

Occupational Pesticide Illness and Injury Surveillance in Michigan 2004

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*Division of Environmental and Occupational Epidemiology
Michigan Department of Community Health*

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Jennifer M. Granholm, Governor
Janet Olszewski, Director

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State of Michigan

Governor – Jennifer M. Granholm

Michigan Department of Community Health

Director – Janet Olszewski, MSW

Surgeon General – Kimberlydawn Wisdom, MD, MS

Public Health Administration – Jean Chabut, RN, MPA

Division of Environmental and Occupational Epidemiology – David R. Wade, PhD

Authors

Abby Schwartz, MPH

Martha Stanbury, MSPH

Contributor

Kenneth Rosenman, MD

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Michigan Department of Community Health

Lorraine Cameron, MPH, PhD

Thomas Largo, MPH

Michigan Department of Agriculture

Brian Rowe, BS

Brian Hughes, PhD, MPH, DABT

Pollyanne Kapala, MPA

National Institute for Occupational Safety and Health

Geoffrey Calvert, MD, MPH

Children's Hospital of Michigan Poison Control Center

DeVos Children's Hospital Regional Poison Center

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Occupational Pesticide Illness and Injury Surveillance in Michigan: 2004

Summary

This is the second annual report on surveillance of acute, work-related pesticide illnesses and injuries in Michigan. The first report covered data from 2001 – 2003 (MDCH 2005). This report summarizes data collected from 2001 – 2004 and presents detailed data on 2004 case reports. From 2001 through 2004, 312 reports were received and 215 (68.9%) were confirmed as cases according to the surveillance case definition; 116 of those confirmed cases were reported in 2004. Ninety (77.6%) of the 2004 cases were reported through Michigan's poison control centers (PCC).

In 2004, where the industry was known, agriculture and landscaping accounted for about one in five (20.3%) of the cases. Service occupations were most frequently reported. This category includes pest control applicators, cleaners or janitors, and food preparation workers. Where the activity of the exposed person was known, 46% were exposed inadvertently while doing their regular work that did not involve pesticide application.

Exposure to a pyrethrin insecticide accounted for the one case classified as high severity in 2004.

In 2004, seven events (described on pages 15 and 16) were referred to the Michigan Department of Agriculture (MDA) for investigation of possible pesticide use violations and six events (described on page 17) met the criteria for priority reporting to the National Institute for Occupational Safety and Health (NIOSH).

Background

Pesticides were developed to help make our lives safer and more comfortable. When used properly they provide a variety of benefits. However, if not properly handled, pesticides can cause harm to the health and well-being of people and the environment. Recognizing the importance of surveillance for acute occupational pesticide-related illness, NIOSH began collecting standardized information about acute occupational pesticide exposure in 1998¹. An analysis of 1998-99 data showed that surveillance could be an important tool to assess acute pesticide-related illness and to identify associated risk factors (Calvert, et al 2004).

In 2001 the Michigan Department of Community Health (MDCH) instituted an occupational pesticide illness and injury surveillance program with financial assistance from NIOSH. The

¹ <http://www.cdc.gov/niosh/topics/pesticides/>

Michigan surveillance program received an additional five years of funding from NIOSH in May 2005.

MDCH developed this surveillance system because of the recognized need for data on work-related pesticide exposures and adverse health effects in Michigan. Agriculture is the second largest income-producing industry in Michigan, and pesticide use is widespread. The adverse health effects of pesticides are of concern to workers exposed in agricultural settings as well as those exposed in non-agricultural settings such as landscaping, structural applications, disinfectant use in health care or food service situations, or bystander exposure during workplace pesticide applications.

The goals of the pesticide surveillance system are to characterize the occupational pesticide-poisoning problem in Michigan and to prevent others from experiencing adverse health effects from occupational pesticide exposure. The surveillance data are used to:

- Identify groups at risk for pesticide-related illnesses;
- Identify clusters/outbreaks of pesticide-related illnesses;
- Detect trends;
- Identify high-risk active ingredients;
- Identify illnesses that occur even when the pesticide is used correctly;
- Identify and refer cases to regulatory agencies for interventions at worksites;
- Provide information for planning and evaluating intervention programs.

Methods

Occupational pesticide poisoning is reportable under the Public Health Code (Part 56 of Act 368 of 1978, as amended). This law requires health care providers (including Michigan's two poison control centers), health care facilities, and employers to report information, including names, of individuals with suspected or confirmed work-related diseases to the state.

The surveillance system also collects information on individuals with occupational exposure to pesticides who have been reported to the Pesticide and Plant Pest Management Division of MDA. MDA receives complaints about pesticide misuse and health effects and is required to conduct investigations to address potential violations of pesticide laws.

Pesticides are a category of chemicals that are used to kill or control insects, weeds, fungi, rodents, and microbes. There are over 600 different approved active ingredients that are sold in about 16,000 products used in the United States (Calvert, 2004).

The MDCH work-related pesticide poisoning surveillance system is a case-based system. A reported individual must meet the case definition established by NIOSH and the participating states (see Appendix 1) to be included in the surveillance system. Data are collected according to standardized variable definitions in a database developed for states that are conducting pesticide surveillance.

A suspected case is any person reported to have been exposed at work to a pesticide product. Individuals are interviewed to determine the circumstances of the reported pesticide exposure, the signs and symptoms they experienced, the name of the pesticide, the name of the workplace where exposure occurred, and other details about the incident. When possible, medical records are obtained to confirm and clarify the conditions reported.

Suspected cases are then classified based on 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. The possible classifications are definite, probable, possible, suspicious, unlikely, insufficient information, exposed but asymptomatic, or unrelated. See Appendix 2 for the case classification system. Cases classified as definite, probable, possible, or suspicious are considered confirmed cases.

Confirmed cases are evaluated regarding the severity of the health effect: low, moderate, high and death. The severity index is based on the signs and symptoms experienced, whether medical care was sought, if a hospital stay was involved, and whether work time was lost. For more information see Appendix 3.

Work sites or work practices where other workers may be at risk are identified. When appropriate, referrals are made to two other state agencies with regulatory responsibility for worker health and pesticide use: the MDA and the Michigan Occupational Safety and Health Administration (MIOSHA) in the Michigan Department of Labor and Economic Growth (DLEG). MDA enforces state and federal legal requirements for the sale and use of pesticides, including training and licensing pesticide applicators. MDA also enforces the federal Environmental Protection Agency's (EPA) Worker Protection Standard, which includes requirements to protect agricultural workers from adverse health effects of pesticides. DLEG enforces MIOSHA standards and performs training in health and safety.

In addition, NIOSH requests prompt reporting of high priority events. The criteria for defining high priority events are:

- a. events that result in a hospitalization or death;
- b. events that involve four or more ill individuals;
- c. events that occur despite use according to the pesticide label; or
- d. events that indicate the presence of a recurrent problem at a particular workplace or employer.

With prompt reporting of these events by states involved in Sentinel Event Notification System for Occupational Risk (SENSOR) Pesticides surveillance, NIOSH can refer cases to the EPA as needed, identify clusters across states and identify the need for national level interventions. Finally, if appropriate, MDCH surveillance staff provide educational consultations to reported individuals and their employers about reducing hazards related to pesticide exposures.

Results

Reports

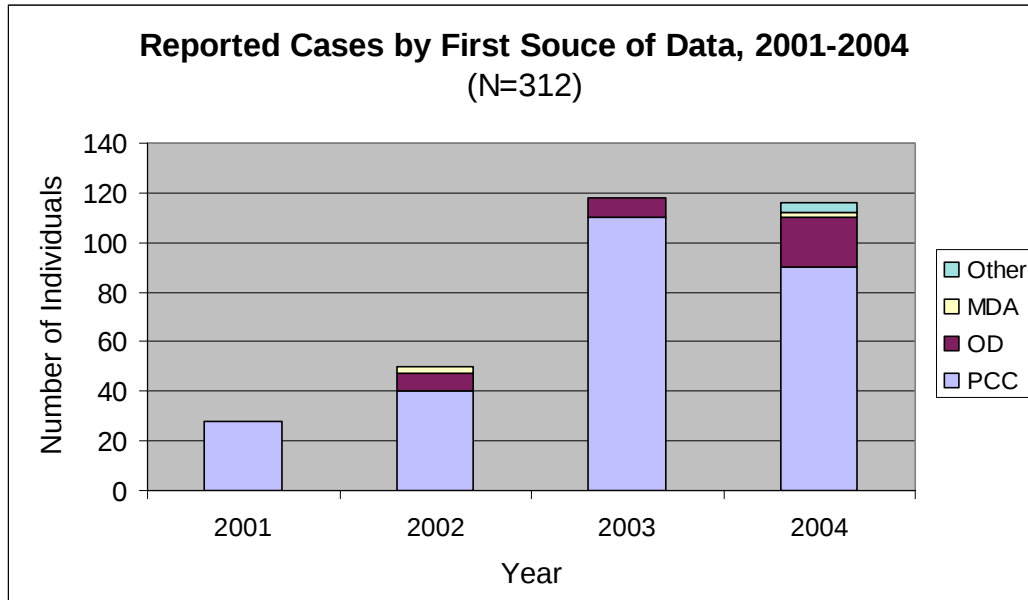
There were 312 reports of acute occupational pesticide poisonings from 2001 – 2004. These represent 285 separate events. Seven events involved two individuals; the remaining four events involved three, five, six, and ten individuals.

Data Source

The distribution of the sources of the case reports is shown in Figure 1. The poison control centers (PCC) remain the major source of reports. In 2004, 90 (77.6%) cases were reported by the PCCs. For 10 of these cases an occupational disease (OD) report from another health care provider was received later; in one instance a PCC report was followed by a report from the MDA. Four (3.4%) cases in 2004 were reported by other sources such as a coworker or worker advocate.

The average time between the event and the report to the state varied by reporting source. The PCCs provided the timeliest reports, with an average time lag of 41 days in 2004. The OD reports were slowest, with an average of 307 days between the incident and the date the report was received.

