevated blood lead reporting and a group of inspections conducted where there was lead use but no blood lead reports, found that the citations and penalties were markedly greater in the group identified by elevated blood lead reports.[6] Furthermore, a comparison of BLLs before and after MIOSHA inspections showed a statistically significant decrease in average BLL following the inspections.

Discussion

Consistent with data from other states, Michigan's data show that occupational lead toxicity continues to be a public health concern, with on average 950 individuals reported annually with a BLL of 10 µg/dL and greater. Studies have suggested that there may be no threshold for the adverse consequences of lead exposure, and that lead-associated impairments may be both persistent and irreversible.[7]

This surveillance system also found that 50% of children of lead-exposed workers who were tested had elevated lead levels. All young children of workers with lead exposure should be tested for blood lead.

Follow-up MIOSHA inspections have found on-going violations of applicable lead standards. These compliance investigations have resulted in reduced blood lead levels of workers.

Studies have suggested that data from laboratory blood lead reporting are an underestimate of the true level of occupational lead exposure. This is because not all worksites with lead exposure have medical surveillance programs for lead, as required by MIOSHA, or because workers who work where MIOSHA does not have jurisdiction (e.g., self-employed painters) are not having routine blood lead testing. Studies are needed in Michigan to ascertain the amount of underreporting.

[6] Rosenman KD, Sims A, Hogan A, Fialkowski J, Gardiner J. Evaluation of the effectiveness of following up laboratory reports of elevated blood leads in adults. AIHAJ 2001; May-Jun; 62(3):371-8.
[7] Canfield RL, Henderson CR, Cory-Slechta DA, Cox, C, Jusko TA, Lanphear BP. Intellectual impairment in children with blood lead concentrations below 10 µg per deciliter. N Engl J Med 2001; 348:1517-1526.

Additional Resources

Annual reports with detailed data on adult blood lead surveillance in Michigan: www.chm.msu.edu/oem

The MIOSHA lead standard for general industry and an educational guide are found at www.michigan.gov/mioshastandards. Click on “General Industry,” then scroll down to "Health Standards."

The MIOSHA lead standard for construction is found at www.michigan.gov/mioshastandards. Click on “Construction,” then scroll down to "Health Standards."

Information about lead abatement contractor licensing and worker certification: www.michigan.gov/leadsafe

6 Silicosis and Other Pneumoconiosis

Background

Pneumoconiosis is a term for a class of non-malignant lung diseases caused by the inhalation of respirable inorganic dust particles, nearly always in occupational settings. These diseases are generally progressive and incurable, even after removal of the affected worker from further exposure, and may ultimately result in death. Most cases of pneumoconiosis develop only after many years of cumulative exposure, thus they are usually diagnosed in older individuals, often long after the onset of exposure. They include silicosis, asbestosis, coal workers' pneumoconiosis (CWP), and, less commonly, pneumoconiosis due to a variety of other mineral dusts, including talc, aluminum, bauxite and graphite. Individuals with some kinds of pneumoconiosis are at increased risk of some other diseases, including cancer, tuberculosis, autoimmune diseases and renal disease.

Nationally, data on pneumoconiosis have been compiled by NIOSH from Medicare hospitalization data, multiple causes of death data submitted by all states to the National Center for Health Statistics, and from the national Coal Workers' X-ray Surveillance Program. Mortality from these diseases has been gradually declining over the past decades.[1] The Bureau of Labor Statistics publishes data on pneumoconiosis collected in their annual survey of a sample of employers' logs recording employee illnesses and injuries. However, it is well established that there is serious under-recording and reporting of these long-latency diseases.[2] These figures do not include the impacts of these dust exposures on other diseases, most notably the epidemic of lung cancer among asbestos-exposed workers.

Primary prevention of pneumoconiosis is mainly through control of occupational exposures to mineral dusts. Federal OSHA (in Michigan, MIOSHA) and the Mine Safety and Health Administration (MSHA) enforce standards for the control of mineral dusts at work. Control of asbestos dust and the elimination of asbestos from many products have contributed to the decline in asbestosis as well as asbestos-related lung cancer, but these conditions still occur. Michigan does not have any coal mines, but it has had copper and iron mines.

Reduction of pneumoconiosis deaths is one of the objectives in *Healthy People 2010.*[3]

[1] NIOSH. Work Related Lung Disease (WoRLD) Surveillance Reports. 1991, 1992, 1996, 1999.
[2] National Research Council. *Counting Injuries and Illnesses in the Workplace: Proposals for a Better System.* E Pollack and D Keimig. Eds. National Academy Press. Washington DC 1987.
[3] U.S. Department of Health and Human Services. *Healthy People 2010*. 2nd Edition. Washington, DC. U.S. Government Printing Office. November 2000. Objective 20-4.

Silicosis has been of particular concern in Michigan because of the exposure to silica in industries such as foundries. The widespread use of power equipment in the mines and factories beginning early in the 20th century, which generated large quantities of silica dust, caused an epidemic of lung disease associated with exposure to this dust.[4] The incidence of silicosis is believed to have declined since the 1920s and 30s, but the disease continues to be diagnosed in Michigan and elsewhere among people who have worked in industries such as foundries or construction, where exposures to hazardous levels of silica continue to be documented.

The annual incidence of silicosis nationwide has been estimated to be over 6,000 cases, with between 150 and 300 cases in Michigan. This estimate is based on an analysis of Michigan silicosis surveillance data and national data on cause of death.[5] Because of the long latency between exposure and work and the non-specificity of the symptoms, the disease is under-diagnosed and underreported, even in states like Michigan with mandatory reporting requirements.

The methods and results for the Michigan silicosis surveillance system are described in Part 1 of this chapter, followed by Part 2 for other pneumoconiosis.

Part 1: Silicosis

Surveillance Methods

Michigan has had a surveillance system for silicosis since 1987. The goal of the surveillance program is the prevention of silicosis through the identification and reporting of patients with the disease. The patient report is regarded as a sentinel health event that may lead to the identification of other employees from the same facility who are at risk of the disease from exposure to silica dust. Sources for the identification of persons with silicosis include occupational disease (OD) reports, claims awarded by workers' compensation, and the Michigan Master Death File, all described in Chapter 1.

The reported patient or next of kin is interviewed to collect diagnostic and exposure information. The patient's chest x-ray and medical record are obtained and reviewed by a physician who is board certified in internal and occupational medicine and who is trained to interpret chest x-rays for pneumoconiosis. A person is considered to have confirmed silicosis if there is (1) a history of exposure to silica, and (2) a confirmatory chest x-ray or lung tissue biopsy report.

[4] Rosner D, Markowitz G. *Deadly Dust: Silicosis and the Politics of Occupational Disease in Twentieth-Century America*. Princeton University Press. Princeton, NJ 1991.
[5] Rosenman KD, Reilly MJ, Henneberger PK. Estimating the Total Number of Newly-Recognized Silicosis Cases in the United States. Am J Ind Med 2003; 44:141-7.

If warranted, industrial hygiene evaluation of the work site where the individual was exposed to silica may then be conducted. The industrial hygienist from the Michigan Department of Consumer and Industry Services' MIOSHA program conducts air monitoring for silica and reviews the company's health and safety program. A report is sent to the company and union or designated labor representative that includes air sampling results and recommendations to prevent exposure among co-workers, as well as findings that are violations of MIOSHA standards.

Results

Eight hundred fifty-seven cases of silicosis in the state of Michigan have been confirmed through the silicosis surveillance system through 2001. Two hundred seventeen (25%) of these individuals had progressive massive fibrosis, the more severe form of silicosis.

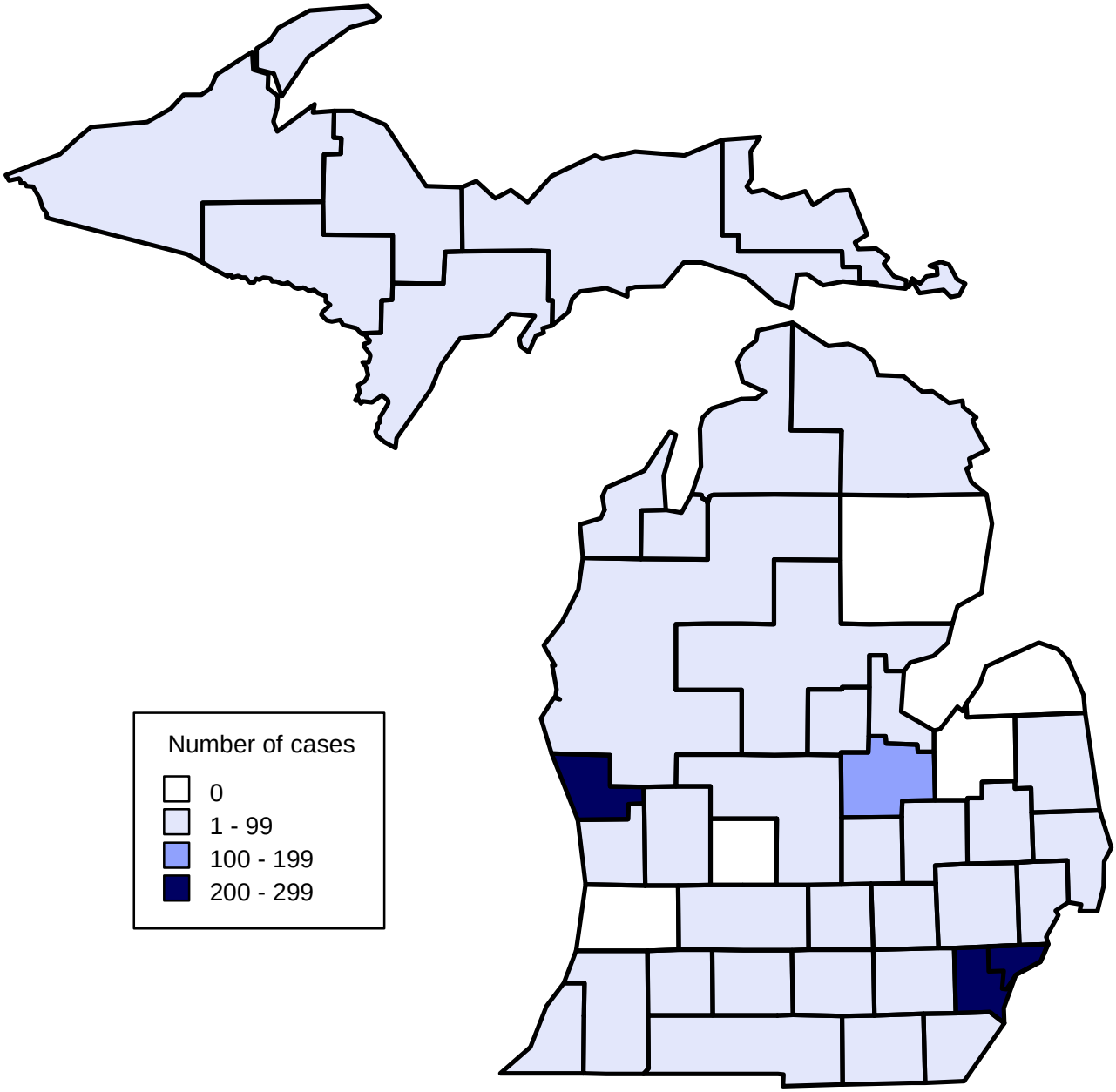
Figure 1 shows the geographic distribution of individuals confirmed with silicosis, by local health jurisdiction (where the silica exposure occurred).

Almost all of these 857 individuals were men (97.7%). African-Americans were markedly over-represented (43.3%), reflecting the migration of southern blacks to the north to work in heavy industry such as foundries.

The average date of birth was 1920 and ranged from 1888 to 1959, illustrating the long latency of the disease and its occurrence predominantly in older individuals. More than half (54%) of these individuals were first exposed in the 1940s and 1950s. Nevertheless, there were eight individuals whose first exposure to silica occurred in the 1980s or 1990s.

Five hundred twenty-one of these individuals are known to be deceased. Seventy (13%) of the 521 death certificates listed silicosis as the underlying cause of death.

FIGURE 1
Silicosis cases by local health department region of exposure
Michigan, 1985 - 2001



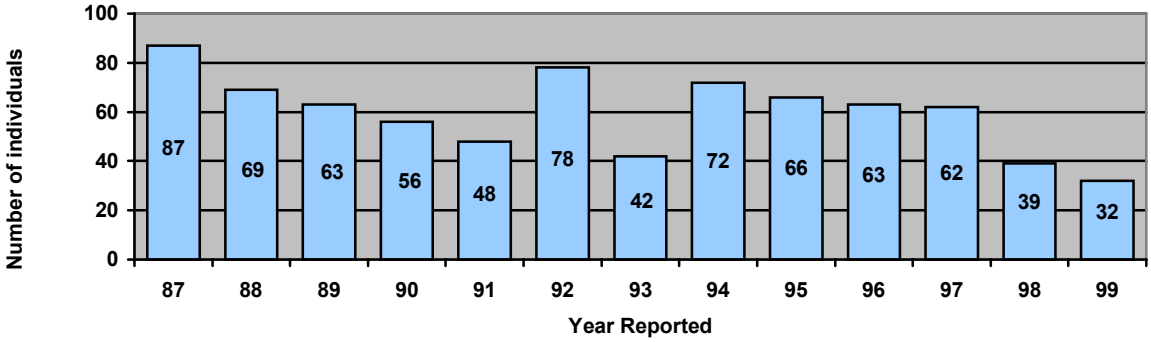
Total Michigan Cases: 857

Detroit cases and Wayne out-county cases were combined.

