Pesticide Illness and Injury Surveillance in Michigan 2011

***September* 2012**

Division of Environmental Health
Michigan Department of Community Health

Pesticide Illness and Injury Surveillance in Michigan: 2011

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Contents

Summary

The Michigan Department of Community Health (MDCH) has been conducting surveillance for acute work-related pesticide illnesses and injuries since 2001. MDCH began collecting data on non-occupational cases in 2006. The Public Health Code grants Michigan the authority to do public health surveillance for work-related conditions (PA 368 of 1978, Part 56, as amended), chemical poisoning (R325.71-R325.75), and laboratory cholinesterase test results (R325.61 and R325.68). This is the ninth annual report on pesticide-related illnesses and injuries in Michigan (MDCH, 2001-3, 2004, 2005, 2006, 2007, 2008, 2009, 2010).

From 2001 through 2011, 1,212 reports of occupational exposures and pesticide illness or injury were received and 839 (69.2%) were confirmed as cases according to the surveillance case definition. Sixty-nine of those confirmed cases were reported in 2011.

Michigan's Poison Control Center (PCC) remained the main data source, contributing 85.5% of confirmed occupational cases in 2011. Disinfectants continued to be the cause for over half of the confirmed occupational cases. A number of these cases would not have occurred if disinfectants were only used in situations where their use was necessary.

Where activity of the exposed person was known, 54.5% of confirmed occupational cases were exposed to pesticides inadvertently while doing their regular work that did not involve applying pesticides. The most common contributing factor for confirmed occupational cases was a spill or splash. The most common occupation was Building and Grounds Cleaning and Maintenance, comprising 27.5% of the confirmed cases in 2011. Of those, 36.8% were cleaners, housekeepers or maintenance workers and 63.2% were pest control operators.

From 2006 through 2011, 2,852 reports of non-occupational exposures and pesticide illness or injury were received and 1,039 (36.4%) were confirmed as cases according to the surveillance case definition. Two hundred twenty-seven of those confirmed cases were reported in 2011.

Michigan's Poison Control Center (PCC) is also the main data source for non-occupational exposures, reporting 73.1% of the confirmed non-occupational cases in 2011. In 2011, disinfectants accounted for 46.6% and insecticides for 34.4% of confirmed non-occupational cases. Again many of these cases would not have occurred if disinfectants were only used in situations where their use was necessary.

Where activity of the exposed person was known, 44.1% of confirmed non-occupational cases were applying the pesticide themselves. 'Bystander' exposure was also important, with 39.1% exposed inadvertently while doing normal activities, not involved in the application of pesticides.

Seven cases in 2011 were investigated by the Michigan Department of Agriculture and Rural Development (MDARD) for possible pesticide use violations, five occupational and two non-occupational. In addition, one occupational case was investigated by the Michigan Occupational Safety and Health Administration (MIOSHA). Ten events met the criteria for priority reporting to the National Institute for Occupational Safety and Health (NIOSH), four occupational and six non-occupational. These events are described on pages 29-31.

Background

Pesticide poisoning is a potential public health threat due to widespread pesticide use. According to the U.S. Environmental Protection Agency (EPA), over 1.1 billion pounds of pesticides were used in the United States in 2007, the last year of published data.[1]

The term pesticide can refer to insecticides, herbicides, fungicides, rodenticides, disinfectants, and various other substances used to control pests.

Evidence has linked pesticides with a variety of acute health effects such as conjunctivitis, dyspnea, headache, nausea, seizures, skin irritation, and upper respiratory tract irritation.(Reigart and Roberts, 1999)The effects of chronic or long term exposures include cancers, immune function impairments, neurological disorders, reproductive disorders, respiratory disorders, and skin disorders. (Schenker et al, 1992)

Pesticides are a category of chemicals that are used to kill or control insects, weeds, fungi, rodents, and microbes. There are 16,117 different pesticides registered for sale in Michigan, containing over 600 different active ingredients.

Acting on concerns about acute occupational pesticide-related illness, NIOSH began collecting standardized information about acute occupational pesticide exposure from selected states in 1998[2] under the Sentinel Event Notification System for Occupational Risk (SENSOR) program. An analysis of 1998-99 data provided by the SENSOR states demonstrated that the surveillance system was a useful tool to assess acute pesticide-related illness and to identify associated risk factors (Calvert, et al 2004).