Figure 1



Classification

A total of 312 cases were reported from 2001 through 2004; 116 of them in 2004. Of the reported cases, 215 (68.9%) met the criteria to be considered confirmed cases. In 2004, 87 (75.0%) cases were considered confirmed cases.

Table 1

Reported Cases by Classification, 2001-2004 (N=312)		
Classification	Number	Percent
Confirmed cases		
Definite	38	12.2
Probable	41	13.1
Possible	129	41.3
Suspicious	7	2.2
<i>total confirmed</i>	<i>215</i>	<i>68.9</i>
Not confirmed		
Unlikely	2	0.6
Insufficient information	68	21.8
Exposed, Asymptomatic	22	7.1
Unrelated	5	1.6
<i>total not confirmed</i>	<i>97</i>	<i>31.1</i>
Total	312	100.0

Location in State

In 2004, there were no reported cases in more than half of Michigan's counties (49 of 83 counties), generally the least populous. The two counties with the largest number of confirmed cases were Wayne County (10 or 12.3%) and Kent County (nine or 11.1%). Since the numbers per county are low, Figure 2 shows the distribution of all cases (2001-2004) to preserve anonymity. The county of exposure was unknown for six (6.9%) confirmed cases in 2004, a decrease from 46 (35.9%) unknown in the previous three years.

Confirmed Pesticide Poisoning Cases by County of Exposure, 2001-2004
(N= 215*)

Number of cases

Number of cases	Color
0	White
1 - 4	Light Gray
5 - 10	Medium Gray
11-20	Black

* County of exposure was unknown in 52 cases.

The summary information that follows includes data on the 87 confirmed cases reported in 2004. Appendix 4 contains a brief narrative of each confirmed case.

Demographics

Gender

Of the 87 persons with confirmed work-related pesticide illnesses or injuries, 44 (50.6%) were men and 43 (49.4%) were women.

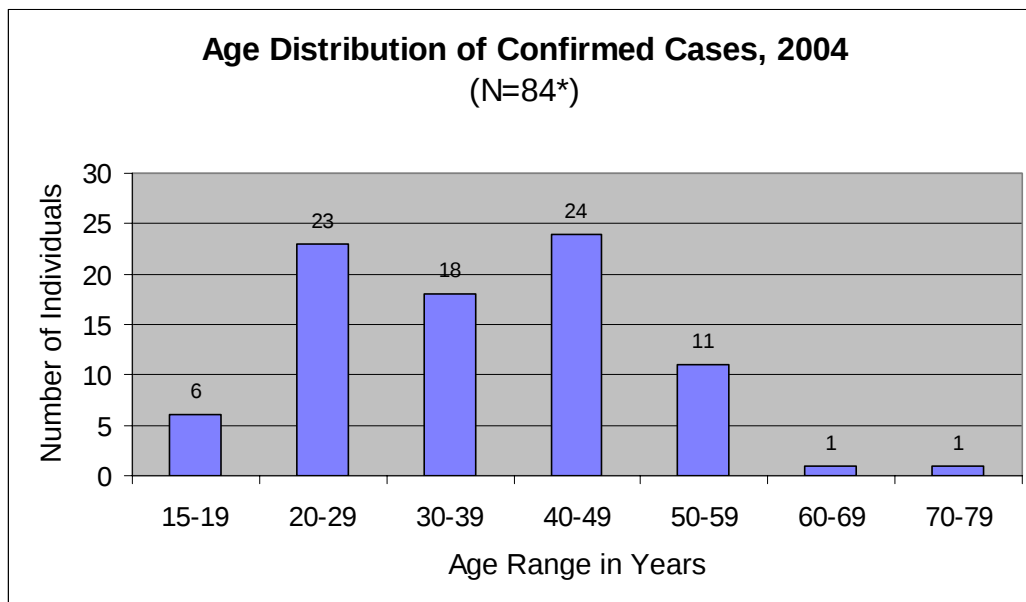
Race and Ethnicity

For 33 (37.9%) individuals, race was unknown. Where race was known, 48 (88.9%) were white. Ethnicity was unknown for 35 (40.2%) cases. Where it was known, 10 (19.2%) were Hispanic.

Age

The age distribution of the 84 individuals where the age was known is shown in Figure 3. The median age was 35, with a range of 15 to 77.

Figure 3



* Age was unknown for three of the confirmed cases.

Industry

The type of industry where individuals were employed provides information on where to target interventions. Industry of employment was known for 79 (90.8%) of the 87 confirmed cases and is shown in Table 2.

Seven (8.9%) injured individuals were working in farming and nine (11.4%) in landscaping. These are included in Agriculture, Forestry, and Fisheries. Twelve (15.2%) individuals worked in a hospital or a health care provider office; they are included in the Professional and Related

Services category. All eight (10.1%) in the Business and Repair Services category were structural pesticide applicators.

Table 2

Industry of Confirmed Cases, 2004 (N=79*)		
Type of Industry	Number	Percent
Agriculture, Forestry, and Fisheries	16	20.3
Professional and Related Services	15	19.0
Retail Trade	12	15.2
Business and Repair Services	8	10.1
Manufacturing	6	7.6
Transportation, Communication, Public Utilities	6	7.6
Construction	5	6.3
Miscellaneous	11	13.9
Total	79	100.0

* Industry was unknown for eight confirmed cases

Occupation

The occupation of the workers who become ill provides additional information that may help to direct interventions and activities. Occupation was known for 76 (87.4%) of the 87 confirmed cases and is shown in Table 3.

The most common service occupations were eleven (14.5%) cleaners/housekeepers, generally exposed to antimicrobials. Seven (9.2%) were involved in food preparation or service and six (7.9%) were pesticide applicators. In addition, there were eight (10.5%) farmers and farmworkers and six (7.9%) gardeners and groundskeepers, all included in Farming, Forestry, and Fishing.

Table 3

Occupation of Confirmed Cases, 2004 (N=76*)		
Occupation	Number	Percent
Service Occupations	28	36.8
Farming, Forestry, and Fishing Occupations	16	21.1
Technical, Sales, and Administrative Support Occupations	16	21.1
Precision Production, Craft, and Repair Occupations	7	9.2
Operators, Fabricators, and Laborers	5	6.6
Miscellaneous Occupations	4	5.3
Total	76	100.0

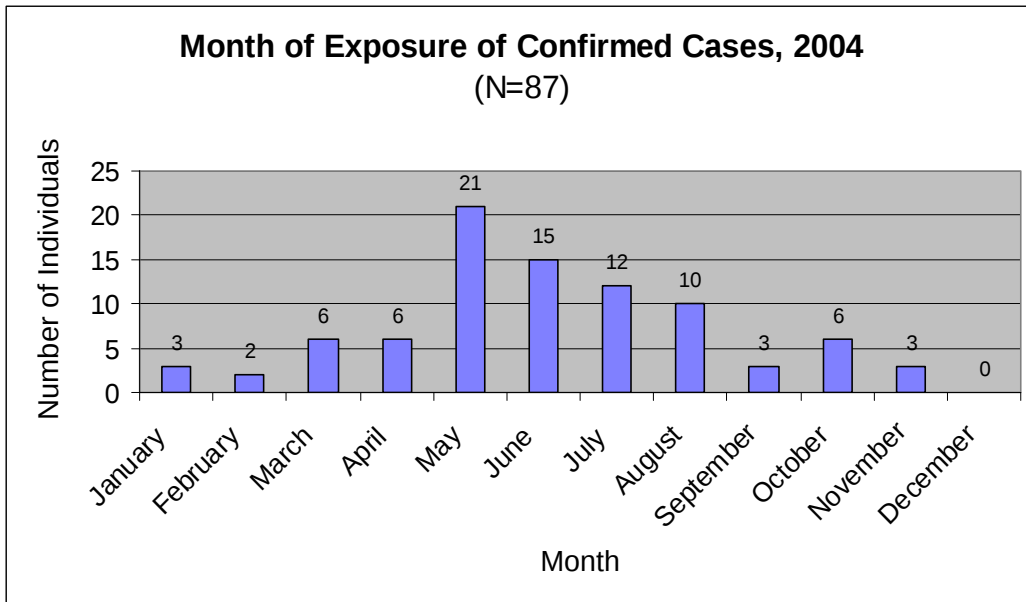
* Occupation was unknown for eleven confirmed cases

Exposures

Month of Exposure

Figure 4 shows that confirmed cases were more likely to be exposed in the spring and summer months.

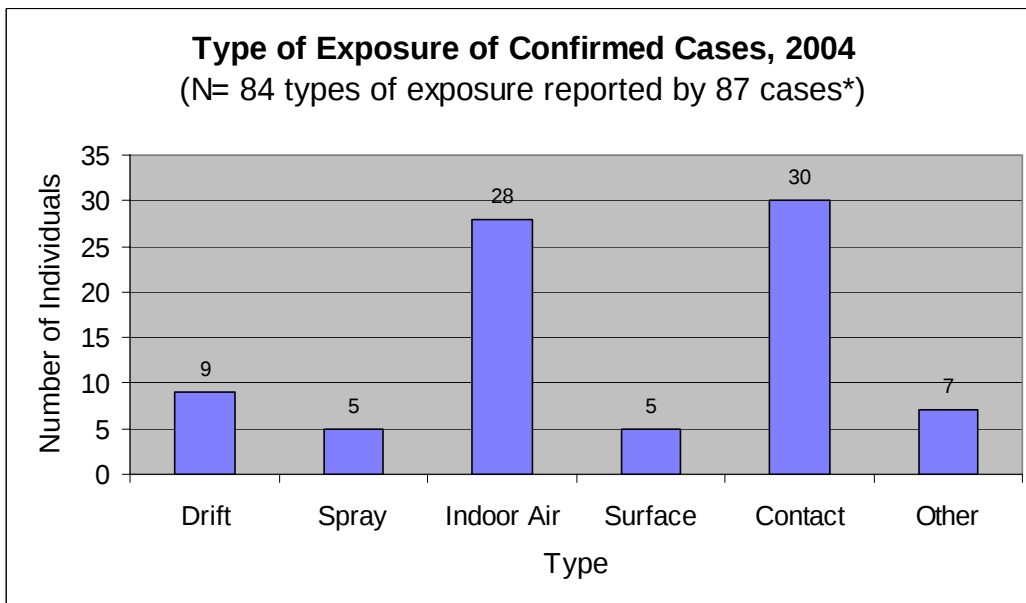
Figure 4



Type of Exposure

Figure 5 shows how workers who become ill were exposed to pesticides. Exposure from direct contact with the pesticide, such as an accidental spill, accounted for 30 (35.7%) cases. Exposure via indoor air accounted for an additional 28 (33.3%) cases. Two workers experienced more than one type of exposure.