Source: Michigan State University, Department of Medicine

Figure 2 indicates the number of cases by year of report,[6] for the years 1987 through 1999, the years for which data are most complete (777 cases).

FIGURE 2
Number of individuals confirmed with silicosis by year reported, Michigan, 1987-1999 (N=777)



Source: Michigan silicosis surveillance system

Seventy-seven percent of these individuals were exposed to silica during foundry work. Construction and mining contributed sources of exposure for, respectively, 5.4% and 2.6% of the cases.

Three hundred twenty-two facilities were identified as the places of exposure to silica. MIOSHA completed inspections at 76 (24%) of these facilities. (Most of the rest were closed or no longer used silica.) Air sampling was conducted at 54 of the 76 inspected facilities. Thirty-three (62%) of these 54 facilities had exposure levels above the level for silica recommended by NIOSH and 21 (39%) were above the enforceable level set by MIOSHA.

Part 2: Asbestosis and Other Pneumoconiosis

Surveillance Methods

Data sources used to identify numbers of pneumoconiosis cases in Michigan include OD reports and the Master Death File. No follow-up is conducted to confirm the diagnosis or to verify that work-related dust exposure occurred, except for reports of silicosis, as discussed above.

[6] Year of report is defined as year the case was identified in source data, not the year the case came to the attention of the surveillance system, which is often one or more years later because of the lack of timeliness in reporting.

Results

In 2001, the most recent year of data, 1,264 individuals with pneumoconiosis (excluding silicosis) were reported to the OD surveillance system. Table 1 shows ten years of data (1992 through 2001) by type of pneumoconiosis for the 14,148 total reports. Ninety-nine percent of these reports were for asbestosis. (Asbestosis reports include individuals with pleural [lining of the lung] changes without radiographic evidence of scarring in their lungs.) The fluctuations in the numbers of reports over the years are believed to be due to compliance with reporting requirements. The small numbers of individuals with CWP worked in coal mines in other states.

TABLE 1
Occupational disease reports:
Pneumoconiosis other than silicosis by year, Michigan, 1992-2001

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CWP	0	6	62	3	0	0	0	0	0	0
Asbestosis	981	773	619	1055	805	1328	2858	3384	906	1261
Other inorganic dusts	1	1	0	0	0	0	0	0	1	1
Unspecified	5	6	5	28	44	6	1	2	4	2
Total	**987**	**786**	**686**	**1086**	**849**	**1334**	**2859**	**3386**	**911**	**1264**

Source: Michigan OD surveillance system

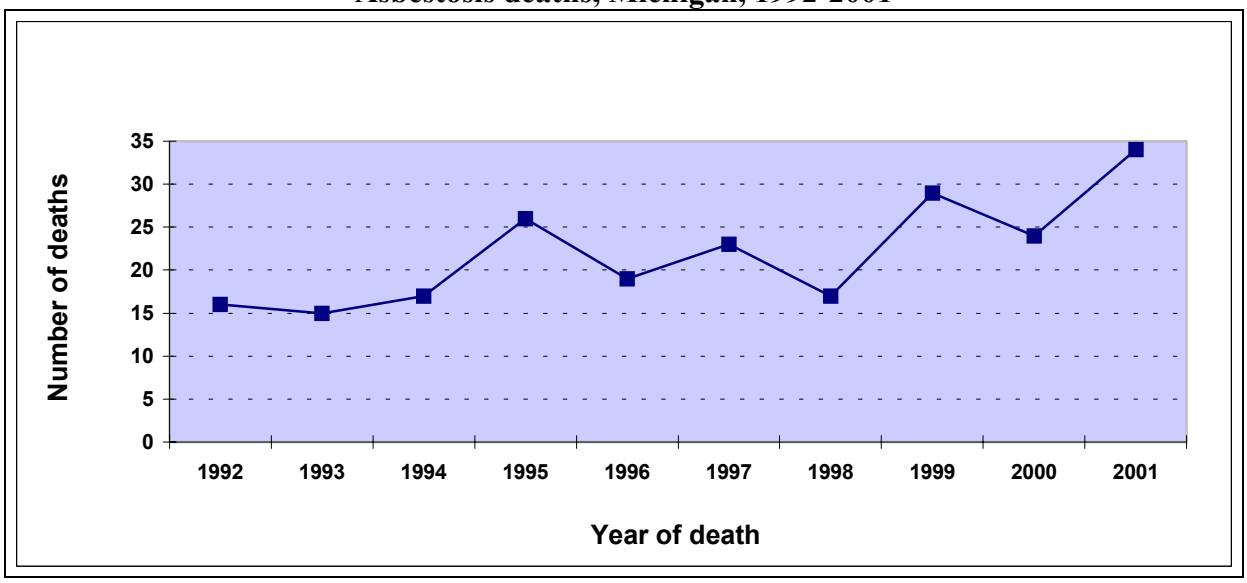
Table 2 shows the numbers of deaths in Michigan where pneumoconiosis was the primary or a contributing cause of death. The number of deaths from asbestosis rose from 16 to 34 over this 10-year period (Figure 3).

TABLE 2
Pneumoconiosis deaths other than silicosis, by year, Michigan, 1992-2001

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CWP	10	11	11	6	9	9	7	6	9	6
Asbestosis	16	15	17	26	19	23	17	29	24	34
Other Dusts	1	0	0	0	0	0	0	0	0	0
Unspecified	6	5	4	3	4	4	5	5	0	1
Totals	**33**	**31**	**32**	**35**	**32**	**36**	**29**	**40**	**33**	**41**

Source: Michigan Death File

FIGURE 3
Asbestosis deaths, Michigan, 1992-2001



Source: Michigan Death File

Discussion

Silicosis: The Michigan silicosis surveillance system confirmed 857 cases of silicosis with data for 1987-2001. Although most of these individuals were first exposed to silica many years ago and working conditions have clearly improved since the 1940s and 1950s, follow-up MIOSHA inspections found that exposure to silica is still occurring, especially in foundries. In construction, the other major industry in Michigan with ongoing silica exposure primarily during abrasive blasting operations, companies need to continue to improve work practices and, where feasible, switch from silica sand to a non-silica abrasive.

Continued vigilance is needed in the surveillance of silicosis. Although the numbers of case reports have declined over the years, new cases and new work sites continue to be identified by the surveillance system. Ongoing overexposure, especially in Michigan foundries and construction sites, poses risks for current workers unless problem sites are identified and protective actions are taken.

Attention and support should be provided for OSHA's current initiative to issue a new silica standard, which would lower the acceptable levels of silica dust in work sites and thus be more protective of workers.

Asbestosis and other pneumoconiosis: The OD reporting system identified from 900 to over 3,000 annual cases of pneumoconiosis other than silicosis in the ten-year time frame of this report, almost all being due to cases of asbestosis. Because of the widespread use of asbestos material in the construction and manufacturing industries historically, the reports of asbestos-related lung disease remain frequent.

BLS SOII data for the years 1992 through 2000 indicated that pneumoconiosis cases were identified only in 1993 and 1994 (8 and 15 cases, respectively). Only seventeen cases of pneumoconiosis were identified in the five years of workers' compensation data that are available (1997-2001). This is not surprising, given that these two data systems are much more likely to identify acute injuries rather than diseases. Diseases with long latency periods, like pneumoconiosis, often are only recognized clinically after the individual has retired or changed employers. These findings emphasize the importance of health care provider-based surveillance systems for occupational diseases in general and pneumoconiosis in particular.

Special laws are in place to protect asbestos remediation workers from hazardous exposures. Oversight of asbestos remediation work is regulated and enforced by the Michigan Department of Labor & Economic Growth (DLEG), formerly Consumer and Industry Services.

Pneumoconiosis reports and deaths should be reviewed routinely in order to identify unusual clusters or trends, with particular attention to asbestosis.

Strict adherence to controls for asbestos should reduce the incidence of asbestosis in the future. The recent discovery of asbestos disease associated with exposure to asbestos-contaminated vermiculite mined in Libby, Montana is an important reminder that vigilance to protect current workers from asbestos hazards is essential.

Additional Resources

Annual reports with detailed data on silicosis in Michigan: www.chm.msu.edu/oem

Information from OSHA on silicosis and control of silica dust:
www.osha.gov/SLTC/silicacrystalline

Information from NIOSH on silicosis and silica dust: www.cdc.gov/niosh/topics/silica

Information about NIOSH's programs and data for pneumoconioses:
www.cdc.gov/niosh/topics/pneumoconioses

Information from NIOSH about occupational hazards of asbestos-contaminated vermiculite:
www.cdc.gov/niosh/docs/2003-141

Information from OSHA on the hazards and regulations regarding asbestos:
www.osha.gov/SLTC/asbestos

Information about the MIOSHA asbestos program: www.michigan.gov/asbestos

7 Acute Occupational Pesticide Poisoning

Background

Pesticides are a category of chemicals that are used to kill or control insects, fungi, rodents, and weeds. There are approximately 850 active ingredients in about 20,000 pesticide products used in the U.S. Depending on the chemicals involved, pesticides can have short and long-term adverse health effects on different organ systems, including the skin, nervous, respiratory and reproductive systems. One class of pesticides, organophosphate pesticides, has received particular attention because of its acute toxicity. Farm workers may be at the highest risk of exposure, but other worker groups are also at risk, including pesticide applicators, workers in pesticide manufacturing facilities and even employees exposed as bystanders because of a pesticide application in their environment.

Although there are many published case reports of workers with acute pesticide poisonings, including occasional deaths, there is no system at the national level to characterize the full scope and magnitude of this problem. Nationally, the Toxic Exposure Surveillance System (TESS) compiles reports from most poison control centers in the United States. TESS identified over 6,300 occupational pesticide-related illnesses from calls between 1993 and 1996.[1] However, calls to poison control centers do not capture all cases of work-related pesticide poisonings.[2] Estimates from the Bureau of Labor Statistics of lost work time illnesses from pesticide exposure ranged from 504 to 914 a year for 1992 through 1996, and these numbers are likely to be an underestimate.[3]

The U.S. Environmental Protection Agency (EPA) regulates the use of all pesticides in the U.S. and provides information and coordination on issues ranging from worker protection to prevention of pesticide misuse. The Michigan Department of Agriculture (MDA) is responsible for overseeing the appropriate use of pesticides in Michigan, including enforcement of worker protection standards, registration of pesticides for use in Michigan, licensing and certification of pesticide applicators, and investigations of pesticide misuse.

With funding support from the EPA, NIOSH has established a standardized occupational pesticide surveillance system that currently involves nine states, including Michigan. These state-based systems are based on multiple data sources, including physician reports, workers' compensation reports and others.[4] In 1999, six participating states reported a total of 735 occupational pesticide poisonings.[5]

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[1] NIOSH. *Worker Health Chartbook, 2000*. DHHS (NIOSH) No. 2000-127. p. 144.
[2] Calvert GM, Sanderson WT, Barnett M, Blondell JM, Mehler LN, Sanderson WT. Surveillance of pesticide-related illness and injury in humans. In : Krieger R, editor. *Handbook of Pesticide Toxicology*. 2nd ed. San Diego: Academic Press; 2001. p. 611.
[3] Calvert, op cit. p. 620.
[4] Ballard TJ, Calvert GM. Surveillance of acute occupational pesticide-related illness and injury: the US experience. Ann. 1st. Super. Sanita, 2001. 37:175-179.
[5] Calvert G. SENSOR-Pesticides Annual Report FY '00. February 2001. http://www.cdc.gov/niosh/pestsurv/pdfs/pest-ar2000.pdf

Surveillance Methods

Occupational pesticide poisoning is reportable under the Public Health Code. MDCH has had an occupational pesticide illness and injury surveillance system since mid-2001. The goals of this system are to characterize the occupational pesticide poisoning problem in Michigan and to take actions to prevent others from experiencing adverse health effects from occupational pesticide exposure. This system uses several data sources to identify individuals, by name, who have had acute adverse health effects from exposure to pesticides at work. These data sources include occupational disease (OD) reports, reports from Michigan's two regional poison control centers, and reports to the MDA. The first two data sources are described in Chapter 1. Individuals can be identified from MDA's Pesticide and Plant Pest Management Division database of complaints of pesticide misapplications or violations. MDA investigates all calls, and, when indicated, takes appropriate regulatory action. MDCH follows up with all individuals who file a complaint with MDA if the complaint is related to an occupational exposure incident and there is an adverse health effect. A fourth data source is the Master Death File, which is analyzed annually to identify Michigan pesticide deaths where location was coded "at work." Michigan workers' compensation information cannot be used as a data source because there is no specific code for pesticide poisoning in the database.

An individual identified from source data must meet the surveillance case definition to be included in the surveillance system. To be considered a case, the individual must meet criteria related to (1) documentation of exposure, (2) documentation of adverse health effects, and (3) evidence supporting a causal relationship between pesticide exposure and health effects. (These criteria are detailed and complex; for more information, go to the NIOSH web site.[6]) If possible, individuals who meet the case definition may be interviewed to determine the circumstances of pesticide exposure, the severity of their illness, the name of the pesticide, the name of the workplace where exposure occurred, and other details about the incident. Medical records may be obtained. Data are collected in a database developed for states that are conducting NIOSH-funded pesticide surveillance.