Agriculture is the second largest income producing industry in Michigan and pesticide use is widespread in Michigan. Currently there are 16,117 different pesticides registered for sale and use in Michigan. Businesses are required to obtain a license from the MDARD if they hold themselves out to the public as being in the business of applying pesticides for hire. There are 2,212 businesses licensed to apply pesticides in Michigan. Pesticide applicators are certified by the MDARD as either private or commercial. Private certification includes applicators involved in the production of an agricultural commodity (farmers). All other certified applicators are considered commercial. These include such categories as forestry, wood preservation, ornamental and turf pest control, seed treatment, aquatic, swimming pool, right-of-way, structural pest control, general pest management, mosquito control, aerial, fumigation and several others. In 2011, there were a total of 22,260 certified pesticide applicators. Table 1 shows the number of licensed businesses and certified applicators since 2001.

[1] http://www.epa.gov/opp00001/pestsales/07pestsales/market_estimates2007.pdf
[2] http://www.cdc.gov/niosh/topics/pesticides/

Table 1. Pesticide Licensing and Certification, 2001-2011

Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Private Certification	10,075	9,576	9,200	8,793	8,352	8,122	7,848	7,722	7,580	7, 490
Commercial Cert.	13,089	13,387	13,588	13,485	13,743	14,123	14,118	14,210	14,199	14,458
Registered Tech.	NA	NA	NA	NA	NA	NA	NA	NA	382	312
Total Applicators	23,164	22,963	22,788	22,278	22,095	22,245	21,966	21,932	22,161	22,260
Licensed Businesses	NA	1,755	NA	1,900	1,962	1,923	2,025	2,147	2,095	2,212

MDARD is the Michigan agency that regulates pesticide use. The Pesticide and Plant Pest Management Division of MDARD investigates allegations of pesticide misuse. They also perform random inspections of licensed businesses. Table 2 shows MDARD's staff levels and numbers of investigations by year.

Table 2. Pesticide Inspections and Investigations, 2001-2011

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Misuse Investigations	165	132	153	182	231	178	180	108	152	130
Other Inspections	1,077	1,261	1,266	1,175	797	655	303	312	613	537
# of Field Staff	20	20	18	18	15	15	16	13	16	16

Recognizing the extent of pesticide use in Michigan, in 2001 MDCH joined other NIOSH-funded states to institute an occupational pesticide illness and injury surveillance program. In 2006 MDCH added surveillance of non-occupational pesticide exposures. The intent of this surveillance is to identify the occurrence of adverse health effects and then intervene to prevent similar events from occurring in the future. MDCH recognizes the need for data on pesticide exposures and adverse health effects in Michigan.

The goals of the pesticide surveillance system are to characterize the pesticide-poisoning problem in Michigan and to prevent others from experiencing adverse health effects from pesticide exposures, with an emphasis on occupational exposure hazards. 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;
- 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 Poison Control Center), health care facilities, and employers to report information about individuals (including names) with suspected or confirmed work-related diseases to the state. In October 2005, laboratories started reporting acetylcholinesterase and pseudocholinesterase test results in accordance with R 325.61 and R 325.68 additions to the Michigan Public Health Code. These tests are sometimes ordered for patients exposed to organophosphate and carbamate insecticides. Regulations to require the reporting of all pesticide injuries and illnesses (including non-occupational) went into effect September 18, 2007 (R 325.71-5).

In addition to information from reports submitted under the public health code, the surveillance system also collects information on individuals with pesticide exposures who have been reported to the Pesticide and Plant Pest Management Division of MDARD. MDARD receives complaints about pesticide misuse and health effects and is mandated to conduct investigations to address potential violations of pesticide laws. Other data sources include Michigan's Hazardous Substances Emergency Event Surveillance (HSEES)[3] program; Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) adverse effects reports; coworkers; and worker advocates.

The MDCH pesticide poisoning surveillance system is a case-based system. A reported individual must meet the case definition established by NIOSH and the participating states[4] to be included as a confirmed case. Data are collected according to standardized variable definitions in a database developed for states that are conducting pesticide surveillance.

Reported occupational cases are interviewed to determine the circumstances of the reported pesticide exposure, the symptoms they experienced, the name of the pesticide, the name of the workplace where the exposure occurred, and other details about the incident. When possible, medical records are obtained to confirm and clarify the conditions reported. Non-occupational cases are not followed up, due to resource constraints.

Reported 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.[5] Cases classified as definite, probable, possible, or suspicious (DPPS) are included in all data analyses. For simplicity, we refer to them as 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

[3] http://www.michigan.gov/mdch/0,1607,7-132-2945_5105-110654--,00.html
[4] http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef2003_revAPR2005.pdf page 1
[5] ibid. pages 2-3

care was sought, if a hospital stay was involved, and whether time was lost from work or daily activities.[6]

Practices where workers or the general public may be at risk are identified. When appropriate, referrals are made to two other state agencies with regulatory responsibility for worker health and/or pesticide use: the Michigan Occupational Safety and Health Administration (MIOSHA) in the Michigan Department of Licensing and Regulatory Affairs (LARA) and MDARD.