Figure 5

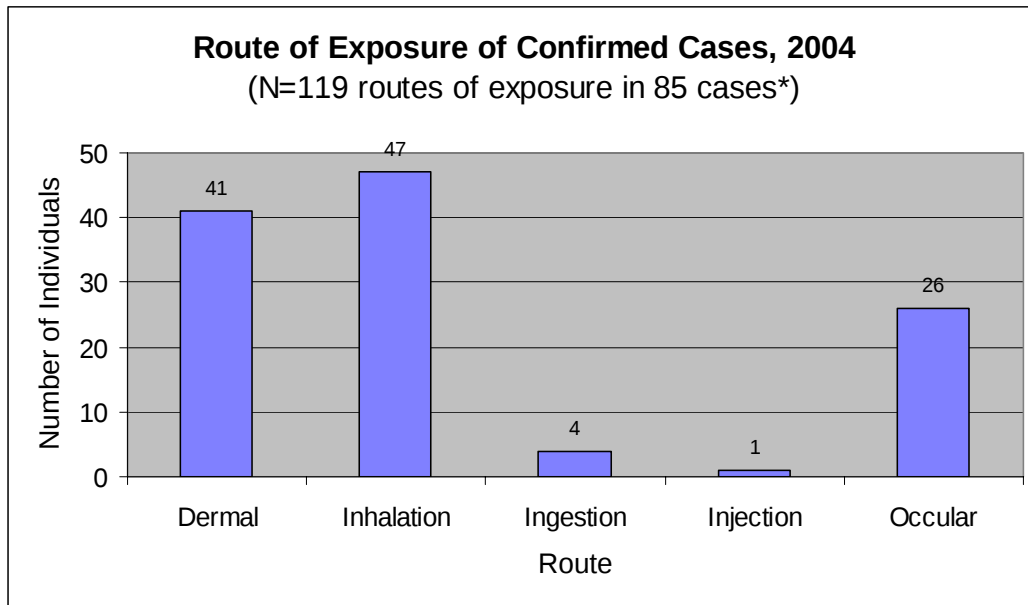


*Type of exposure was unknown for five confirmed cases

Route of Exposure

Route of exposure indicates how the pesticide entered the body. Figure 6 shows that 85 individuals identified one or more routes of exposure for a total of 119 routes, including 47 (39.5%) inhalations and 41 (34.5%) dermal exposures. All of the 27 individuals with more than one route of exposure included a dermal exposure – 22 with two routes of exposure, three individuals exposed three ways and two exposed through four routes.

Figure 6



*Route of exposure was unknown for two confirmed cases; 27 had multiple routes of exposure.

Product Used

Among confirmed cases, the largest number of reported exposures, 38 (43.7%), was due to insecticide use. Nine (23.7%) of the 38 insecticide exposures were organophosphates. Disinfectants (27 or 31.0%) and herbicides (15 or 17.2%) account for most of the remaining cases (Table 4). Table 5 shows the severity of the case by the type of product used. Insecticide use accounts for the one case with a high severity and almost half (44.4%) of the moderately severe cases.

Table 4

Product Type of Confirmed Cases, 2004 (N=87)		
Product Type	Number	Percent
Insecticide	38	43.7
Antimicrobial	27	31.0
Herbicide	15	17.2
Fungicide	3	3.4
Mixture	4	4.6
Total	87	100.0

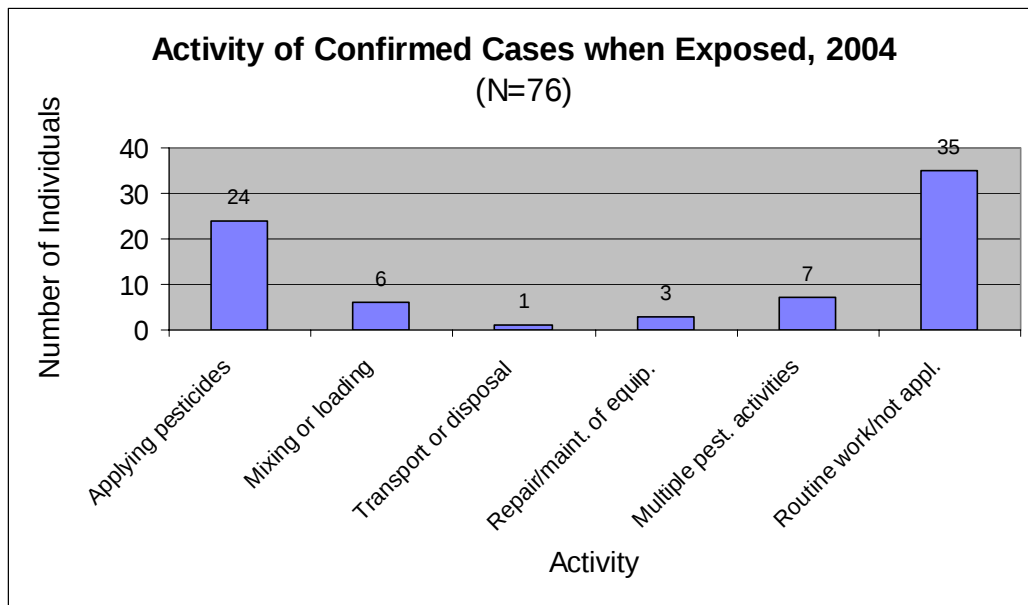
Table 5

Severity by Product Type of Confirmed Cases, 2004 (N=87)						
Product Type	Low		Moderate		High	
	Number	Percent	Number	Percent	Number	Percent
Insecticide	33	42.9	4	44.4	1	100.0
Antimicrobial	24	31.2	3	33.3	0	0.0
Herbicide	13	16.9	2	22.2	0	0.0
Fungicide	3	3.9	0	0.0	0	0.0
Mixture	4	5.2	0	0.0	0	0.0
Total	77	100.0	9	100.0	1	100.0

Activity at Time of Exposure

Activity at time of exposure was determined for 76 (87.4%) of the confirmed cases. Of those, Figure 7 shows that 35 (46.1%) were doing work activities that did not involve pesticide applications and thus had “bystander” exposure. Twenty-four (31.69%) individuals who became ill were applying pesticides when they were exposed.

Figure 7



* Activity was unknown for 11 cases

Medical Care

Table 6 shows where confirmed cases first sought medical care. Forty (46.0%) of the 87 cases first sought medical advice from an emergency department; in some instances medical personnel consulted with poison control. Twenty-eight (32.2%) first sought medical advice from a poison control center.

Table 6

First Source of Medical Care of Confirmed Cases, 2004 (N=87)		
First Care	Number	Percent
Emergency room/urgent care	40	46.0
Advice from poison control	28	32.2
Physician office visit	6	6.9
Ambulance	4	4.6
Occupational health center	4	4.6
None	5	5.7
Total	87	100.0

Outreach, Education, and Prevention Activities

Publications and Presentations

An educational booklet, “What You Need to Know About Pesticides and Your Health” was prepared in 2004. It is distributed to individuals interested in receiving such information and is available on-line www.michigan.gov/mdch-toxics (under Pesticide Information). From July 2004, when the booklet was posted, through December 2004 the site was accessed 306 times.

An article on the use of lindane to control head lice was published in “EpiInsight”, a newsletter prepared by MDCH for state and local public health epidemiologists.

MDCH contributed to an article published in the Journal of the American Medical Association (Alarcon et al, 2005). The surveillance program is also coauthoring, with NIOSH, an article about cases occurring in retail establishments.

A staff member of the surveillance program represents MDCH on the MDA Pesticide Advisory Committee and provides an activity report each quarter. In addition, staff regularly attend the Michigan Primary Care Association’s Migrant and Seasonal Farmworkers Workgroup.

Surveillance staff visited five clinic sites in the spring of 2004. At two of these sites, staff from related clinics were also present. There were 8-12 people present at each site, for a total of about 50 people. Information about the program, pesticide safety, and occupational disease reporting requirements was provided.

An overview of the surveillance system was presented at the annual MDCH-PCC meeting. Information about the program and data collected were also presented to the Interagency Migrant Services Committee.

Educational materials about West Nile Virus (WNV) and mosquito control were updated. Letters were sent to local health departments and mosquito control districts regarding surveillance of adverse effects as a result of WNV spraying activities.

MDA Referrals

Seven events reported in 2004 were referred to MDA for regulatory investigation.

One case involved a sales worker for a pesticide retailer. He was putting insecticide in a sprayer. Since he was not registered or certified to handle pesticides the exposure was referred to MDA for investigation. The inspector was told that the sales worker was carrying unopened jugs of pesticide and that only certified applicators run the inductor or sprayers. Neither the owner nor the exposed worker could remember if the worker was wearing coveralls, but the worker supposed he had been because of the pesticide involved. The inspector also looked at decontamination supplies and investigated the training program, which was in compliance with Worker Protection Standards. No violations were cited.

The second MDA referral involved a farm worker who sprayed some empty silos without wearing proper Personal Protective Equipment (PPE). MDA issued a warning letter citing two violations. The worker did not wear the PPE required by the label and label safety recommendations were not followed regarding washing thoroughly and changing clothes after the application.