Work sites or work practices where other workers are at risk are identified. When appropriate, referrals are made to other state agencies with regulatory responsibility for worker health and pesticides: the Michigan Department of Labor & Economic Growth, formerly Consumer and Industry Services (MDCIS), and MDA. MDCH also provides educational consultations to reported individuals, their employers, and health care providers about reducing hazards related to pesticide exposures. Data are summarized and two case studies are presented in this report.

[6] *Case definition for acute pesticide-related illness and injury.* http://www.cdc.gov/NIOSH/pestsurv/pdfs/pest-casdef2000.pdf

Results

Seventy-seven cases identified from source data met the case definition for inclusion in the surveillance system. These included 12 cases reported in 2001, 41 cases reported in 2002, and 24 cases reported through June of 2003. Because of lag times between the date of onset of illness and case reporting in the surveillance system, the 77 cases included 11 cases where onset of illness was earlier than 2001. Occupations at the time of exposure are tabulated in Table 1.

TABLE 1
Occupational pesticide illnesses and injuries by occupation (N=77), Michigan, 2001-2003

Occupation	Cases
Commercial Pest Control	16 (21%)
Farming	9 (11%)
Non-commercial pesticide application[1]	26 (34%)
Bystander exposure[2]	26 (34%)

[1]Non-applicators who applied pesticides at work
[2]Inadvertently exposed while performing other duties or exposed while someone else applied pesticide
Source: Michigan pesticide surveillance system

Table 2 summarizes the type of pesticide by the severity of illness. No deaths were identified. Sixty-five (84%) of the 77 cases were classified as low severity because the individuals' symptoms generally resolved within a few days without medical treatment, and there was minimal or no lost work time. Those with moderate severity had medical treatment with minimal lost work time.[7]

TABLE 2
Occupational pesticide illnesses and injuries by pesticide class and severity (N=77), Michigan, 2001-2003

Severity	Insecticides	Herbicides	Fungicides	Rodenticides	Microbicides
Death	0	0	0	0	0
Severe	0	0	0	0	0
Moderate	9	3	0	0	0
Low	32	17	3	5	8
Total	42	20	3	5	8

Source: Michigan pesticide surveillance system

Case Studies

Case Study 1: A commercial pesticide applicator was applying Ficam-D, a carbamate insecticide, to rid residential dwellings of the Asian lady beetle. After applying the dust six days a week, 10-12 hours a day, mostly in spaces over her head, she began experiencing headaches, muscle weakness, ataxia (failure of muscle coordination), blurred vision and burns to the eyes,

[7] The surveillance system uses a severity index, described in detail at http://www.cdc.gov/NIOSH/pestsurv/pdfs/pest-sevindexv6.pdf.

dizziness, nausea, vomiting, and sweating. She was initially given a respirator and briefly trained in worker protection, but not fitted properly for a respirator. Repeated requests for a new respirator went unanswered, as well as a request for a ladder so she would not have to apply the insecticide over her head. She did wear boots, a hat, long-sleeved clothing and glasses. She filed a complaint with MDA and MIOSHA. The worker ended her employment due to her medical condition, and her health gradually improved.

Case Study 2: A 19-year old farm worker working in fields that had been treated with a pesticide presented at the emergency room with a throbbing headache, stomachache, and dizziness. For five days prior, during the day, he had been lightheaded and shaky with muscle cramps and blurred vision. Once the evening came and he rested, he was relatively symptom-free. An initial cholinesterase test in the ED showed a level of 6,980 (normal range = 7,790-17,400), a test result compatible with organophosphate pesticide poisoning. His follow-up cholinesterase level five days later at an outpatient clinic was within normal range (12,700). He was diagnosed with organophosphate pesticide poisoning. It was recommended that he be off work to avoid re-exposure until his cholinesterase level increased and stabilized. The patient was lost to follow-up by the community health center where he had been a patient and by MDCH.

Discussion

The MDCH pesticide surveillance system has identified 77 cases meeting the nationally established case definition between mid-2001 and mid-2003. In spite of federal and state requirements for licensing, training and use of personal protective equipment for commercial pesticide applicators, these data suggest that applicators are at risk of hazardous exposures to pesticides. In addition, 34% of the reported cases were exposed while applying a pesticide even though they were not licensed applicators. Employers should be made aware of the risk of asking untrained employees to apply pesticides and encouraged to employ licensed commercial applicators.

Similar to many other occupational disease and illness surveillance systems, the Michigan pesticide surveillance data are likely a significant undercount of the true number of work-related pesticide poisoning cases in Michigan.

The problem of identifying pesticide-related illness begins with physician recognition and reporting. Other difficulties with occupational pesticide surveillance include the reluctance on the part of workers and their health care providers to involve state agencies because of concerns about job security, the time lag between the occurrence and the reporting of the incident, and difficulties in following up with reported cases because of language barriers or worker mobility, especially among seasonal farm workers. Additional education to promote recognition of pesticide poisoning and compliance with the reporting requirement is needed.

Additional Resources

For information on Michigan's Occupational Pesticide Surveillance Program: www.michigan.gov/mdch/0,1607,7-132-2945_5105-12875--,00.html

NIOSH occupational pesticides surveillance system: www.cdc.gov/niosh/pestsurv

Information on pesticide products: www.cdpr.ca.gov/docs/epa/epamenu.htm

Information on licensing and registration for pesticide application businesses, credentials for certified technicians, and laws and regulations for pesticide application: www.michigan.gov/mda/0,1607,7-125-1569_16988---,00.html

Information on the federal Worker Protection Standard (worker exposure to pesticides in agriculture): www.epa.gov/pesticides/health/worker.htm
In Michigan, call the Pesticide and Plant Pest Management Division, MDA, at (517) 373-1087.

Michigan State University's Pesticide Education Program: www.pested.msu.edu

8 Occupational Noise-Induced Hearing Loss

Background

Noise-induced hearing loss (NIHL) is an insidious condition that may take years to develop to a stage where it affects an individual's ability to communicate at home and at the workplace. Hearing loss can be caused by noise at work, noise elsewhere, a variety of drugs and medical conditions, and simply as part of aging. For these reasons, the occupational causes of NIHL are often unrecognized.

Hazardous levels of noise are most prevalent in construction, mining, agriculture and manufacturing. The National Institute for Occupational Safety and Health (NIOSH) has estimated that approximately 30 million workers in the United States are exposed to hazardous levels of noise.[1] The BLS SOII showed an annual average of only 200 individuals with work-related hearing loss resulting in lost work time nationwide. Based on the National Health Interview Survey, it is estimated that there are approximately 86,000 individuals in Michigan with NIHL related to workplace exposures.[2] Michigan is the only state with a comprehensive occupational NIHL surveillance system.

There are well-accepted control methods that allow for effective intervention at the workplace to prevent NIHL. Prevention of occupational NIHL is one of the U.S. Public Health Service's health objectives for the nation (*Healthy People 2010),*[3] is a research priority at NIOSH under its National Occupational Research Agenda (NORA), and is a priority activity at MIOSHA, as identified in the MIOSHA's Strategic Plan.

OSHA has requirements for a comprehensive hearing conservation program in general industry, but not for construction and agriculture. Facilities covered by the general industry standard are required to institute hearing conservation programs if the eight-hour time weighted average noise levels are at or above 85 decibels (dB).

[1] Franks JR, Stephenson MR, Merry CJ. 1996. Preventing occupational hearing loss - A practical guide. DHHS (NIOSH) Publication No. 96-110. p. 1.
[2] Reilly MJ, Rosenman KD. Noise-induced hearing loss. In *Workplace Health Surveillance: An Action-Oriented Approach.* Ed N. Maizlish. Oxford University Press, 2000. pp. 160-1.
[3] U.S. Department of Health and Human Services. *Healthy People 2010.* 2nd edition. Washington DC. U.S. Government Printing Office. November 2000. Objective 20-11.

Surveillance Methods

In 1992, Michigan received funding from NIOSH to establish an occupational NIHL surveillance program. This program is based on the occupational disease (OD) reporting system (see Chapter 1). The program has conducted considerable outreach both to employers in noisy industries and physicians and audiologists to improve compliance with the reporting requirement.

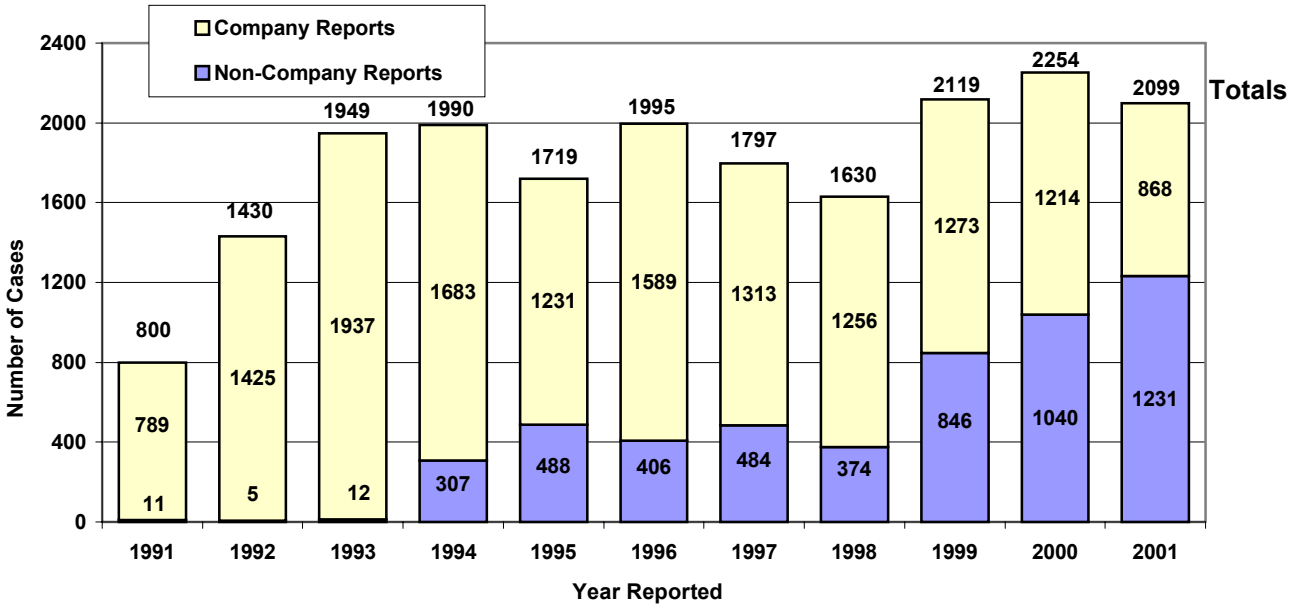
An individual is considered to have occupational NIHL if a health professional determines that the individual has audiometric findings consistent with NIHL and has a history of exposure to noise at work sufficient to cause hearing loss. Company medical departments report employees with Standard Threshold Shifts (STS) of 10 decibels (dB) or more in either ear. (STS is where the subject's threshold of barely audible sound shifts to a higher level of sound.) Private audiologists/otolaryngologists report patients' fixed hearing loss. Individuals reported by a company medical department are assumed to be enrolled in their company's hearing conservation program. Those with fixed hearing loss who are reported by a private practice audiology clinic or by an otolaryngologist not part of a company are followed up to determine if the company where they were exposed has a hearing conservation program. These individuals are administered a brief telephone questionnaire about the history of their exposures to noise.

After the reported individual has been interviewed, a referral for an industrial hygiene investigation is forwarded to MIOSHA, so long as the individual reports exposure to noise at the workplace and was not provided regular audiometric testing and hearing protection by their employer. MIOSHA conducts an inspection during which noise is addressed. (Facilities not covered by the OSHA noise standard, such as those in construction and agriculture, generally are not followed up by MIOSHA.) An industrial hygienist conducts monitoring for noise and reviews the completeness and quality of the company's hearing conservation program, if one exists. A report of the results of the investigation and any recommendations are sent to the company, union and reporting health care provider.

Results

The surveillance system identified 20,731 cases of occupational NIHL through 2001, including 949 (5%) reported between 1985 and 1990 and 19,782 (95%) from 1991 through 2001. Non-company sources reported 5,204 (26%) fixed hearing loss cases among the 19,782 reports submitted between 1991 and 2001, when company and non-company sources were differentiated in the data (Figure 1). Mandatory reporting greatly increased after the initiation of the surveillance program's outreach in the early 1990s, especially reporting from non-company health care providers. The percent of reports from non-company physicians increased from less than 1% in 1992, the first year of active surveillance, to 58% in 2001.

FIGURE 1
NIHL cases reported to the Michigan Dept. of Consumer and Industry Services, by reporting source, 1991-2001 (N=19,782)



Source: Michigan noise surveillance system

Interviewing of individuals with a fixed loss began in 1992. Three thousand seven hundred fifty-one (72%) of the 5,204 individuals who were reported between 1992 and 2001 with a fixed hearing loss were interviewed.