The third case referred to MDA involved a printing press operator who was at work when his supervisor sprayed a product indoors that was labeled for outdoor use only. MDA issued a warning letter because the pesticide was not used in accordance with its label. The disposition letter indicated that the company had addressed the issues and identified changes they made to prevent this from occurring again.

The fourth case involved a groundskeeper at a school who was exposed to herbicides due to equipment failure. The individual was concerned because the eyewash at the school was in a locked closet with the key in a locked office. MDA conducted a planned use inspection, which revealed several areas in need of correction. The school was in partial compliance with the requirement that any person who uses pesticides have immediate access to a spill kit; their spill kit was considered inadequate for the quantity of pesticide their equipment holds. They were in noncompliance with the requirement to have a mixing pad. They were also in partial compliance in their record keeping. All the PPE required by the products used were available, and none of the products required immediate access to an eyewash kit or eyewash station. However the Building and Grounds Supervisor said he would install portable eyewash kits in each service vehicle.

The fifth MDA referral involved a farm worker at a Christmas tree farm who had been applying an herbicide in an area he had sprayed the day or two before with an organophosphorous insecticide. The insecticide was a restricted use pesticide and he was not a certified applicator, nor was one present. In addition, he may have used equipment prohibited by the label and may have entered the area before the restricted entry interval was over. Because of these concerns the case was referred to MDA for a planned use inspection. The farm owner only had one employee at the time and said he was unaware of the requirements of the Worker Protection Standard. A report serving as a warning letter was issued listing eight areas of noncompliance:

- failure to display a Pesticide Safety Poster at the central notification area;

- failure to provide emergency medical information on or near the pesticide safety poster;
- failure to provide specific information about the application;
- failure to notify workers on farms, in nurseries, or in forests of pesticide applications;
- failure to provide pesticide safety information to untrained workers;
- failure to provide general pesticide safety information;
- failure to properly train workers every five years; and
- failure of the person conducting the training to meet minimum requirements.

The sixth event reported to MDA involved an incident where five workers in a human service office were exposed to an herbicide through the ventilation system when a maintenance worker mixed an herbicide using a styrofoam cup. It dissolved and left a puddle outside an air intake for the ventilation system. According to some of the affected employees, this was not the first time the applicator spilled something outside the ventilation system. One of the workers reported the event to their union, which filed a complaint with MIOSHA. MIOSHA issued a warning, but no citations and also referred the incident to MDA. MDA conducted a pesticide use inspection and issued a warning letter citing six rule violations:

- the applicator was not commercially certified;
- the applicator did not maintain commercial applicator records;
- the applicator did not post lawn markers after pesticide applications;
- the applicator applied pesticides that were not ready-to-use and so should have been a certified applicator but was not;
- employees did not have verifiable training in Integrated Pest Management (IPM) elements; and
- commercial pesticide applications were made without a verifiable IPM program.

A licensed commercial pesticide applicator has been hired to perform all future indoor and outdoor applications.

The last case reported to MDA in 2004 involved a maintenance employee in a school who entered a room that had been sprayed for bees. The room was not ventilated or posted and he entered to clean it. He had pain in his shoulders, shortness of breath, a tight feeling in his chest, cough, headache and later developed pneumonia. He also reported that the school did not have an IPM plan. This case was not confirmed because he did not know the product used and thus it could not be determined if the symptoms were consistent with the known toxicology. Due to the issues involved, the case was referred to MDA and a warning letter was sent citing the following violations:

- the school did not have an Integrated Pest Management (IPM) plan in place.;
- the applicator had not participated in an IPM training program;
- records of the application were not maintained; the building was not posted; and
- the pest control company that had a contract with the food service company did not have an IPM plan in place.

NIOSH Reports

There were six priority reports to NIOSH in 2004.

A garbage collector was exposed to something on her route and developed a number of symptoms associated with cholinesterase inhibiting pesticides. She was taken to an emergency department, decontaminated, and diagnosed with organophosphate exposure. She responded to treatment with atropine and pralidoximine. She was hospitalized overnight.

A pesticide applicator used a product according to the label, which did not require any PPE. He was using a face shield but the wind shifted and the spray blew around the sides into his face and eyes. His eyes burned, were red, tearing, and swollen; and he had trouble seeing. He also was congested, sneezing, had shortness of breath, pain on deep breathing, and an asthma attack.

A number of employees of a fruit packing plant became ill from exposure to chlorine dioxide on different occasions. Three individuals described three different incidents and their symptoms after these incidents. Staff from the Michigan Migrant Legal Assistance Project alerted MIOSHA and MDA. MDA issued a warning letter, and MIOSHA issued one serious and one 'other' citation, with fines totaling \$1,400. Staff from the Michigan Migrant Legal Assistance Project later reported that the employees who reported problems were no longer employed by the company.

Twelve hospital employees were exposed to an insecticide that one brought in to share among coworkers who were having a problem with ladybugs at home. Four employees divided it into smaller plastic containers and the product 'ate through' the containers and spilled all over the desks and the floor. Several individuals became ill.

The incident described on the previous page where five employees at a human services office became ill after an herbicide melted a styrofoam cup outside a ventilation intake was also reported to NIOSH.

The last report to NIOSH, also forwarded to the EPA, concerned a product container. A person was spraying lice killer when the seam of the can opened up. It started to dribble down his arm and when he looked to see why, the seam opened completely and he was sprayed in the face. This was the first such incident reported to the EPA for this product.

Discussion

Surveillance Data

In the first two-and-a-half years of occupational pesticide illness and injury surveillance in Michigan (June 2001 – 2003), 196 cases were reported to the surveillance system of which 128 (65.3%) were confirmed as acute pesticide illness or injury cases using the published NIOSH case definition. Timeliness and completeness of reporting and data quality improved markedly as

the new surveillance system matured, so that 75% of cases reported in 2004 were able to be confirmed.

Close to half of the exposed workers in 2004 were engaged in activities not related to pesticide application. Workers in technical, sales and administrative support occupations accounted for over one-fifth of the exposed workers. Better education on pesticide safety is needed to prevent inadvertent workplace exposures.

Almost a third of all cases were due to antimicrobial exposure. These cases were similar in severity to those exposed to other pesticides and represent an area of ongoing concern.

Interventions

MDCH has continued to refer cases to MDA for investigation of possible safety violations. Most of the events reported in 2004 resulted in warning letters and improved safety for current and future employees at the worksites inspected. MDCH also worked to improve pesticide education for individuals and groups through the activities listed above. Education must remain a priority for both certified and non-certified pesticide applicators, since both groups may be exposed or expose other workers.

Challenges to Surveillance

Pesticide poisoning is a complex condition for surveillance because it encompasses many kinds of illnesses and injuries from skin rash to nerve toxicity. In addition, health care providers receive limited education in the toxic effects of pesticides and pesticide-related illnesses are frequently overlooked. The potential for pesticides to harm people depends in part on the dose (length of exposure and chemical concentration), and the route of entry into the body. It is also related to the specific chemicals in each product. Pesticide products are often mixtures including one or more active ingredients as well as other ingredients, which may also be toxic. Depending on the chemicals involved, pesticides can have short and long-term adverse health effects on different organ systems, including the skin, gastrointestinal, respiratory, nervous, and reproductive systems.

The problem of identifying pesticide-related illness for public health surveillance begins with difficulties in recognition and diagnosis, because the diverse signs and symptoms experienced can resemble an acute upper respiratory illness, acute conjunctivitis, or acute gastrointestinal illness, among other conditions. In these cases, patients may not seek medical care, or may not be correctly diagnosed if an occupational and environmental history that asks about pesticide exposure is not taken (Calvert, 2004). Migrant workers face additional barriers such as language difficulties, lack of access to care, and fear of job loss or deportation. Another problem is that even when diagnosed, pesticide-related illnesses and injuries may not be reported due to the reluctance on the part of workers and their health care providers to involve state agencies because of concerns about job security, lack of knowledge of the public health code reporting requirements, or lack of time to report (Calvert et al, 2001). Additional education to promote recognition of pesticide poisoning and compliance with the reporting requirement is needed.

More outreach is needed to educate health care providers on the importance of recognizing and reporting instances of occupational pesticide illnesses and injuries. While the emergency room was the first source of care for 40 (46%) of cases in 2004, the hospital submitted an occupational disease report for only 12 (30.0%) of those cases. The remaining cases were brought to the program's attention by PCC, but if the health care providers in the hospital do not call the PCC for advice, the case will not be identified by the surveillance system.

As in many other occupational disease and illness surveillance systems, the Michigan occupational pesticide surveillance data are likely a significant undercount of the true number of work-related pesticide poisoning cases in Michigan. A 2004 study done in the State of Washington found that the primary barrier for migrant farm workers in seeking health care was economic. Workers could not afford to take time off to seek medical care and were afraid that they might lose their jobs if they did so. That study also found that only 20-30 percent of pesticide-related illnesses among farm workers who filed a workers' compensation claim were given a diagnosis code that indicated pesticide poisoning. (Michigan's workers' compensation data identify poisonings as a group but are not specific enough to capture pesticide exposures.)

This surveillance system continues to face some data quality challenges due to the time lag between the occurrence and the reporting of the incident for occupational disease (OD) and MDA reports. This presents difficulties in following up with reported cases because of worker mobility, especially among seasonal farm workers. PCC reports are received promptly, but do not always contain sufficient information to allow contact with the exposed individual. Lack of information from follow-up often results in a case classification of "insufficient information."

Notwithstanding these limitations, the Michigan occupational pesticide surveillance system is receiving and investigating reports of occupational pesticide illness and injury, and has launched follow-up prevention activities. Plans to expand the system to include non-occupational pesticide injuries and illnesses began in 2005 with laboratory reporting of all acetylcholinesterase and pseudocholinesterase testing in Michigan. Future plans include the development of regulations to require the reporting of all pesticide injuries and illnesses, not just work-related events.

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Michigan Department of Community Health, Division of Environmental and Occupational Epidemiology. Occupational Pesticide Illness and Injury Surveillance in Michigan: 2001-2003. www.michigan.gov/mdch-toxics Pesticide Information.