- Ninety three percent of the reported individuals were male.
- Of the 3,450 individuals for whom race was known, 85% were white, 12% were African-American, and the rest were of other race/ethnicity.
- Only 44% of these individuals worked most recently at a company that had a hearing conservation program.
- Five hundred ninety-four (16%) of interviewed individuals had at least part of their exposure to noise in construction jobs.
- Ninety-four percent had no regular hearing testing provided by their employer; however, 45% were given hearing protection.

Table 1 shows the distribution of reported individuals (company and non-company reports) by industry type for 2001, the most recent year of data. Most of the reports were for individuals working in manufacturing facilities, including "transportation" manufacturing (e.g., automobile manufacturing). Non-company health professionals reported more individuals from industries outside of manufacturing than company health professionals reported.

TABLE 1
Noise-Induced Hearing Loss: Distribution of reported individuals by industry, Michigan, 2001

Industry groups	Number of Individuals	Percent
Agriculture/forestry	**6**	**0.3**
Construction	**115**	**5.9**
Manufacturing	**1,586**	**81.3**
Food	6	0.3
Lumber	5	0.3
Furniture	6	0.3
Paper	7	0.4
Printing	5	0.3
Chemicals	27	1.4
Petroleum and coal products	8	0.4
Rubber	33	1.7
Stone/clay/glass	8	0.4
Primary metals	287	14.7
Metal fabrication	230	11.8
Machinery	58	3.0
Electronics	55	2.8
Transportation	825	42.3
Instruments	1	0.1
Miscellaneous mfg industries	25	1.3
Transportation/Commercial services	**63**	**3.2**
Retail trade	**17**	**0.9**
Finance, insurance and real estate	**6**	**0.3**
Services	**129**	**6.6**
Public administration	**28**	**1.4**
TOTAL	**1950***	**100**

* Industry unknown for 149 individuals
Source: Michigan noise surveillance system

Inspections were conducted at 101 companies where the individual reported that they had not received audiometric testing within the last five years. Of the 101 companies, 57 (56%) were required to have a hearing conservation program because they had noise levels at or above 85 dBA; 43 of these 57 companies (75%) had either no hearing conservation program or a deficient hearing conservation program.

Discussion

This surveillance system identified 20,731 cases of occupational noise-induced hearing loss from 1985 through 2001, with an annual average of approximately 1,900 reports a year since 1992. This can be compared to the BLS SOII, which shows approximately 200 cases annually nationally and no reported cases in Michigan for the years 1995-2000; it can also be compared to Michigan workers' compensation data with an annual average of 12 filed claims for NIHL for the years 1997-2001.

Even so, the Michigan data are very likely to be an undercount of the true number. There are approximately 450 audiologists and 150 otolaryngologists in the state. Reports were received in 2000 from only seven of the 80 estimated group practices in the state and 43 practitioners not known to be associated with a group practice. Outreach to company medical programs and practitioners should continue in order to improve reporting.

Reporting of individuals with NIHL has led to the identification of worksites with inadequate hearing protection programs. Data from this surveillance project are useful for the evaluation of the success of outreach and workplace inspections initiated under MIOSHA's strategic plan for the reduction of occupational NIHL. The surveillance system should continue to be used to identify companies with inadequate hearing conservation programs.

Regulatory protections for workers in construction who are exposed to noise need to be improved. Federal OSHA has indicated its intention to initiate rulemaking on this subject.

Additional resources

Annual reports with detailed data on occupational noise-induced hearing loss in Michigan: www.chm.msu.edu/oem

MIOSHA information about noise-induced hearing loss and the occupational noise exposure standard: www.michigan.gov/cis/0,1607,7-154-11407-42328--,00.html

9 Occupationally-Acquired Communicable Diseases

Background

Communicable diseases can be acquired in an occupational setting, either by close contact with infected persons or animals or handling laboratory samples from infected sources. A number of occupational groups are at increased risk of contracting a communicable disease during the course of their workday. Health care workers, laboratory workers, and correctional institution workers are particularly at risk. There are approximately 10 million health care workers in the United States, making up eight percent of the workforce. There are half a million correctional workers in the U.S.

Many communicable diseases are reported to have been acquired at work, including diseases from bloodborne pathogens such as HIV and hepatitis, tuberculosis, Legionnaires' disease, vaccine-preventable diseases such as rubella and pertussis, diseases from viruses such as influenza and varicella-zoster, skin conditions, acute gastrointestinal infections and others. Diseases from bloodborne pathogens and tuberculosis are of particular concern because of their severity and frequency among occupational groups.

Bloodborne pathogens, transmitted through exposure to contaminated blood or bodily fluids, include hepatitis B, hepatitis C, and the human immunodeficiency virus (HIV/AIDS). Hepatitis B is a liver disease caused by the hepatitis B virus (HBV) that can result in cirrhosis of the liver, liver cancer, liver failure and death. The estimated number of hepatitis B infections among U.S. health care workers (HCWs) has decreased dramatically from the mid-1980s to the mid-1990s, from approximately 12,000 cases per year to 800 cases per year.[1] The decline in infections is attributed to vaccination against hepatitis B and the adoption of universal precautions against exposure to bodily fluids in health care facilities.

Hepatitis C is a liver disease caused by the hepatitis C virus (HCV). This infection is the most common chronic bloodborne infection in the United States.[1] Approximately two to four percent of acute HCV infections in the U.S. occurred among HCWs exposed to human blood in the workplace. Nationwide, 648 HCWs were reported with HCV from June 1995 to October 1999. The transmission rate of HCV following a needlestick injury from an infected patient has been estimated to be in the range of zero to seven percent.[2]

[1] Worker Health Chartbook, 2000. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.
[2] Morbidity and Mortality Weekly Report, *Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HBV, HCV, and HIV and Recommendations for Postexposure Prophylaxis*. U.S. Department of Health and Human Services, CDC, June 29, 2001, Vol. 50, No. RR-11

HCWs are also at risk of HIV through exposure to blood or other body fluids infected with the virus. In the U.S., as of June 2000, there were 56 reports nationally of documented HIV seroconversion associated with occupational exposure, and an additional 138 cases of possible occupational HIV transmission. Twenty-five of the 56 documented cases of HIV infection have progressed to AIDS.[3] The average transmission rate of HIV infection following a needlestick injury from an infected patient has been estimated to be 0.3 percent.

Injuries from sharps (e.g., needles, scalpels) are the most frequent source of exposure to bloodborne pathogens for health care workers. The CDC estimated that 384,000 percutaneous injuries from contaminated sharps occur annually among health care workers in hospitals in the U.S.[3] About 60 percent of health care workers work in non-hospital settings, and the number of needlestick injuries for this group is unknown.[3]

The federal government and the Michigan OSHA program (MIOSHA) have issued rules that employers must follow to protect employees from exposure to blood and other potentially infectious material.[4, 5] In Michigan, the rule was first promulgated in 1993; it was amended most recently in 2001 to include additional federally mandated requirements related to injuries from sharps. Recognizing that most injuries from sharps can be prevented by using safer medical devices, this new rule requires employers to use safer sharps devices. The rule also requires employers to keep a detailed log of injuries from sharps.

Tuberculosis (TB) is a disease caused by *Mycobacterium tuberculosis*. The tubercle bacilli are spread in airborne droplet nuclei produced by people with pulmonary TB when they cough or sneeze. A number of outbreaks have occurred among workers in health care settings and other work settings in recent years. TB remains a threat to health care and corrections workers because of their close contact with individuals who have active TB. From 1994 through 1998, there were 2,732 TB cases nationally among HCWs, constituting three percent of all TB cases.[6] Seasonal farm workers are another high-risk occupational group; they are approximately six times more likely to develop tuberculosis than the general population of employed adults.[7]

MIOSHA has issued requirements for the prevention of transmission of TB in high-risk workplaces, including health care facilities, correctional facilities, long-term care facilities, homeless shelters and drug treatment centers (Program Directive No. 96-9). This directive is based on the 1994 CDC "Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health Care Facilities."

All states conduct surveillance of communicable diseases and report data to the CDC in a variety of data systems. Some of these data systems obtain information on occupational risk factors. Data systems specific to occupational disease, such as mandatory occupational disease reporting

[3] United States General Accounting Office, Washington, DC. GAO-01-60R Needlestick Prevention. 11/17/00.
[4] Federal Register January 18, 2001. U.S. Department of Labor, Occupational Safety and Health Administration. Part IX. 29 CFR Part 1910. *Occupational Exposure to Bloodborne Pathogens; Needlesticks and Other Sharps Injuries; Final Rule.*
[5] Michigan Administrative Code Part 554 R 325.7001-70018.
[6] Worker Health Chartbook. *Loc cit* p. 154.
[7] Prevention and Control of Tuberculosis in Migrant Farm Workers Recommendations of the Advisory Council for the Elimination of Tuberculosis. MMWR; June 06, 1992/41(RR10)

systems, the BLS Annual Survey and workers' compensation also identify occupationally acquired communicable disease. There is no national system for collecting and reporting on occupationally acquired communicable disease, although there has been considerable attention given specifically to the problems of exposure to bloodborne pathogens and tuberculosis in the workplace.

Surveillance Methods

There are five sources of data on work-related communicable diseases: the reports submitted to MDCH under the Michigan Public Health Code Communicable Disease (CD) Rules, reports submitted under the occupational disease (OD) reporting law, MIDB (hospitalization data where workers' compensation is the primary payer), BLS annual survey data, and workers' compensation data. Chapter 1 describes these data sources. Because of the confidentiality of case reports, it is difficult to determine how many individuals are identified by more than one of these data systems.

All reports to the OD, BLS, and workers' compensation data systems are, by definition, work-related. Work-related communicable diseases are identified in MIDB where the patient's principal discharge diagnosis code is an ICD-9-CM code for an infectious disease (ICD-9-CM: 001-136, 482.84) and workers' compensation is the primary payer.

There are no specific data items in any of the CD data systems that would identify work-related communicable disease cases. However, for hepatitis, HIV/AIDS, and TB, there is information about occupation, specifically high-risk occupations, which could suggest work-relatedness. In this report, hepatitis cases are counted as work-related if the individual was noted to have been employed in the last six months "in a medical, dental, or other field involving contact with human blood." For HIV/AIDS, a case is considered work-related if the reported person worked in a health care or clinical laboratory setting and had no other risk factors for HIV. For TB, if the reported individual is in one of the following high-risk groups - health care worker, correctional employee, or migratory agricultural worker - they are considered to have acquired TB at work. The work-relatedness of case reports with other communicable diseases was determined by reviewing paper files of communicable disease case follow-up investigations and by asking staff for their recollection of such cases.

The years of data availability vary across data sources: OD and CD data are presented for 1991-2001, workers' compensation data for 1997-2001, and MIDB and SOII data for 1999-2001. In addition, hepatitis data are within the CD data set beginning in 1999. Because of very small numbers, the maximum number of years of available data is presented for each data source.

Results

Table 1 summarizes the types and numbers of occupationally acquired communicable diseases in Michigan. The data are presented by disease and data source. The years represented are noted. (A dash in a cell means that the data system did not code using that diagnostic category.)

TABLE 1
Work-related communicable disease reports by data source, Michigan

Disease	CD	OD (1991-2001)	Workers' comp (1997-2001)	MIDB (1999-2001)	BLS (1999-2001)
Hepatitis B, acute infection	34 (1999-2001)	-	-	0	0
Hepatitis C, acute infection	20 (1999-2001)	-	-	0	0
Hepatitis, unspecified	-	11	67	2	0
HIV/AIDS	2 (1991-2001)	0	-	1	0
Tuberculosis*	145 (1991-2001)	102	18	1	+**
Legionnaires' Disease	1 (1991-2001)	0	-	0	0
Foodborne/ Zoonotic	2*** (1991-2001)	16	-	6	+**
Other viral****	-	13	-	3	-
Other and unspecified	2***** (1991-2001)	20	125	27	125
TOTAL	**206**	**162**	**210**	**40**	**125**

* The CD data are for active disease only. The other data systems do not distinguish between infection and active disease.
** At least one case, but numbers too small to be released by BLS.
*** These two cases were part of a multi-state outbreak of multidrug-resistant (MDR) *Salmonella* Newport in the U.S., which included two workers in Michigan.[8] Dairy cattle were the suspected source.
**** For example, chicken pox, herpes zoster.
***** These two cases involved: (1) An outbreak of Legionnaires' Disease, associated with cooling towers at a correctional facility in Michigan in 1993, which included one employee among the 17 diagnosed persons, [9] and (2) The death of a laboratory worker in Michigan from laboratory-acquired meningitis.[10]

[8] Morbidity and Mortality Weekly Report, *Outbreak of Multidrug-Resistant Salmonella Newport – United States, January – April 2002*. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, June 28, 2002. 51(25); 545-548.
[9] Morbidity and Mortality Weekly Report, *Legionnaires' Disease Associated with Cooling Towers – Massachusetts, Michigan, and Rhode Island, 1993*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, July 15, 1994. 43(27); 491-493, 499.
[10] Morbidity and Mortality Weekly Report, *Laboratory-Acquired Meningococcal Disease – United States, 2000*. U.S. Department of Health and Human Services, CDC, February 22, 2002, Vol. 51(07); 141-4.

Discussion

The numbers presented in the table are probably a significant undercount of the true number of occupationally-acquired communicable diseases in Michigan. Except for HIV/AIDS, the CD surveillance system generally does not collect sufficient information about occupational exposure to be able to confirm the work-relatedness of the disease. Occupational information is not collected or, where it is collected, often is missing on case reports. Only rarely is laboratory confirmation (e.g., DNA fingerprinting) conducted to establish the source of infection. More complete occupational information in communicable disease surveillance systems would provide important new data on the incidence and risk factors for work-related communicable disease.

Completeness of occupationally-acquired communicable disease reporting to the OD system has not been evaluated; however, it has been estimated that OD reports may represent less than one-third of the number of individuals diagnosed with occupational diseases overall.[11] Reasons for underreporting in the BLS and workers' compensation data systems are discussed in Chapter 1.

Currently there are no provisions for sharing of case reports between the OD and CD reporting systems for communicable disease, even though both reporting requirements fall under the Public Health Code and both surveillance systems collect data for the same purpose: to take actions to prevent additional disease in others. Although there have been occasions where MIOSHA and the CD program at MDCH have collaborated on work-related communicable disease follow-up investigations, as in the case of a laboratory worker with meningitis, sharing of case reports is not routine. A system should be established to match communicable disease case reports between the CD and OD systems to ensure that reporting is complete in both systems and to allow for appropriate preventive actions.

Adherence to standard precautions, including hand washing, barrier precautions, vaccination against infectious agents and post-exposure prophylaxis is the primary strategy to prevent transmission of infectious agents in health care and other high-risk environments.[12] Newer technologies – safer needlestick devices, for example – are also important. Compliance with MIOSHA requirements and guidelines, such as those for tuberculosis and bloodborne pathogens, is essential.

The recent (2001) amendment to MIOSHA's bloodborne infectious disease standard requires facilities to select safer sharps instruments and to maintain detailed logs of sharps injuries. Compliance with these requirements should be assessed, and training provided where the need is identified. Information in sharps injury logs can also be used to identify specific hazards in work environments and evaluate program and device effectiveness to further reduce injuries. If reported to a public health agency either voluntarily or as mandated (which is the case in

[11] Reilly MJ, Rosenman KD, Kalinowski DJ, Deliefde JW. Summary of 1996 Occupational Disease Reports to the Michigan Department of Public Health. Lansing MI. March 20, 1997.
[12] Bolyard E, Tablan OC, Williams WW, Pearson ML, Shapiro CN, Deitchman SD, and the Hospital Infection Control Practices Advisory Committee. Guidelines for infection control in health care personnel, 1998. Am J Infection Control. 1998. 26:289-354.

Massachusetts), these data would be useful for enhanced surveillance of the risks of bloodborne diseases to health care and other high-risk workers.

The introduction of universal precautions to protect workers from exposure to blood has been accompanied by another occupational health problem: allergic reactions to natural rubber latex. Use of powder-free or low-protein gloves, or, if necessary, complete avoidance of latex products remains the cornerstone for preventing sensitization and reactions to natural rubber latex products.

Emerging occupational communicable disease concerns need to be monitored in Michigan, including the risk of TB infection among veterinarians exposed to bovine TB (*Micobacterium bovis*) (two documented cases recently), the risk of West Nile virus infection in workers who spend time outdoors in warm weather (three probable cases in 2001), adverse reactions to smallpox vaccination among health care workers who elect to participate in the national smallpox response effort, and HCWs' risk of infection from exposure to patients with Severe Acute Respiratory Syndrome (SARS) or monkeypox.

Additional Resources

MIOSHA information on bloodborne infectious disease and tuberculosis:
www.michigan.gov/cis/0,1607,7-154-11407-42328--,00.html

OSHA information on bloodborne infectious diseases:
www.osha.gov/SLTC/bloodbornepathogens

Communicable disease data in Michigan, including data on hepatitis, TB, meningitis, Legionnaires' disease: http://mappp.org/epi

Michigan HIV/AIDS data:
www.michigan.gov/mdch/0,1607,7-132-2944_5320_5331---00.html

10 Work-Related Musculoskeletal Disorders

Background

Work-related musculoskeletal disorders (MSDs), repetitive trauma, repetitive strain, and cumulative trauma disorder are some of the terms used to describe the effect of repeated awkward or forceful movements upon one's muscles, nerves, ligaments, joints, and tendons. Although work-related MSDs can involve many parts of the body, the most frequently reported anatomic sites are the upper extremities (hands, wrists, elbows, shoulders), and back, especially lower back. Carpal Tunnel Syndrome (CTS), a medial nerve compression disorder, is a specific MSD diagnosis of the hand and wrist. [1]

The causes of MSDs are not completely understood. Most researchers agree that physical factors in the workplace increase risk, especially when there are high levels of exposure and when more than one physical factor is present (such as repeated lifting of heavy objects in extreme or awkward postures). These physical factors can be grouped as: repetitive movements, forceful movements, awkward postures, and exposure to vibration. Typical jobs of workers at risk for upper extremity MSDs include food processors, automobile and electronics assemblers, carpenters, office data entry workers, grocery store cashiers and garment workers. Nursing aides, licensed practical nurses, construction laborers, carpenters, and truck and tractor operators are at risk for low-back MSDs. Other factors which may influence an individual's risk for MSDs include: prior history of MSDs, obesity, age, gender, smoking, and physical fitness or strength.[2]

Work-related MSDs are major causes of lost work time and disability in Michigan and the United States. According to the National Institute for Occupational Safety and Health (NIOSH), MSDs are the largest single problem facing American workers today, with estimated costs between $13 and $20 billion annually.[3] The Bureau of Labor Statistics (BLS) estimated in their annual survey (SOII) that in 2001 there were 216,400 workers in the private sector with repetitive motion disorders, for an incidence rate of 23.8 per 10,000, of which 65,162 (30%) resulted in lost work days. The incidence of musculoskeletal disorders resulting in lost work time, according to SOII data, was 52.2 per 10,000 workers for 2001. Over one-third of the cases involved the back. The workers' compensation cost in the U.S. for back pain alone is estimated at $11 billion per year,[4] and for MSDs of the upper extremities the estimate is $2.1 billion in workers' compensation costs.[5] Besides direct costs in terms of lost work and medical expenses, there are social costs to the worker and his/her family and diminished quality of life.

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[1] Weeks JL, Levy B, Wagner G. eds. *Preventing occupational disease and injury*. American Public Health Association, 1991. pp. 194-203.

[2] *Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back,* Second Printing July 1997**.** DHHS (NIOSH) Publication No. 97-141.

[3] NORA musculoskeletal disorders website. http://www2.cdc.gov/NORA/teamposters/psmsd.html

[4] NORA low back disorders website http://www2.cdc.gov/NORA/NaddinfoLowBack.html

[5] NORA musculoskeletal disorders website. http://www2.cdc.gov/NORA/NaddinfoSkeletal.html

CTS is a type of work-related MSD that has the longest average disability duration among the top 10 workers' compensation conditions in the United States.[6] The 2001 BLS Survey identified 26,794 CTS cases with lost work time, for an annual incidence of 3.0 per 10,000 workers in the private sector in the United States. The median number of days off work for CTS in 2001 in the U.S. was 25, compared with six days for all conditions with lost workdays. Leigh, et al[7] estimate the medical costs alone at $2,674 per CTS case.

MIOSHA has recognized the impact of MSDs and has established a goal of reducing their prevalence in Michigan workers by 15 percent by 2003.[8] This is being accomplished by targeting enforcement and educational interventions to the industries with the highest rates of work-related MSDs. *Healthy People 2010*[9] targets the reduction of injury and illness cases involving days away from work due to overexertion or repetitive motion.

Surveillance Methods

This chapter uses data from the BLS SOII, the Michigan workers' compensation data files, and the Michigan occupational disease reporting system (OD), all of which are described in Chapter 1. Each data system allows for the identification of the numbers of MSDs based on the way information is captured and coded, none of which is ideal for distinguishing chronic (i.e., repetitive) from acute causes of the MSD. The definitions for each data system are as follows.

Bureau of Labor Statistics (SOII)

Information from the 1992-2001 SOII is presented. Numbers and rates of all "disorders associated with repeated trauma" were derived from tabulations by BLS based on the numbers of cases employers identified in this illness category. Additional information was extracted on those cases resulting in lost work time. For this analysis, MSDs were defined as those lost work time cases classified into one of two "Event" types ─ "Repetitive Motion" and "Overexertion." Because of their prevalence, cost, and relationship to work factors, additional data were compiled on two subgroups: work-related musculoskeletal disorders of the upper extremities and of the back. CTS has its own "Nature of Injury" code; however, it should be noted that 99% of all of the CTS cases are also coded as "Repetitive Motion" events.

Occupational disease reporting system (OD)

In this system, work-related musculoskeletal disorders are classified as cases with ICD-9 codes of 710 through 739 (Diseases of the Musculoskeletal System and Connective Tissue), and ICD 354 (CTS). Data from the OD reporting system are available from 1991 through 2001.

[6] Work Loss Data Institute. State report cards for workers' compensation – a WLDI special study based on data from 2000 BLS OSHA form 200. March 2003. WLDI, Corpus Christi, TX. p. 8
[7] Leigh JP, Markowitz S, Fahs M, and Landrigan P. Costs of occupational injuries and illnesses. U. Michigan Press, Ann Arbor, MI, 2000. p. 149.
[8] MIOSHA. Strategic plan, fiscal years 1999-2003. Bureau of Safety and Regulation, Michigan Occupational Safety and Health Act (MIOSHA). December 11, 1998. Now part of MI Department of Labor & Economic Growth.
[9] U.S. Department of Health and Human Services. *Healthy People 2010.* 2nd edition. Washington DC. US. Government Printing Office. November 2000. Objective 20-3.

Michigan workers' compensation system

Cases are tabulated by "Nature of Injury" codes: Inflammation or Irritation of Joints, Muscles or Tendons, or Sprains, Strains, Pinched Nerves and Torn Cartilage, plus CTS. For a case to be counted in this system, the condition must result in a disability of eight or more consecutive days. Data are available from 1997 through 2001.

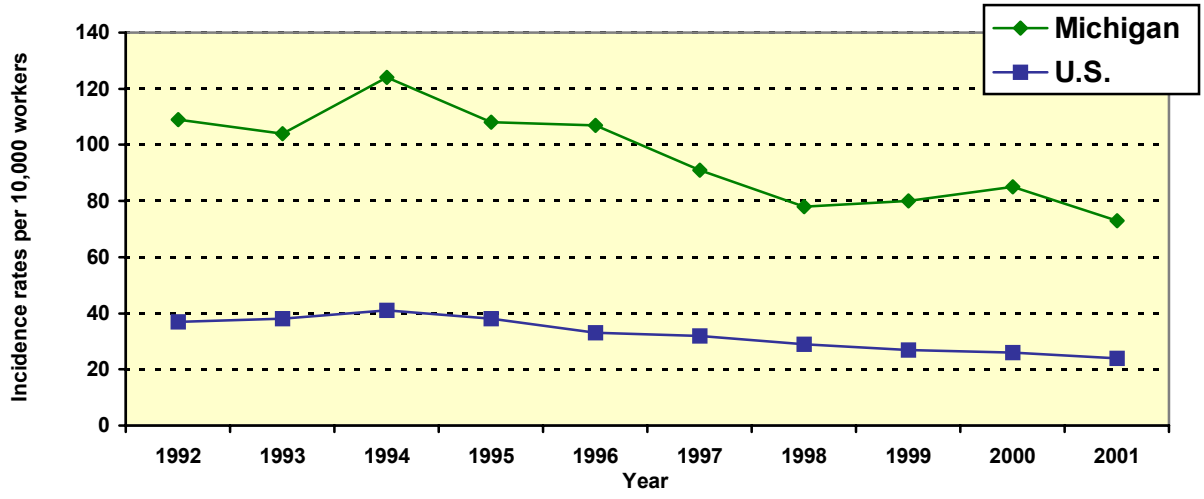
Results

Bureau of Labor Statistics (SOII)

Disorders associated with repeated trauma

There were 23,200 work-related disorders associated with repeated trauma reported by SOII in Michigan in 2001, for an incidence of 65 per 10,000 workers. Ninety-seven percent (22,700) were in the private sector, with an incidence of 73.4. Figure 1 shows trends over the ten-year period comparing incidence rates in Michigan's private sector to rates in the United States. Michigan's rates were consistently more than double those of the U.S. for this time period.