State of Washington. Improving Data Quality in Pesticide Illness Surveillance – 2004. June 17, 2004. <http://www.doh.wa.gov/ehp/ts/pubs-pesticides.htm>

Additional Resources

MDCH Division of Environmental and Occupational Epidemiology pesticide information: www.michigan.gov/mdch-toxics

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

Pesticide-Related Illness and Injury Surveillance: A How-To Guide for State-Based Programs
DHHS (NIOSH) publication number 2006-102. October 2005

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

To report occupational pesticide exposures in Michigan: www.chm.msu.edu/oem

Appendix 1

Case Definition for Acute Pesticide-Related Illness and Injury Cases Reportable to the National Public Health Surveillance System¹

Clinical Description

This surveillance case definition refers to any acute adverse health effect resulting from exposure to a pesticide product (defined under the Federal Insecticide Fungicide and Rodenticide Act [FIFRA]²) including health effects due to an unpleasant odor, injury from explosion of a product, inhalation of smoke from a burning product, and allergic reaction. Because public health agencies seek to limit all adverse effects from regulated pesticides, notification is needed even when the responsible ingredient is not the active ingredient.

A case is characterized by an acute onset of symptoms that are dependent on the formulation of the pesticide product and involve one or more of the following:

- Systemic signs or symptoms (including respiratory, gastrointestinal, allergic and neurological signs/symptoms)
- Dermatologic lesions
- Ocular lesions

This case definition and classification system is designed to be flexible, permitting classification of pesticide-related illnesses from all classes of pesticides. Consensus case definitions for specific classes of chemicals may be developed in the future.

A case will be classified as occupational if exposure occurs while at work (this includes: working for compensation; working in a family business, including a family farm; working for pay at home; and, working as a volunteer Emergency Medical Technician (EMT), firefighter, or law enforcement officer). All other cases will be classified as non-occupational. All cases involving suicide or attempted suicide should be classified as non-occupational.

A case is reportable to the national surveillance system when there is (see the Classification Criteria section for a more detailed description of these criteria):

¹http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef2003_2.pdf

²Pesticides are defined under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) as any substance or mixture of substances intended to prevent, destroy, repel or mitigate insects, rodents, nematodes, fungi, weeds, microorganisms, or any other form of life declared to be a pest by the Administrator of the US EPA and any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant. Pesticides include herbicides, insecticides, fungicides, disinfectants, wood treatment products, growth regulators, insect repellents, etc.

Please note that adverse health effects resulting from exposure to disinfectant products are not reportable in many states because the volume of reports could overwhelm the state's surveillance system; therefore, these cases will not be routinely reported to the national surveillance system. However, states may collect data on health effects resulting from disinfectant exposure, and report relevant cases to the national surveillance system.

- Documentation of new adverse health effects that are temporally-related to a documented pesticide exposure; AND
- Consistent evidence of a causal relationship between the pesticide and the health effects based on the known toxicology of the pesticide from commonly available toxicology texts, government publications, information supplied by the manufacturer, or two or more case series or positive epidemiologic investigations; OR
- Insufficient toxicological information available to determine whether a causal relationship exists between the pesticide exposure and the health effects

Laboratory criteria for diagnosis

If available, the following laboratory data can confirm exposure to a pesticide:

- Biological tests for the presence of, or toxic response to, the pesticide and/or its metabolite (in blood, urine, etc.);
 - Measurement of the pesticide and/or its metabolite(s) in the biological specimen;
 - Measurement of a biochemical response to the pesticide in a biological specimen (e.g. cholinesterase levels);
- Environmental tests for the pesticide (e.g. foliage residue, analysis of suspect liquid); or
- Pesticide detection on clothing or equipment used by the case subject.

Appendix 2

Case Classification Criteria¹

Reports received and investigated by state programs are scored on the three criteria provided below (criteria A, B and C). Scores are either 1, 2, 3, or 4, and are assigned based on all available evidence. The classification matrix follows the criteria section (Table 1). The matrix provides the case classification categories and the criteria scores needed to place the case into a specific category. Definite, probable, possible and suspicious cases (see the classification matrix) are reportable to the national surveillance system. Additional classification categories are provided for states that choose to track reports that do not fit the criteria for national reporting.

A. Documentation of Pesticide Exposure

1. Laboratory, clinical or environmental evidence corroborate exposure (*at least one of the following must be satisfied to receive a score of “1”*):
 - a. analytical results from foliage residue, clothing residue, air, soil, water or biologic samples;
 - b. observation of residue and/or contamination (including damage to plant material from herbicides) by a trained professional [Note: a trained professional may be a plant pathologist, agricultural inspector, agricultural extension agent, industrial hygienist or any other licensed or academically trained specialist with expertise in plant pathology and/or environmental effects of pesticides. A licensed pesticide applicator not directly involved with the application may also be considered a trained professional.];
 - c. biologic evidence of exposure (e.g. response to administration of an antidote such as 2-PAM, Vitamin K1, or repeated doses of atropine);
 - d. documentation by a licensed health care professional of a characteristic eye injury or dermatologic effects at the site of direct exposure to a pesticide product known to produce such effects (these findings must be sufficient to satisfy criteria B.1 under “documentation of adverse health effect”);
 - e. clinical description by a licensed health care professional of two or more post-exposure health effects (at least one of which is a sign) characteristic of the pesticide.
2. Evidence of exposure based solely upon written or verbal report (at least one of the following must be satisfied to receive a score of “two”):
 - a. report by case;
 - b. report by witness;
 - c. written records of application;
 - d. observation of residue and/or contamination (including damage to plant material from herbicides) by other than a trained professional;
 - e. other evidence suggesting that an exposure occurred.
3. Strong evidence that no pesticide exposure occurred.

¹http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef2003_2.pdf

4. Insufficient data.

B. Documentation of Adverse Health Effect

1. Two or more new post-exposure abnormal signs and/or test/laboratory findings reported by a licensed health care professional.
2. At least one of the following must be satisfied to receive a score of “two”:
 - a. Two or more new post-exposure abnormal symptoms were reported. When new post-exposure signs and test/laboratory findings are insufficient to satisfy a B1 score, they can be used in lieu of symptoms toward satisfying a B2 score.
 - b. Any new illness or exacerbation of pre-existing illness diagnosed by a licensed physician, but information on signs, symptoms and/or test findings are not available or insufficient for a B.1 or B.2.a score.
3. No new post-exposure abnormal signs, symptoms, or test/laboratory findings were reported.
4. Insufficient data (includes having only one new post-exposure abnormal sign, symptom, or test/laboratory finding).

C. Evidence Supporting a Causal Relationship Between Pesticide Exposure and Health Effects

1. Where the findings documented under the Health Effects criteria (criteria B) are:
 - a. characteristic for the pesticide as provided in Appendix 2, and the temporal relationship between exposure and health effects is plausible (the pesticide refers to the one classified under criteria A), and/or;
 - b. consistent with an exposure-health effect relationship based upon the known toxicology (i.e., exposure dose, symptoms and temporal relationship) of the putative agent (i.e., the agent classified under criteria A) from commonly available toxicology texts, government publications, information supplied by the manufacturer, or two or more case series or positive epidemiologic studies published in the peer-reviewed literature;
2. Evidence of exposure-health effect relationship is not present. This may be because the exposure dose was insufficient to produce the observed health effects. Alternatively, a temporal relationship does not exist (i.e., health effects preceded the exposure, or occurred too long after exposure). Finally, it may be because the constellation of health effects are not consistent based upon the known toxicology of the putative agent from information in commonly available toxicology texts, government publications, information supplied by the manufacturer, or the peer-reviewed literature;
3. Definite evidence of non-pesticide causal agent;
4. Insufficient toxicological information is available to determine causal relationship between exposure and health effects. (This includes circumstances where minimal human

health effects data are available, or where there are less than two published case series or positive epidemiologic studies linking health effects to the particular pesticide product/ingredient or class of pesticides.)

Table 1 ~ Case Classification Matrix:

CLASSIFICATION CATEGORIES ²											
CLASSIFICATION CRITERIA	Definite Case	Probable Case		Possible Case	Suspicious Case	Unlikely Case	Insufficient Information		Not a Case		
									Asymptomatic ³	Unrelated ⁴	
A. Exposure	1	1	2	2	1 or 2	1 or 2	4	-	-	3	
B. Health Effects	1	2	1	2	1 or 2	1 or 2	-	4	3	-	
C. Causal Relationship	1	1	1	1	4	2	-	-	-	-	3

² Only reports meeting case classifications of Definite, Probable, Possible and Suspicious are reportable to the National Public Health Surveillance system. Additional classification categories are provided for states that choose to track the reports that do not fit the reporting criteria.

³ The matrix does not indicate whether asymptomatic individuals were exposed to pesticides although some states may choose to track the level of evidence of exposure for asymptomatic individuals.

⁴ Unrelated = Illness determined to be caused by a condition other than pesticide exposure, as indicated by a '3' in the evidence of 'Exposure' or 'Causal Relationship' classification criteria.

Appendix 3

Severity Index

for Use in State-based Surveillance of Acute Pesticide-Related Illness and Injury¹

Purpose: The purpose of the severity index is to provide simple, standardized criteria for assigning severity to cases of acute pesticide-related illness and injury.

Rationale: It is important to assign a severity category to each case of acute pesticide-related illness and injury. An understanding of illness severity will be useful for evaluating the morbidity of acute pesticide-related illness and injury, for assessing its impact on society, and to assist with limited intervention/prevention resources toward the most pressing pesticide problems.

Description: This severity index is based upon existing systems for ranking severity of poisonings, including pesticide illness^{2, 3, 4, 5}. It takes into account the following: signs and symptoms; whether medical care was sought; whether the individual was hospitalized; and, whether there was lost time from work or usual activities. Severity should only be assigned to acute pesticide-related illnesses or injuries classified as definite, probable, possible, or suspicious. As such, this severity index should be used in conjunction with the Case Definition for Acute Pesticide-Related Illness and Injury Cases Reportable to the National Public Health Surveillance System⁶.