FIGURE 1
Disorders associated with repeated trauma:
incidence rates, Michigan and U.S., 1992-2001

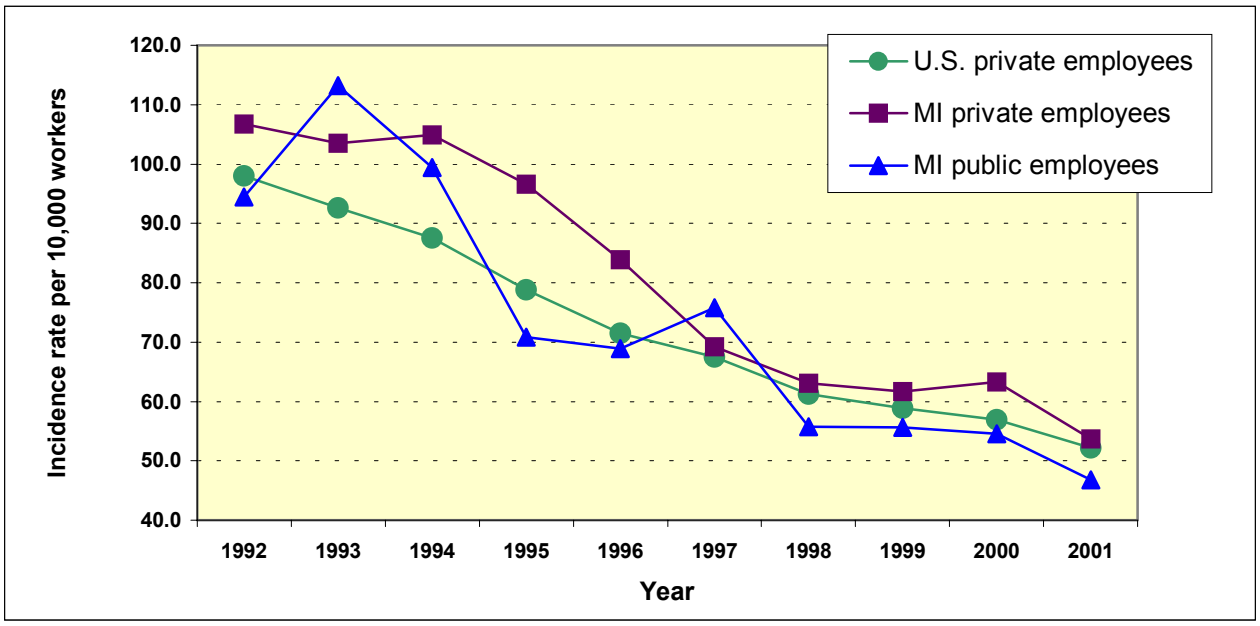


Source: BLS SOII

Disorders due to overexertion and repetitive motion with days away from work

In 2001, there were 16,631 work-related MSDs with days away from work in the private sector and 2,177 in the public sector reported in Michigan, for a total of 18,808, of which 15,178 (80.7%) were classified as overexertion and 3,630 (19.3%) as repetitive motion. This is an incidence rate of 53.7 per 10,000 workers for private industry and 46.7 for the public sector. Both the numbers and rates declined from the 1994 high of 30,721 cases at a rate of 104.9 for the private sector and 3,991 cases at a rate of 99.4 for the public sector (Figure 2). Rates in both the private and public sectors in Michigan paralleled the overall rate decline in U.S. private industry workers. Private sector industries in Michigan with the highest incidence rates were manufacturing and construction; this is consistent with national data.

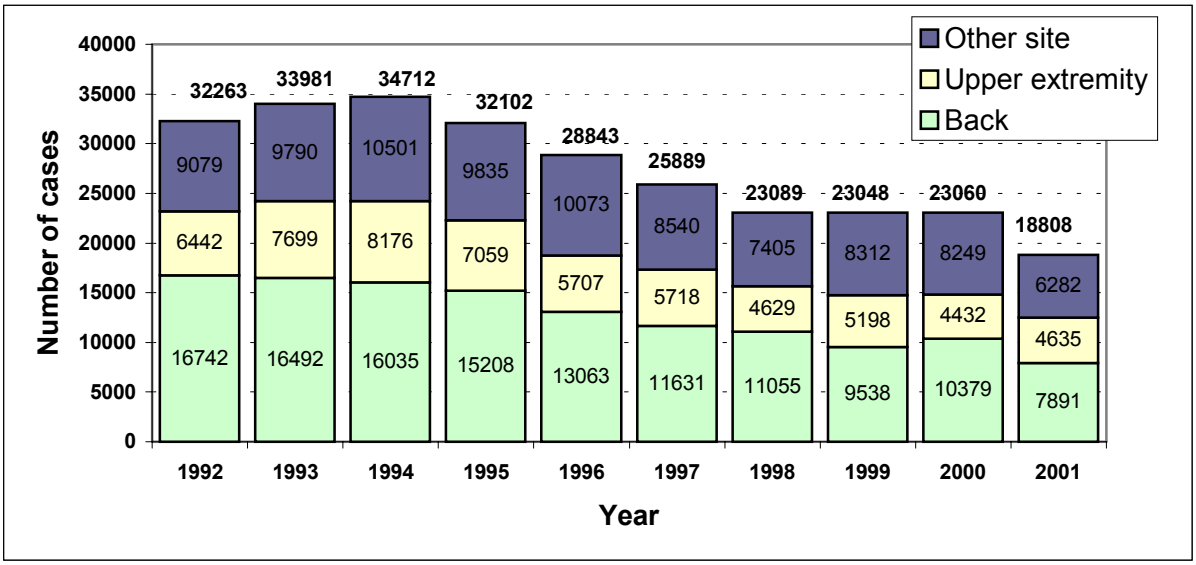
FIGURE 2
MSDs with days away from work:
incidence rates, Michigan and U.S., 1992-2001



Source: BLS SOII

Upper extremity disorders, including CTS, accounted for 22% of all MSDs over the ten-year period, and MSDs of the back were 46% of the total. Figure 3 shows the numbers of MSDs by anatomical site for 1992-2001 for public and private sectors combined in Michigan.

FIGURE 3
Number of MSDs with days away from work, by anatomical site, Michigan, 1992-2001

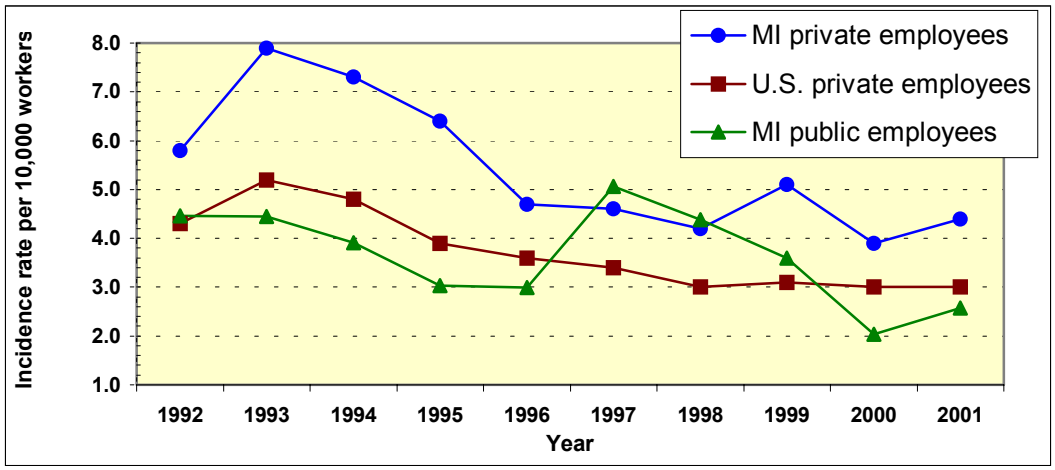


Source: BLS SOII

Carpal Tunnel Syndrome (CTS)

Over the ten-year period, CTS comprised, on average, 6.7% of all lost work time MSD cases with days away from work in the private sector and 4.9% in the public sector in Michigan. In 2001, there were 1,347 cases in the private sector and 117 in the public sector, or an incidence of 4.4 and 2.6 per 10,000 workers respectively. Figure 4 illustrates trends in CTS incidence data for the period 1992-2001, comparing rates between Michigan private, Michigan public, and U.S. private sectors. Michigan rates for CTS in the private sector have been consistently higher than the U.S. rates. Further years of data are needed to determine the significance of the rise in rates in 2001.

FIGURE 4
CTS with days away from work: incidence rates for Michigan and the U.S., 1992-2001

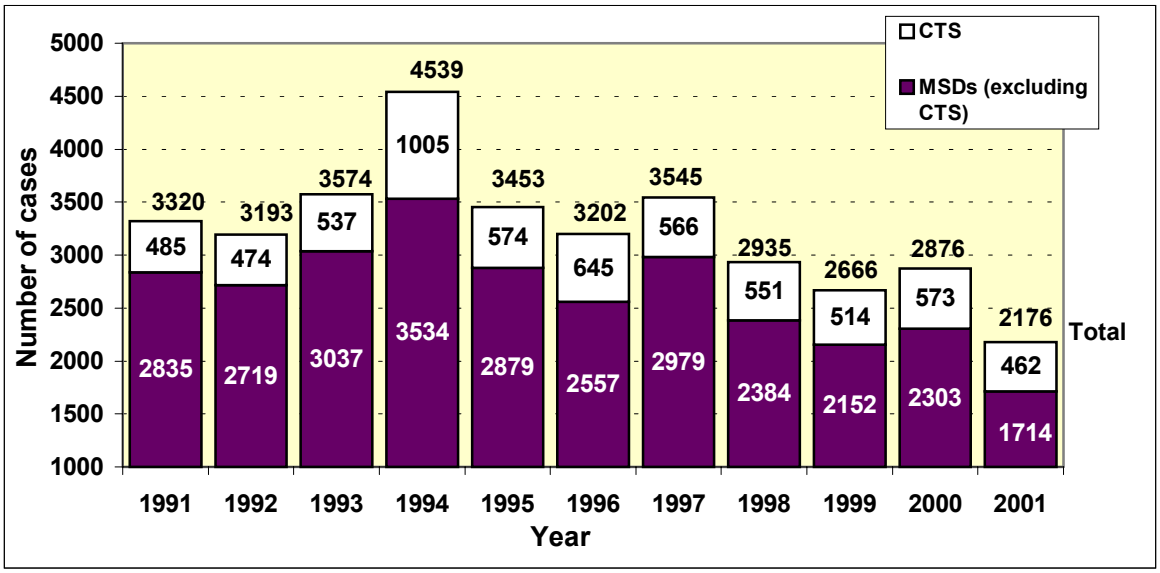


Source: BLS SOII

Occupational disease reporting system

The number of MSD cases reported in 2001 was 2,176, a 53% decline from a high of 4,539 cases reported in 1994 (Figure 5). CTS represented, on average, 17% of all MSDs in this reporting system over the time period.

FIGURE 5
Numbers of MSD cases, Michigan, 1991-2001

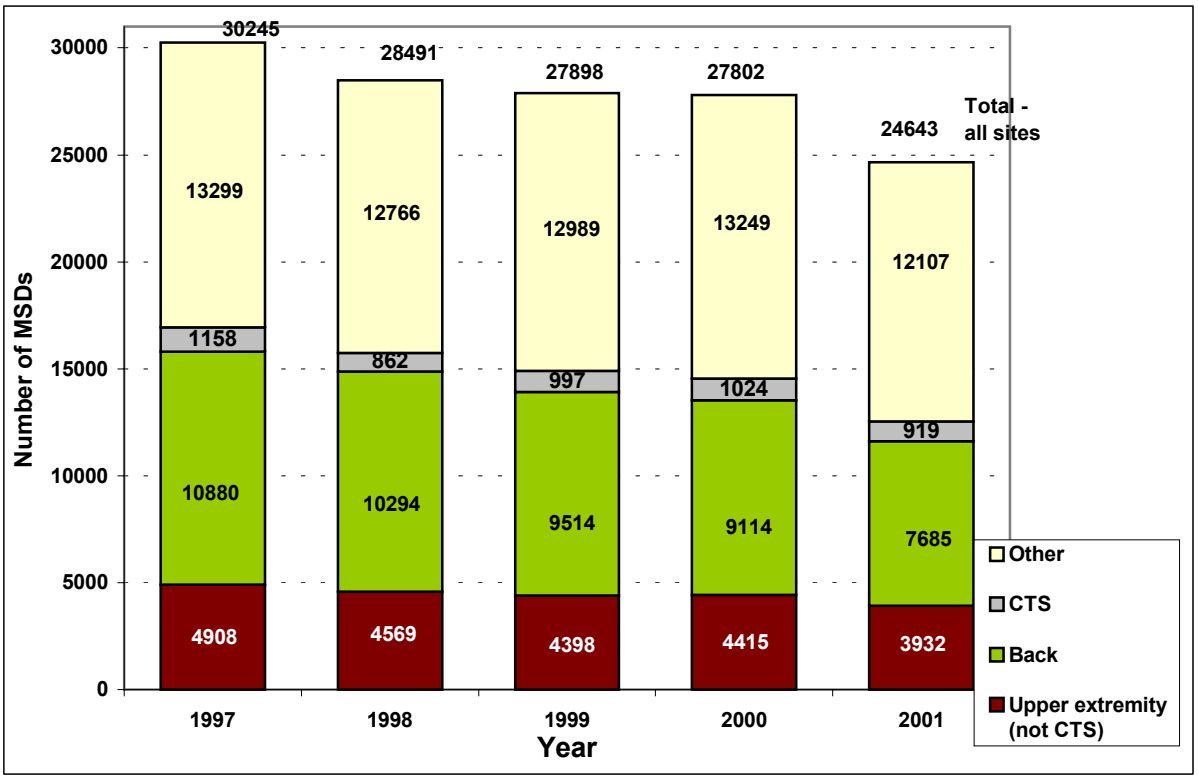


Source: Michigan OD reporting system

Michigan workers' compensation system

Overall numbers of claims for MSDs with eight or more days of lost work time have declined about 19 percent over the years examined, from a high of 30,245 in 1997 to 24,643 in 2001. During this time period, the back was by far the most common site reported, averaging 26% of all MSDs, while CTS comprised 3.6% of reports (Figure 6).

FIGURE 6
Numbers of MSD cases by anatomic site, Michigan, 1997-2001



Source: Michigan workers' compensation data

Discussion

It is notable that BLS/SOII rates for disorders of repeated trauma in the private sector in Michigan were more than twice those of national rates throughout this time period, although rates for MSDs with days away from work were similar to U.S. rates. These findings need further investigation.

Until 2002, employers were required to indicate on their BLS survey form the numbers of illnesses of repeated trauma and six other illness categories, regardless of whether the individual had lost work days or not. New rules in 2002 deleted diseases of repeated trauma from this list. Thus, from 2002 on, numbers of cases attributed to repetitive motion can only be tabulated and analyzed for those cases with days away from work. The loss of these data will make tracking the trends in MSDs more problematic in the future.

The proportion of cases of MSDs with CTS in Michigan was considerably greater (17%) in the OD reporting system than in either SOII (6.7% private and 4.9% public) or workers' compensation (3.6%) data. This may be because the latter two only include data on cases with days away from work.

All of these data sources are limited by a lack of specificity; in particular, it is not possible to completely differentiate cases resulting from repetitive motions from cases resulting from an acute event. This is most problematic when looking at effects on the back. The BLS has attempted to address this problem in SOII data by developing a definition of MSDs for cases with days away from work, and making state-specific SOII data on cases with this definition available on a special section of the BLS web site for 2000 and 2001.[10] The case definition includes: the nature of injury/illness code for sprains, strains, tears; back pain, hurt back; soreness, pain, hurt, except back; carpal tunnel syndrome; hernia; or musculoskeletal system and connective tissue diseases - and - event/exposure codes for body reaction/bending, climbing, crawling, reaching, twisting; overexertion; or repetitive motion. Using this definition, there were 21,017 MSD cases with lost work days in 2000 and 17,378 in 2001 in the Michigan private sector, slightly larger numbers than those presented in the results section above (20,485 and 16,631 respectively.)

As with most work-related conditions, MSDs are commonly thought to be under-recognized and underreported in the available surveillance systems. Back pain is extremely common. Nearly 20% of U.S. workers report suffering from an episode of back pain lasting one week or more in a given year, and about 50% of back pain sufferers never seek medical care; less than 10% of workers' compensation claims for back pain receive any award.[11] Similarly, CTS is thought to be underreported, especially when BLS/SOII data are used for the estimate, as many CTS cases do not result in lost work time.[12] Targeted surveillance through the NIOSH state-based surveillance programs and population-based surveys such as the Occupational Health Supplement to the National Health Interview Survey can provide other information that can be used to estimate the extent of under-reporting and the potential biases that arise from differential reporting levels.

Interventions such as redesign of tools and workstations and changes in work practices can be effective in reducing the physical factors that increase the risk of MSDs, and can be targeted to jobs and industries that are at highest risk. Ergonomics is the study of human characteristics for the appropriate design of the living and working environment. Although there is no federal or state ergonomic standard to regulate workplace exposures to reduce physical risk factors for MSDs, there are ergonomics information and consultative resources available through OSHA, MIOSHA, the National Safety Council, insurers, and other professional occupational safety and health groups to aid employers, health care providers and individual workers who wish to reduce workplace MSDs.

[10] ftp://ftp.bls.gov/pub/special.requests/ocwc/osh/

[11] Papers by Behrens et al 1994, Reisbord and Greenland 1985, and Chaffin 1979 as cited in Guo HR et al. Back pain among workers in the United States: national estimates and workers at high risk. Am J Ind Med. 1995. 28:591-602.

[12] Study by the Washington State Department of Labor and Industries, as cited in "The role of States in a nationwide, comprehensive surveillance system for work related diseases, injuries and hazards," a report from the NIOSH-CSTE Surveillance Planning Work Group, July 2001.

Additional Resources

BLS SOII data are at www.bls.gov/iif

NIOSH ergonomics workgroup; information on musculoskeletal and back disorders www2.cdc.gov/NORA/default.html

Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back, Second Printing, July, 1997. DHHS (NIOSH) Publication No. 97-141. www.cdc.gov/niosh/ergosci1.html

OSHA ergonomics website; resources available at the national level www.osha-slc.gov/SLTC/ergonomics

National Safety Council Online Ergonomics Resources www.nsc.org/issues/ergotop.htm

11 Occupational Cancer

Background

Cancer is a term for a category of diseases that are characterized by abnormal cell growth. The causes of most cancers are not well defined, although epidemiologic studies have identified various environmental and genetic factors associated with some types of cancer. Some of the first observations of the relationship of environmental exposures and cancer were among occupational groups, including scrotal cancer in chimney sweeps (polycyclic aromatic hydrocarbons) and bladder cancer in workers exposed to dyes (aromatic amines). Epidemiologic studies of workers have established the carcinogenicity of many substances, including arsenic, asbestos, benzene, chromium and vinyl chloride. In addition, a variety of occupations have been associated with an increased risk of cancer, yet the etiologic agents have not been identified.

The link between occupation and cancer is not easy to establish because cancers associated with occupational exposures are indistinguishable clinically and pathologically from cancer of non-occupational origin. The generally long latency period between onset of exposure and disease adds to the difficulty of recognizing the association between work and cancer. In addition, non-occupational risk factors such as cigarette smoking may have a synergistic effect with a workplace exposure in the cause of cancer. Mesothelioma, a cancer of the lining of the lung and abdomen, and hemangiosarcoma of the liver are the only cancers that are almost uniquely associated with exposure to asbestos and vinyl chloride, respectively.

It has been estimated that between six and ten percent of cancer in the United States is due to occupational exposure to cancer-causing substances.[1] This would suggest that there were between 76,080 and 126,800 work-related cancers among the estimated 1,268,000 newly diagnosed cancers in 2001 in the U.S.[2] There is no national surveillance system for occupational cancer even though cancer registry data cover most of the U.S. population and population-based cause of death data is available at the state and national level. This is partly due to the diagnostic difficulties in determining what has caused an individual's cancer. There are no unique diagnostic codes for work-related cancer. Statistical methods have been developed to identify the associations between industry and occupation, data that are captured in some cancer registry and mortality data sets, and specific types of cancer cases, but these methods have many limitations.

Federal OSHA has promulgated comprehensive standards for protecting workers from exposure to 26 specific cancer-causing substances. These standards include provisions for medical surveillance, air monitoring, labeling personal protective equipment, employee training, and other protective measures requirements. These standards have resulted in reduced exposure at many worksites, but risks still remain. Because of the long latency between exposure and disease, any cancer caused by current exposures may not be evident for many years.

[1] Leigh JP, Markowitz S, Fahs M, Landrigan P. *Cost of Occupational Injuries and Illnesses*. The University of Michigan Press. Ann Arbor. 2000. p. 60.
[2] American Cancer Society. *Cancer Facts and Figures, 2001*. www.cancer.org/downloads/STT/F&F2001.pdf

Surveillance methods

Data sources for occupational cancer in Michigan include the occupational disease (OD) reporting system, the Cancer Registry, the BLS SOII, and Michigan's workers' compensation data set, all of which are described in Chapter 1. No follow-up is conducted to confirm the work-relatedness of cancer reports to the OD system.

Also of interest is information about the presence of cancer-causing agents in worksites in Michigan. The Environmental Protection Agency (EPA) requires companies in certain industrial classifications to report quantities of selected hazardous substances released and/or transferred. These data are compiled and made available online in EPA's Toxic Release Inventory (TRI). The database can be searched online at the TRI website by chemical name; companies reporting that chemical are listed by name. While this data has many limitations because of reporting requirements, it is the most comprehensive information available on chemical inventories. Companies in Michigan reporting any of the 26 OSHA-regulated carcinogens were identified using the TRI online.[3]

Results

The OD surveillance system included 706 cancer reports for 1991 through 2001. Reports by year and by anatomic site of the cancer are shown in Table 1.

TABLE 1
Work-related cancers: numbers reported to the occupational disease surveillance system, by year of report, Michigan, 1991-2001

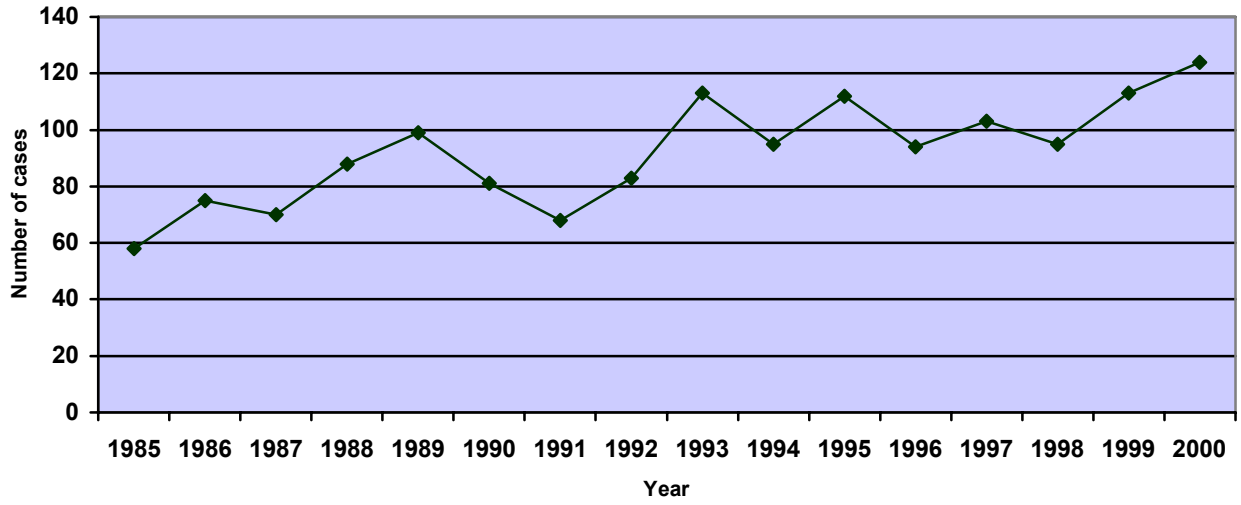
Cancer site	Year									
	1991	1992	1993	1994	1995/96*	1997	1998	1999	2000	2001
Nasopharynx		1								
Digestive	1	1		1	1				1	
Respiratory	51	59	48	50	79	77	50	63	85	27
Skin		2								
Genitourinary		2	2	1				1		
Lymphatic and hematopoietic	3	2	1	1						
Unspecified, ill-defined	11	11	12	10	9	9	5	9	14	6
TOTAL	**66**	**78**	**63**	**63**	**89**	**86**	**55**	**73**	**100**	**33**

* Because of a reporting delay, the '95 data were combined with '96 data.
Source: Michigan OD surveillance system

[3] http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?TRI

The Michigan Cancer Registry identified 1,471 incident malignant mesothelioma cases among Michigan residents for the years 1985 through 2000, for an annual average of 92. Incident cases increased from 58 in 1985 to 124 in 2000 (Figure 1). In that same time period, there were 22 incident hemangiosarcomas of the liver, or less than two cases per year. These are the two cancers noted above to be almost uniquely associated with occupational exposures.

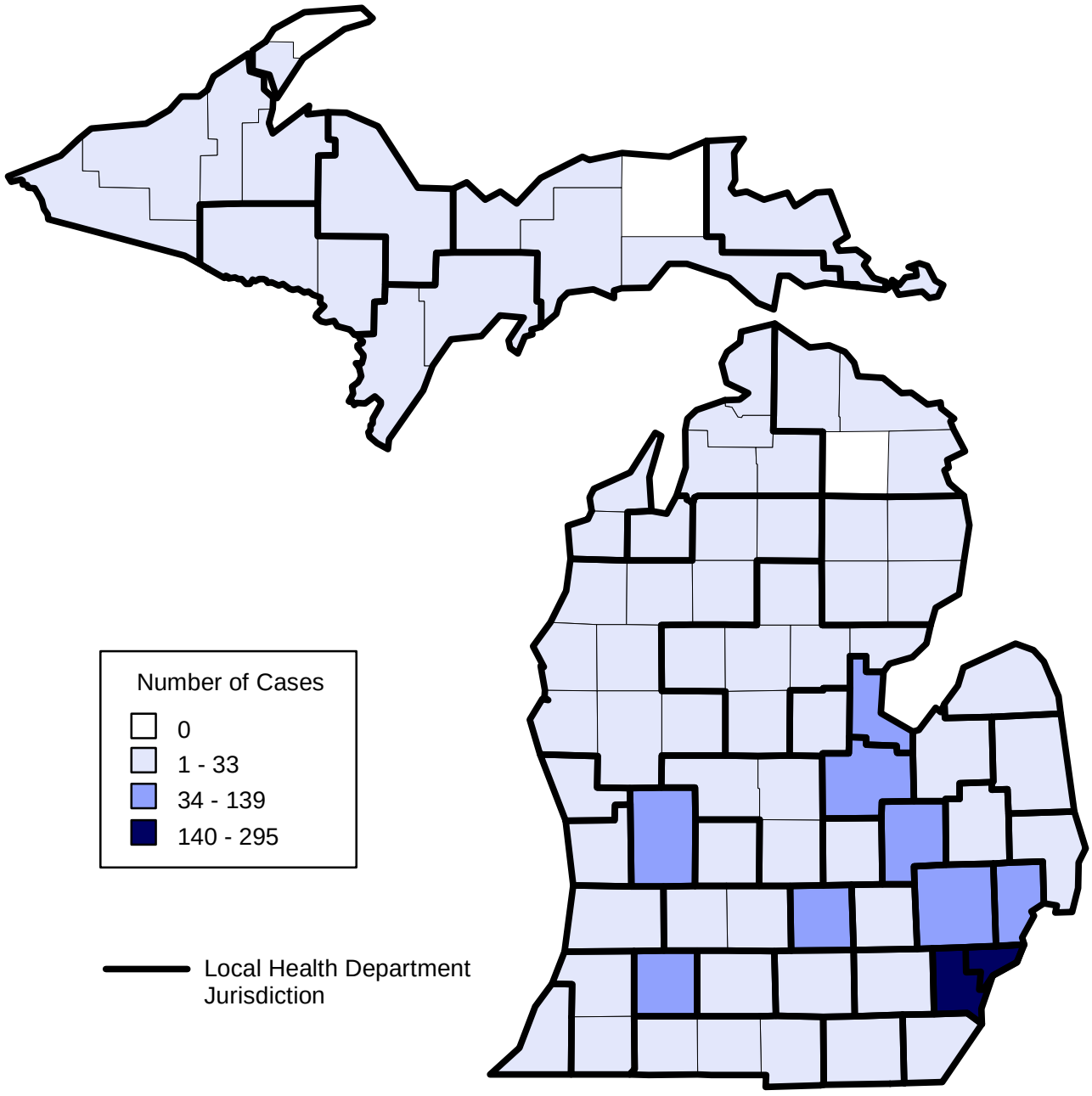
FIGURE 1
Number of incident mesothelioma cases by year, Michigan, 1985-2000



Source: Michigan Cancer Registry

Malignant mesothelioma incident cases predominately occurred in people 55 years of age and older (87%), among males (75%), and whites (94%). Figure 2 shows the number of malignant mesothelioma incident cases by county of residence at the time of diagnosis. More populated counties had a greater proportion of the statewide cases than less populated ones.