This severity index provides standardized criteria to ensure inter-rater uniformity in assigning severity. However, we recognize that this severity index cannot address all conceivable clinical situations. Therefore, it is not realistic to insist on strict adherence to these criteria. The user must be flexible when using this severity index, given that the user will not infrequently need to employ judgment and experience when assigning severity.

A brief description of each of the four severity categories follows.

S-1 Death

This category describes a human fatality resulting from exposure to one or more pesticides.

¹ <http://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sevindexv6.pdf>

² AAPCC, 1992. Toxic Exposure Surveillance System (TESS) Manual. American Association of Poison Control Centers, Washington, D.C.

³ Washington Department of Health, 1999. 1998 Annual Report, Pesticide Incident Reporting and Tracking Review Panel. Washington State Department of Health, Office of Environmental Health and Safety, Olympia, WA.

⁴ EPA, 1998. Expanded Explanation for the new FIFRA 6(a)(2)'159.814 (5)(i)(A-E) and (5)(ii)(A-E) Exposure Severity Categories.

⁵ Persson HE, Sjoberg GK, Haines JA, de Garbino JP. 1998. Poisoning severity score. Grading of acute poisoning. Clin Toxicol 36:205-213.

⁶ NIOSH, 2000. Case definition for acute pesticide-related illness and injury cases reportable to the national public health surveillance system. Cincinnati, OH: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. 2000. Unpublished.

S-2 High severity illness or injury

The illness or injury is severe enough to be considered life threatening and typically requires treatment. This level of effect commonly involves hospitalization to prevent death. Signs and symptoms include, but are not limited to, coma, cardiac arrest, renal failure and/or respiratory depression. The individual sustains substantial loss of time (> 5 days) from regular work (this can include assignment to limited/light work duties) or normal activities (if not employed). This level of severity might include the need for continued health care following the exposure event, prolonged time off work, and limitations or modification of work or normal activities. The individual may sustain permanent functional impairment.

S-3 Moderate severity illness or injury

This category includes cases of less severe illness or injury often involving systemic manifestations. Generally, treatment was provided. The individual is able to return to normal functioning without any residual disability. Usually, less time is lost from work or normal activities (= 3-5 days), compared to those with severe illness or injury. No residual impairment is present (although effects may be persistent).

S-4 Low severity illness or injury

This is the category of lowest severity. It is often manifested by skin, eye or upper respiratory irritation. It may also include fever, headache, fatigue or dizziness. Typically the illness or injury resolves without treatment. There is minimal lost time (<3 days) from work or normal activities.

Appendix 4

Case Narratives, Confirmed Cases

Insecticides and insect repellents

MI00129 – A 30-year-old male farm worker was trying to prime a homemade pesticide injection system. He thought there was an air leak in the filter and accidentally twisted the filter the wrong way. The pressurized carbamate insecticide squirted into his eyes. He flushed them immediately but they burned and he developed blurry vision. He went to an emergency department where he was diagnosed with chemical conjunctivitis.

MI00130 – A 46-year-old male sales worker for a pesticide retailer was putting a pyrethroid insecticide in a sprayer. He hit a wrong button and it sprayed back on him. He washed right away and changed clothes. He'd been wearing goggles and a hat, but he felt burning, tingling, itching, and numbness on his face and neck where he had not been protected and his skin was red. It continued to burn and he went to an emergency department the next day where he was diagnosed with contact dermatitis. He was not registered or certified to handle pesticides so the exposure was referred to MDA for investigation. The inspector was told that the sales worker was carrying unopened jugs of pesticide only. The inspector also looked at decontamination supplies and investigated the training program, which was in compliance with Worker Protection Standards. No violations were cited.

MI00153 – A 23-year-old pet store employee used two pyrethrin insecticides on caged rodents and a carbaryl insecticide on their cages as a treatment for mites. He developed a headache, itchy and burning skin, a film in his mouth, and burning eyes. He did not seek medical care but did report this to MDA, which cited five violations. The pyrethrin insecticides were not used according to their labels as one was for use on cats only and the other for dogs, cats, puppies and kittens. In addition, the carbaryl insecticide was applied contrary to label directions, without PPE, and by an employee who was not certified or registered to apply the pesticide.

MI00154 – A 51-year-old male plumber was working on remodeling a basement. He pulled down some ceiling drywall and a bag of a carbamate insecticide fell down on him. It hit him in the face and got in his eyes and mouth. He went home to shower and vomited. Then he went to an urgent care center complaining of eye and throat burning sensation, chest pain, and tingling sensation in face. They irrigated his eyes and had him drink lots of water. His eyes were checked and no corneal abrasions were seen. He was told to stay off work for the rest of the day. He continued to have watery eyes over a month later.

MI00155 – A 34-year-old female fruit packing warehouse supervisor had an allergic reaction after being exposed to a pyrethrin containing insecticide in the warehouse. She developed hives with swelling around her eyes and trouble breathing. She went to an emergency department where she was diagnosed with an acute allergic reaction to pesticides, with bronchospasm and hives.

MI00205 – A 38-year-old female garbage collector was collecting garbage (using gloves) on her route in a residential neighborhood. Shortly after starting she became weak, sweaty, had excess salivation, abdominal cramps, shortness of breath, a rash, bradycardia hypotension, and diarrhea. She went to an emergency department where she was decontaminated and treated with atropine and pralidoximine. About 45 minutes later she was nearly normal, except for being tired. She was diagnosed with organophosphate toxicity. She was hospitalized overnight and missed two days of work.

MI00202 – A 48-year-old male cable installer used about one-quarter of a can of an organophosphate bee spray in a telephone box before working on a cable above the box. He started getting dizzy, then sweating and vomiting. His skin felt fiery and he became incoherent. An ambulance was called and he was taken to an emergency department and then admitted to the hospital for three days. He had increased salivation and lacrimation. It took 48 hours for him to be able to walk steadily without assistance, but his symptoms did resolve on their own. He was told not to return to work for a week. His workplace called MIOSHA who advised them to use a different type of bug spray.

MI00225 – A 34-year-old male office worker sprayed his office for bugs with a pyrethroid insecticide and got some in his eye. It was irritated and his vision was blurry. He called poison control and they advised him to irrigate his eye.

MI00252 – An 18-year-old male cashier in a store was scanning a bottle of an organophosphorous insecticide when the cap seal broke and he got it all over his hands. He then wiped his eye, which became irritated and red. He went to a medical center and was diagnosed with chemical conjunctivitis.

MI00262 – A 77-year-old male farmer used an organophosphorous insecticide without proper respiratory protection. He experienced gradually worsening fatigue, malaise, weakness, anorexia, lightheadedness, and mild back and chest discomfort and went to an emergency department. He was instructed to use PPE when spraying his trees and to increase his fluid consumption.

MI00258 – A 17-year-old farm worker sprayed some empty silos with an organophosphorous insecticide. He did not wear proper PPE and on the way home from work became dizzy, tired, nauseous and vomited up green foam. He went to an emergency department and was diagnosed with acute exposure to pesticides. The case was referred to MDA. It was determined that label instructions regarding PPE use were not followed and a warning letter was issued.

MI00266 – A 36-year-old female housekeeper at a hotel walked through an area the manager was spraying with a pyrethrin insecticide. She felt short of breath, had chest pains and a headache. She went to a medical center.

MI00268 – A 23-year-old male pesticide applicator had some pyrethroid insecticide blow back in his face. He developed a red rash and went to an emergency department.

MI00269 – A 24-year-old male pesticide applicator was using a pyrethroid insecticide to spray a house for bees and wasps. The wind shifted and some spray came in the side of his face shield and into his eyes. His eyes were burning, red, tearing, and swollen and he had trouble seeing. He also was congested, sneezing, had shortness of breath, pain on deep breathing, and had an asthma attack. He went to a medical center where he was given albuterol inhalant treatments and his eyes were irrigated. He was then transferred to an emergency department where he was diagnosed with chemical conjunctivitis. His eyes were irrigated again and he was sent home with medications and a referral to an ophthalmologist.

MI00273 – A 23-year-old male pizza deliverer swept up ants that had been sprayed with a pyrethrin insecticide by his boss. He had a sore throat and cough and called poison control.

MI00277 – A 37-year-old male structural pest control applicator was using a pyrethroid insecticide to spray for wasps and bees. The hose had a leak he did not know about and some insecticide got on his hand. He then rubbed his itchy eye, which began to hurt. He rinsed his eye for 3-4 minutes and it felt better, but gradually got worse again. It was red, tearing and painful and his vision was affected. He called poison control.

MI00283 – A 30-year-old female general manager in a bar was using a pyrethroid insecticide for fruit flies. She had used most of a can over three days, standing in the mist most of the time. On the fourth day she developed a heavy, tight, burning sensation in her chest, shortness of breath, and pain on breathing. She called poison control and was referred to an emergency department but she did not go. Her symptoms gradually improved over two days. She missed one day of work.

MI00288 – A 44-year-old female teacher spent the day in a classroom with two children who had been treated for lice with an organophosphate insecticide. After smelling the fumes all day she was nauseous and had a severe headache with photophobia. She said she never felt so bad before. She called poison control and was advised to take a shower.

MI00290 – A 41-year-old female financial clerk in a hospital was one of 12 persons exposed to a pyrethroid insecticide that an employee brought in to share among coworkers who were having a problem with ladybugs at home. Four employees divided it into smaller plastic containers. The product 'ate through' the containers and spilled all over the desks and the floor. She worked between two cubes where the insecticide spilled and left when she smelled the fumes. She had a dry throat and a tingly feeling in her fingers, legs, and feet. She went to the emergency room and was told to take a shower.

MI00292 – A 46-year-old female medical records clerk in a hospital was one of 12 persons exposed to the pyrethroid insecticide noted above. She had a history of asthma and when she walked down the hall near the spill she developed shortness of breath, coughing, wheezing and sweating. She went to the emergency room and was given albuterol and took a shower.

MI00294 – A 41-year-old female financial clerk in a hospital was one of 12 persons exposed to the pyrethroid insecticide noted above. Some spilled on the desk where she was working. She

became lightheaded, dizzy, and her hands tingled. She went to the emergency room where she was advised to go home and shower.

MI00296 – A 41-year-old female financial clerk in a hospital was one of 12 persons exposed to the pyrethroid insecticide noted above. She was next to one of the desks where it spilled and she developed a bad headache and was nauseous. She went to the emergency room and showered.

MI00297 – A 26-year-old female housekeeper in a hospital was one of 12 persons exposed to the pyrethroid insecticide noted above. She was down the hall but smelled it and became light-headed, dizzy, nauseous, had a headache, and her eyes were tearing. She went to the emergency room and showered.

MI00298 – A 44-year-old female financial clerk in a hospital was one of 12 persons exposed to the pyrethroid insecticide noted above. Some spilled on her desk and smelled awful. She had chest discomfort, tingling all over, was nauseous, and “didn’t feel right”. She went to the emergency room, showered, and was given an antihistamine.

MI00300 – A 35-year-old cashier at a convenience store came to work one day shortly after the store was treated by a commercial pesticide applicator with a carbamate insecticide. She developed a red, itchy, rash on her hands, head, and feet. Her tongue was tingling, numb and swollen. Her lip was also numb. She went to an emergency room and was diagnosed with an allergic reaction. She reported the incident to the MDA and the pesticide company was given a warning letter for not providing complete and timely written information to the customer and not maintaining complete records.

MI00301 – A 62-year-old female nurse spent time on her breaks in an area outside the hospital that had been sprayed with an insecticide. She developed a rash, swollen face, tachycardia, anxiety, tremor, blurred vision, and dyspnea. She went to the emergency room and was diagnosed with an allergic reaction. She did not return to full-time work for about two months.

MI00302 – A 45-year-old male printing press operator was at work when his supervisor sprayed a pyrethroid insecticide. He had an asthma attack, cough, sore throat, and nasal irritation. He called poison control that day and went to his doctor two days later where he was diagnosed with bronchitis. He missed three days of work. The insecticide used was formulated for outdoor use so this case was referred to MDA, which sent a warning letter to the print shop.

MI00310 – A 51-year-old female assistant manager in a pet food store looked up as a pyrethrin insecticide was being automatically dispensed. She was wearing glasses but got some on her face and in her mouth. She washed out her mouth but not her face. The next morning she was dizzy, nauseous and vomited and her right eye was so swollen she could not open it. She went to an urgent care clinic and was given a steroid injection. She continued to feel worse, with sinus pressure, nausea, vomiting, and a headache, and went to an emergency department the following day. She lost one day of work.

MI00312 – A 40-year-old male superintendent of properties was using a pyrethroid insecticide. The trigger on the fogger malfunctioned and he stayed in the area too long. He developed shortness of breath, a runny nose, and a rash. He went to an urgent care center.

MI00313 – A 30-year-old male carpet cleaner entered a house that had been treated four days previously with a pyrethroid insecticide. When he entered the house he could only stay a few minutes because of the smell. He became nauseous, dizzy, and developed a headache right away. His partner vomited. The next day he was coughing, had a stuffy nose, difficulty breathing, and a headache. He did not see a doctor due to lack of funds. He missed two days of work.

MI00315 – An adult male pesticide applicator inhaled flea dust which contained a pyrethrin insecticide. He called poison control the next day with a runny nose, queasy stomach and low-grade temperature.

MI00316 – A 42-year-old male farm worker used a pyrethroid insecticide and another insecticide. Three days later he went to an emergency department complaining of drooling, spitting, skin irritation, dry heaves, sore throat, cough, nasal congestion, and trouble breathing.

MI00318 – A 57-year-old male farm worker was using a pressure hose to clean equipment that had some residual carbamate insecticide. The water sprayed all over him. He became shaky, dizzy, nauseous, and felt very hot. He went to an emergency department. The symptoms resolved by the next day.

MI00322 – A 22-year-old man sprayed bees with a pyrethroid insecticide. Some blew back in his face. He was nauseous, vomited, and felt dizzy. He called poison control.

MI00320 – A 42-year-old male landscaper was moving rocks and touched pellets of an organophosphorous insecticide that had been placed between the rocks. He developed a headache, nausea, bad taste in his mouth, and bad smell with a burning sensation in his nose. He called poison control.

MI00327 – A 35-year-old male landscaper working with the above case also touched the organophosphorous ant poison while moving rocks. He had a headache and felt nauseous and dizzy. He went home early and spent the rest of the day in bed.

MI00330 – A 20-year-old male shipping trainer at a department store distribution warehouse was riding on a forklift. He ran over a can of DEET containing insect repellent that had fallen to the ground. The can exploded and he got sprayed in the face and right eye. His eye was red, burning, and tearing. He went to an emergency department where he was diagnosed with chemical conjunctivitis.

MI00337 – A 51-year-old custodian in a school entered a classroom that had been treated for bees with a pyrethroid insecticide. The room was not posted. When he went to clean the room he could smell the chemical. He developed a cough right away and a headache that lasted about two days. He also developed pain in his shoulders that moved down to his chest. He subsequently

developed pneumonia. He saw a doctor several times. The school did not have an IPM plan so the case was referred to MDA, which issued a warning letter.

MI00339 – A 47-year-old male resident care assistant in a psychiatric hospital was spraying a chair for head lice with a pyrethroid insecticide. The seam of the can opened up and product leaked on his arm and sprayed in his face and eyes. He was wearing glasses but developed burning, red, itchy, tearing eyes. He also had a burning, dry throat, slight cough and red pharynx. He went to an emergency department and diagnosed with chemical conjunctivitis.

MI00342 – A 34-year-old female office worker was present when her office was sprayed with an organophosphorous insecticide formulated for outdoor use only. She felt detached from her body, was dizzy, drowsy, and nauseous, and had a headache. Her eyes were burning, her throat was scratchy, her nose was running, and her lips and tongue were numb. There was no window to open for fresh air. She called poison control, and was referred to an emergency department. About a week later she called poison control again because she still had a cough and runny nose.

Herbicides

MI00254 – A 21-year-old male maintenance worker in a park was spraying streets and curbs with a glyphosate herbicide. He got some on his skin and inhaled some. He had difficulty breathing, his stomach hurt and he was nauseous. He called poison control and was advised to wash well with soap and water.

MI00264 – A 44-year-old male pesticide applicator for a lawn care company was filling a truck with an herbicide when a piece of equipment fell apart due to a stripped bolt. The herbicide spilled on him and he washed and changed his clothes immediately. He had a rash on his legs with an itchy, burning sensation and went to an emergency department.

MI00272 – A 28-year-old male grader foreman for an asphalt company was spraying a 2,4-D herbicide. Something went wrong with the wand and it sprayed on his neck. He did not wash off until he went home. The area was red and burning. He called poison control.

MI00303 – A 20-year-old male pesticide applicator for a lawn care company inhaled some herbicide spray at work. He felt chest tightness and pain, dizziness, had a cough, and trouble breathing. He went home and took a shower. The next day he still had shortness of breath and a sore throat and called poison control. He lost two days from work.

MI00311 – A 52-year-old female groundskeeper at a school had a sprayer malfunction due to an o-ring failure. She was ‘drenched’ with glyphosate and another herbicide. She developed nausea, dry heaves, diarrhea, felt weak, and had an asthma attack. She went to an emergency department. She was concerned because the eyewash at the school was in a locked closet with the key in a locked office. This was reported to MDA and they issued a warning. In addition to making the corrections required by MDA, the Building and Grounds Supervisor said he would install portable eyewash kits in each service vehicle.

MI00321 – A 21-year-old male construction worker was fixing a sprayer that had been used to spray a glyphosate herbicide. He was not wearing gloves and later touched his eye. His eye burned, felt dry and itchy, and was red. He went to an emergency department where he was diagnosed with corneal abrasion.

MI00332 – A 25-year-old female typist in a human service office was exposed to an herbicide through the ventilation system. A maintenance worker was mixing an herbicide using a styrofoam cup which dissolved and left a puddle outside an air intake for the ventilation system. She became dizzy and nauseous and went outside. The workers' union contacted MIOSHA and although MIOSHA did not issue any citations they requested the agency to develop a written safety plan. MDCH referred the case to MDA who issued a warning letter citing six rule violations. A licensed commercial pesticide applicator has been hired to perform all future indoor and outdoor applications.

MI00333 – A 47-year-old female typist in a human service office was exposed to the herbicide through the ventilation system in the same incident. She developed a headache, felt faint, had chest pain, trouble breathing, weakness, and nausea. She went outside. She tried to come back in, but felt worse and went back outside.

MI00334 – A 24-year-old pregnant typist in a human service office was exposed to the herbicide through the ventilation system in the same incident. She developed a headache, dizziness, sinus pressure, nausea, red, swollen, watery eyes, and sharp pains in her stomach. She saw her obstetrician and was off work for a month.

MI00335 – A 56-year-old male clerical worker in a human service office was exposed to the herbicide through the ventilation system in the same incident. He had a headache that lasted several days, his lips were numb, and he was nauseous and dizzy. Later he developed a sore throat and sinus problems. He went to his primary care physician and was off work three days.

MI00338 – A 35-year-old male laborer for a construction company was placing a fabric containing a time-release herbicide under a walkway in a park. He got some on his hands and clothes. He did not wash his hands before smoking. He could taste the herbicide and his lips burned. He called poison control.

MI00347 – An adult male worker for a landscaping company was working on a truck hose line. It ruptured and squirted a mix of two herbicides in his face and eyes. His eyes were irritated and he had a bad taste in his mouth. He called poison control.

MI00348 – A 25-year-old woman was closing a bag of an herbicide and some fine particles puffed out and went in her eye. She irrigated her eye but a burning sensation and blurred vision continued and she went to an emergency department. Her eye was red but no corneal lesions were seen. She was diagnosed with chemical irritation of the left eye.