FIGURE 2
Malignant mesothelioma cases by county of residence*
Michigan, 1985-2000



Total Michigan Cases: 1,471

* County of residence at time of diagnosis

Detroit cases and Wayne out-county cases were combined.

Source: Michigan Resident Cancer Incidence File, Michigan Department of Community Health

The 22 hemangiosarcoma of the liver incident cases were evenly distributed over the 15 years. Sixty-eight percent of the cases were between the ages of 55 and 84. Cases in males were more common than in females (59% versus 41%), and 91% were among whites.

Fifty-one individuals filed workers' compensation claims for cancer for the five-year period of 1997-2001: 17 in 1997, eight in 1998, 15 in 1999, eight in 2000 and three in 2001.

There were no cancer cases in the BLS SOII data.

Table 2 lists the number of Michigan companies reporting any of the OSHA-regulated carcinogens. Of the 26 OSHA-regulated substances, 12 were reported by one or more companies in 2000. One large chemical company reported seven of the 12 carcinogens.

TABLE 2
Number of Michigan companies reporting OSHA-regulated carcinogens, 2000

Carcinogen	Number of companies
1,3-Butadiene	2
2-Acetylaminofluorene	1
3,3'-Dichlorobenzidine	1
Acrylonitrile	3
Arsenic	3
Benzene	40
Ethylene oxide	4
Formaldehyde	31
Methyl chloromethyl ether	1
Methylene chloride	25
Methylenedianiline	23
Vinyl chloride	1

Source: EPA's Toxic Release Inventory

Discussion

There are approximately 48,000 incident cancers annually in Michigan. Applying the estimate that between six and ten percent of all cancers can be attributed to work exposure, this would suggest that there are between 2,880 and 4,800 incident cancers each year in Michigan that are associated with work.

The OD reporting system identified 706 cancer cases between 1991 and 2001, in contrast to Michigan workers' compensation and SOII data systems, which identified few and zero cases, respectively. Some of the reasons for this are the difficulties in recognizing the work-relatedness of cancer due to the latency between exposure and disease, and non-specificity of etiology among most cancers.

Mesothelioma cases in the cancer registry indicated a definite upward trend over the 15 years of available data, consistent with trends seen in asbestosis, another disease associated with asbestos exposure. NIOSH has calculated that the age-adjusted mortality rate for mesothelioma in Michigan in 1999 was 9.07 per million people, ranking it 38th among the states. In numbers of mesothelioma deaths, however, Michigan's 69 deaths in 1999 ranked it 12th among all the states.[4]

Asbestos-related diseases, including lung cancer and mesothelioma, have been projected to continue to increase for at least another decade, as the population exposed to asbestos prior to the time when asbestos exposure was controlled continues to age. Although exposure to asbestos at work is regulated by a comprehensive OSHA standard, there is a continued risk to those exposed to asbestos in place, particularly to asbestos removal workers. Asbestos abatement contractors must be licensed and workers must be accredited under a program administered by MIOSHA.

Individuals at work may become concerned when they or their co-workers are diagnosed with cancer, and want to know if there is some exposure at work that is causing these cancers. The Michigan Department of Community Health evaluates concerns about perceived clusters of cancers in a workplace to determine if there is an unusual clustering of a particular cancer that might warrant additional follow-up. Some of the important findings of the etiologic role of chemicals and other substances in cancer began with an observation of an unusual clustering of a particular cancer in a group of workers. Lung cancer among chromium smelter workers and asbestos insulation workers are two examples.

Additional Resources

OSHA information about carcinogens and the regulation of carcinogens in the workplace:
www.osha-slc.gov/SLTC/carcinogens

Information from NIOSH regarding occupational cancer:
www.cdc.gov/niosh/topics/cancer/

NIOSH list of substances considered potential carcinogens:
www.cdc.gov/niosh/npotocca.html

CDC information on cancer clusters: www.cdc.gov/nceh/clusters/

Michigan Department of Labor & Economic Growth (DLEG) information on asbestos, including contractor licensing and worker accreditation:
www.michigan.gov/asbestos

[4] NIOSH. *Work-Related Lung Disease Surveillance Report 2002*. DHHS (NIOSH) Number 2003-111. p. 163

12 Occupational Skin Diseases

Background

Occupational skin diseases (OSDs) include a wide variety of infectious and non-infectious skin conditions. Allergic and irritant contact dermatitis account for over 90% of all OSDs. There are four direct causes of OSDs in order of their importance and frequency: chemical, mechanical, physical and biological. Thousands of chemicals have the potential to cause contact dermatitis through direct contact with contaminated surfaces, deposition of aerosols, immersion, or splashes.[1]

The Bureau of Labor Statistics (BLS) estimates that in the U.S., there were approximately 38,900 OSDs in 2001 for an incidence of 4.3 per 10,000 workers in the private sector. OSDs comprised 12% of all reported occupational diseases in 2001 data from BLS. The BLS data show a downtrend both in the number and incidence of OSDs in the previous ten years. Agriculture and manufacturing have had the highest rates of OSDs when compared to other industry groups. It has been estimated that the number of actual OSDs may be on the order of 10-50 times higher than reported by the BLS with total annual costs of up to $1 billion.[2]

Allergic and irritant dermatitis were included as priority research areas in the National Occupational Research Agenda (NORA)[3] of NIOSH because of their high prevalence, the poor prognosis for a significant proportion of those affected, and the general lack of knowledge necessary for the development of effective prevention programs. Reduction in the number of OSDs is included as one of the nation's health objectives in *Healthy People 2010.* [4]

Surveillance Methods

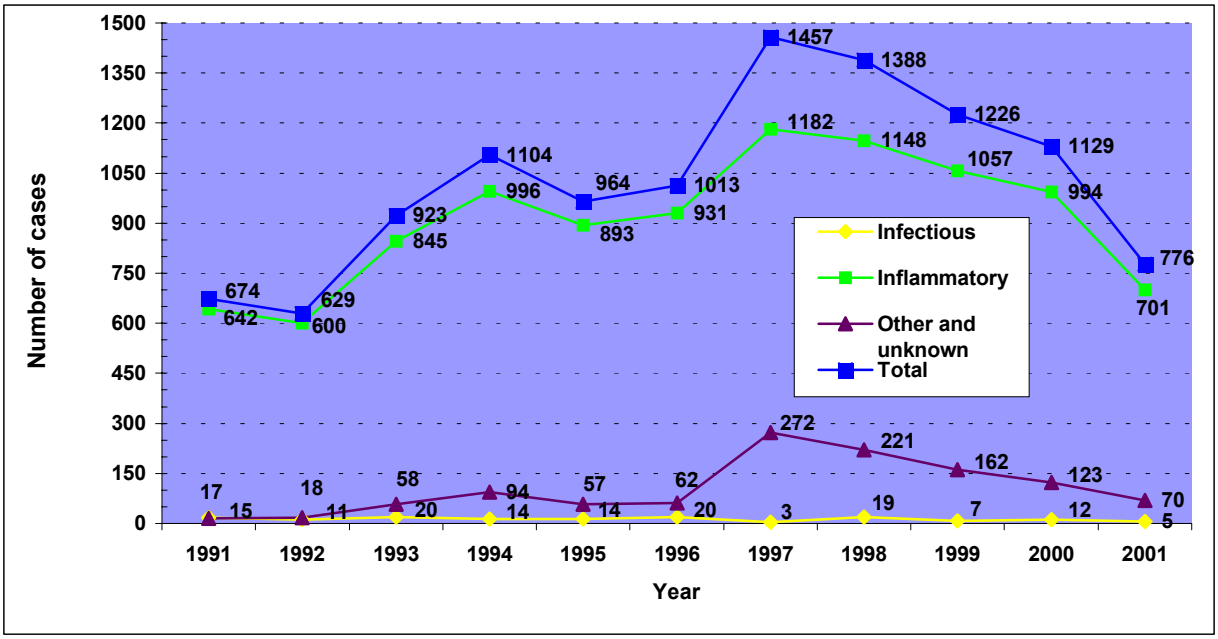
Data sources used to identify numbers of OSDs in Michigan include the occupational disease (OD) surveillance system, BLS SOII data, and workers' compensation data. These data sources are described in Chapter 1. There is no follow-up to OD case reports to confirm the work-relatedness of the reported OSDs. The amount of overlap of cases between each of these data sources cannot be determined because of the unavailability of personal identifiers in the latter two.

[1] NIOSH, *Occupational dermatoses – A program for physicians*. http://www.cdc.gov/niosh/ocderm.html.
[2] Matthias CG. The cost of occupational skin disease. Arch Dermatol. 1985; 121:332-4.
[3] http://www2.cdc.gov/nora/
[4] U.S. Department of Health and Human Services. *Healthy People 2010.* 2nd edition. Washington DC. US. Government Printing Office. November 2000. Objective 20-11.

Results

Figure 1 shows the numbers of OD reports for OSDs by year. There were a total of 11,198 reported cases between 1991 and 2001, an average of 1,018 reported cases a year. Reporting increased in the late 1990s and then declined. Inflammatory OSDs predominated (at about 90%) over OSDs due to infectious agents or other causes.

FIGURE 1
Number of cases of skin disease reported to the occupational disease reporting system, Michigan, 1991-2001



Source: Michigan OD surveillance system

SOII data for 1998-2001 showed that there were an average of 3,850 cases per year during this period (Table 1). Sixty percent of the cases in the private sector were in manufacturing. Approximately 12% of all cases resulted in at least one day away from work, and, of those with lost workdays, 47% of the lost workday cases in the private sector were due to chemicals. The incidence rate for private and public sectors combined declined slightly from 10.9/10,000 in 1998 to 9.2/10,000 workers in 2001.

TABLE 1
Number of skin disorders by year, SOII data, Michigan, 1998-2001

Industry sector	Year			
	1998	1999	2000	2001
Private	3,900	3,900	3,600	2,800
Public	200	400	200	400
TOTAL	**4,100**	**4,300**	**3,800**	**3,200**

Source: BLS SOII

Michigan workers' compensation data recorded 904 cases of lost work-time due to OSDs for the five-year period 1997-2001, with an annual average of 181.

Discussion

Unlike most of the other diseases discussed in this report, skin disorders usually occur within a short time period relative to exposure, and thus are more readily recognized as work-related. This may account for why there are more case reports in SOII than in the OD system.

Both SOII and OD data suggest a downward trend in the most recent years. Additional years of data are needed to determine the significance of this finding.

Unfortunately, none of these data systems collect sufficient data to identify specific emerging problems such as latex-related OSDs. Allergic dermatitis resulting from exposure to natural rubber latex has been the focus of prevention efforts in health care settings over the last decade. Latex sensitization has emerged as an occupational health problem because of the increased use of latex gloves to prevent exposure to bloodborne pathogens in the health care industry. Prevention of sensitization includes use of powder-free gloves and substitution of non-latex for latex gloves.

Many new chemicals capable of injuring the skin are introduced into the workplace each year. Ongoing analysis of surveillance data may assist in detecting adverse consequences of workplace exposures to new skin irritants and sensitizers.

Additional resources

Additional data from SOII on occupational skin disorders:
www2a.cdc.gov/chartbook/chap5/chartbk5.htm#4par

Information from NIOSH on latex allergy: www.cdc.gov/niosh/topics/latex

Information from OSHA on dermal exposure:
www.osha.gov/SLTC/dermalexposure