MI00344 – A 50-year-old man was exposed to an herbicide that soaked through his gloves. His hand became red and swollen, and hurt. He went to an occupational health care provider.

Fungicides

MI00158 – A 49-year-old female nursery worker thought she absorbed a fungicide through her shoes. She felt nauseous, had numbness in her extremities, itchy legs and anxiety. She went to an emergency department and was diagnosed with a possible allergic reaction.

MI00261 – A 42-year-old male farmer was in a hurry and did not tighten the cap on a jug of fungicide he was mixing. When he shook it some splashed on his face. His eyes were burning and his mouth irritated. He rinsed immediately and then went to an emergency department, where he was diagnosed with conjunctivitis due to chemical exposure.

MI00270 – A 21-year-old female sales worker in the nursery section of a store was at work the morning after plants had been sprayed with a fungicide. The area was not ventilated. She had a rash where her hand touched her face, chest tightness, cough and vomiting later in the week. She called poison control.

Antimicrobials

MI00170 – A 22-year-old female dental technician splashed an alcohol-containing antimicrobial in her eyes, which became red and irritated. Poison control recommended irrigating her eyes. In a follow-up call an hour later the technician said she did not irrigate her eyes because it hurt too much. Poison control then recommended going to an emergency department. She did not go due to lack of insurance.

MI00168 – A 40-year-old woman splashed a quaternary ammonium chloride-based cleaner on her skin at work. She had six small pink spots on her face that were irritated. None got in her eyes. She called poison control.

MI00164 – An adult female cleaner used a rag soaked in a bucket of an incorrectly diluted quaternary ammonium chloride-based sanitizer for about four hours with no gloves. Her hands became red and burned. She called poison control, which recommended rewashing her hands. They followed up the next day and her hands were still irritated but better.

MI00223 – An adult man working at a golf course got some quaternary ammonium chloride-based detergent in his eyes at work. He went to an emergency department with red, burning eyes. He was diagnosed with alkali chemical burns.

MI00224 – A 24-year-old woman working in a hot tub facility was sprayed in the eye with a pine-oil cleaner. Her eye developed redness and tearing. The manager called poison control and they recommended irrigating her eye.

MI00227 – A 33-year-old male day laborer was cleaning a floor with a sodium hypochlorite (bleach) solution and got some on his shirt and then his arm and shoulder. About ten days later he went to a medical clinic where he was diagnosed with 2nd and 3rd degree chemical burns with necrosis.

MI00243 – A 23-year-old female housekeeper had a needle stick with a quaternary ammonium chloride-based disinfectant to her hand. Her hand became discolored and painful.

MI00245 – A 39-year-old male water technician was adding sodium hypochlorite to a well and it spilled on his skin. He coughed for about 20 minutes and had skin and eye irritation. He went to an emergency department.

MI00248 – A 35-year-old male water technician adding sodium hypochlorite to the same well was also splashed with the hypochlorite solution. His face and chest were red, irritated, and itchy and his eyes were draining and felt dry. He flushed his eyes at the time and went home and called poison control, which recommended a shower and re-irrigation of his eyes. They also recommended that he see a doctor, but it is unknown if he did.

MI00250 – A 42-year-old male janitor at a hospital was cleaning a ventilation grill. He sprayed a sodium hypochlorite solution on the vent in the ceiling and then began cleaning the wall. The solution dripped on his back but he did not notice because he was wearing two layers of clothing. He stopped for lunch and leaned back and the hypochlorite solution came into contact with his back. He felt immediate intense pain. He went to the emergency department and was diagnosed with a 2nd degree chemical burn.

MI00251 – A 23-year-old female fast-food worker got some dish sanitizer in her eye. She pushed the top of the sanitizer, stored overhead, and some sprayed into her eye. She rinsed the eye right away and went home. It became red, irritated, and her vision was blurry. She went to an emergency department and was diagnosed with chemical conjunctivitis.

MI00267 – An 18-year-old female food service worker in a fast food restaurant got some sodium hypochlorite sanitizer in her eye when a worker threw a rag towards a washing machine and it hit her in the face. Her eyes began to burn and her vision became blurry. A coworker called poison control and they recommended flushing the eye. Her eye continued to itch and burn so she went to an emergency department where they irrigated her eyes again and diagnosed conjunctival injection.

MI00274 – A 30-year-old woman got some quaternary ammonium chloride-based disinfectant in her eye and face. She had a burning sensation, a red area on her face, and conjunctival injection. She went to an emergency department.

MI00275 – A 25-year-old male dairy worker got some quaternary ammonium chloride-based disinfectant in his eye. His eye was red and swollen and he went to an emergency department. His sclera was injected and his cornea had abrasions.

MI00278 – A 42-year-old woman working in a fruit processing plant was exposed to chlorine dioxide fumes. Her eyes, ears, and face were itchy; she had a runny nose, cough, and difficulty breathing. Two days later she had a doctor's appointment and her provider noticed that she was wheezing. She was sent to the hospital for a chest X-ray. She reported this to someone from the Michigan Migrant Legal Assistance Project who reported the employer to MDA and MIOSHA. The woman was laid-off from work with no explanation.

MI00279 – A 23-year-old pregnant woman working in the same fruit processing plant was also exposed to chlorine dioxide fumes. She was wheezing, had shortness of breath, chest pains, and a cough. She went to an emergency room at night because she still could not breathe and was diagnosed with acute bronchospasm. She also reported this to the same person from the Michigan Migrant Legal Assistance Project. She was laid-off about a month later with no explanation.

MI00280 – A 57-year-old woman working in the same fruit processing plant was also exposed to chlorine dioxide fumes and her face and eye started to swell. The next day her mouth, face, and both eyes were swollen and she went to an emergency room. She also reported this to the same person from the Michigan Migrant Legal Assistance Project. She was transferred to work in the cold room and later quit.

MI00285 – A 16-year-old female childcare worker in a school was putting some ammonia-based sanitizer in a bucket to clean tables. She mistakenly replaced the tube the sanitizer is dispensed from facing up instead of down. When it fell down some splattered in her eye. Her eye became red and irritated and she went to an emergency department where she was diagnosed with injected conjunctiva.

MI00304 – A 53-year-old woman had some sodium hypochlorite detergent splash in her eye while washing dishes. Her eye was irritated, itchy, and tearing. She went to an occupational health clinic where her eye was irrigated.

MI00305 – A 22-year-old female employee at a department store was removing a return label from a container of a quaternary ammonium chloride-based disinfectant. The lid was off and it splashed on her face, neck, and arms. She developed a red, blistered rash. Her employer called poison control and they referred her to a health center, where she was diagnosed with an allergic reaction.

MI00308 – A 54-year-old female hospital housekeeper was mixing a quaternary ammonium chloride-based detergent in a bucket. Some splashed in her eyes and they started burning, itching, tearing, and swelling. She went to the emergency department where she was diagnosed with conjunctival and scleral injection. She had several follow-up visits to an eye clinic and lost 9-10 days of work.

MI00314 – A 30-year-old male employee for an airline was changing a holding tank for a lavatory on an airplane and some of the fluid splashed on his face, neck, and arms. The fluid contained a quaternary ammonium chloride-based disinfectant as well as human waste. He felt weak, nauseous, had body aches, and joint pain and went to an emergency room where he was diagnosed with acute chemical exposure.

MI00323 – A 45-year-old female cleaner put sodium hypochlorite in a container that had ammonia. Chloramine gas was generated and she began coughing, had pain with deep breaths, congestion, and a sore throat. She took a shower and called poison control.

MI00329 – A 55-year-old female cleaner in a hospital was using a gluteraldehyde cleaner and inhaled some due to a defective mask. The next day she went to an emergency department with a cough and a tight chest.

MI00341 – A 34-year-old male worker at a car wash mixed ammonium bifluoride and sodium hypochlorite together, which created fumes. He left the area right away but had chest pain, difficulty breathing, and a headache. His girlfriend called poison control and they recommended he shower.

MI00345 – A 19-year-old housekeeper was in a home where there was a pine oil disinfectant in an unmarked bottle and she got some in her eye. Her eye was red and irritated and her vision was blurry. She called 911 and the fire department responded; they called poison control. The eye irritation lasted several days.

MI00346 – A 20-year-old female dishwasher in a fast food restaurant had some quaternary ammonium chloride-based sanitizer splash in her eye. Her eye was irritated. It was flushed immediately and her employer sent her to an emergency department where she was diagnosed with chemical conjunctivitis.

Mixtures

MI00249 – An 18-year-old female stockperson at a store opened a box of a product containing a fungicide, an organophosphorous insecticide and a carbamate insecticide. One of the bottles had a leaky seal and some got on her. Her hands became dry and red. She washed immediately and called poison control.

MI00282 – A 48-year-old male manager at a department store walked by a store room where someone had been moving a pallet full of pesticides. The wrapping came loose and the pallet fell 15-20 feet to the ground. A variety of insecticide and herbicide bottles (plastic) broke. Two other employees were exposed but did not get sick. He had a history of work-related asthma and when he walked by the spill he had asthma attack; an ambulance was called.

MI00307 – A 54-year-old female arborist was working on a landscaping job when a truck began spraying trees at the house next door with a fungicide and an organophosphorous insecticide. It drifted on her and she developed a headache and nausea. She reported the applicator company to MDA and they sent a warning letter citing inadequate paperwork.

MI00317 – A 59-year-old male farm worker at a Christmas tree farm had been applying a glyphosate herbicide in an area he had sprayed the day or two before with an organophosphorous insecticide. He could smell the insecticide all day and by the end of the day he felt dizzy, nauseous, and vomited. The next day he was too sick to work, feeling dizzy, nauseous, and sweating. The dizziness lasted four days, so he went to an urgent care center. This farm was referred to MDA, which conducted an inspection and cited eight areas of noncompliance with Worker Protective Standards.

*Michigan Department
of Community Health*



Jennifer M. Granholm, Governor
Janet Olszewski, Director

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