MIOSHA enforces workplace standards on exposure limits, education, and Personal Protective Equipment (PPE) and performs training in safety and health.

MDARD enforces state and federal legal requirements for the sale and use of pesticides, including label violations and instances of human exposure. MDARD also enforces the federal EPA's Worker Protection Standard, which includes requirements to protect agricultural workers from adverse health effects of pesticides.

In addition, NIOSH is provided information about high priority events, both occupational and non-occupational. 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 pesticide illness and injury 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/or their employers about reducing hazards related to pesticide exposures.

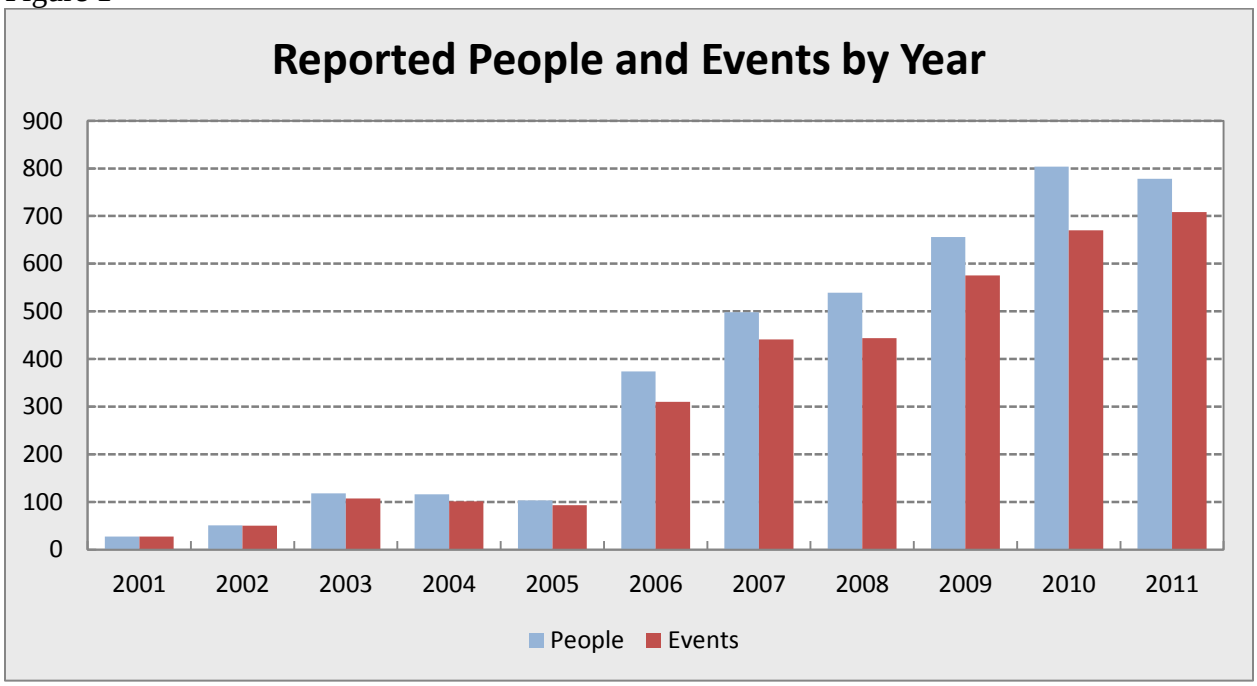
[6] http://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sevindexv6.pdf

Results

Section I. All Reports

There were 4,064 reports of acute pesticide poisonings from 2001 – 2011. These represent 3,526 separate events. In 2011 there were 778 people, from 708 events reported. Figure 1 shows the number of reported cases and events by year.

Figure 1



Of the 4,064 reports from 2001 through 2011, 1,878 (46.2%) met the criteria for confirmed cases. See Table 3.

Table 3 : Case Confirmation by Work-Relatedness, 2001-2011 and 2011 Occupational separately

	Occupational 2001-2011	Non-Occupational 2006-2011	Total	Occupational 2011
Definite Case	90	17	107	5
Probable Case	194	164	358	7
Possible Case	544	798	1342	57
Suspicious Case	11	60	71	0
Subtotal	*839*	*1039*	*1878*	*69*
Unlikely Case	5	4	9	0
Insufficient Information	324	1314	1638	20
Exposed/Asymptomatic	28	462	490	0
Unrelated	16	33	49	3
Subtotal	*373*	*1813*	*2186*	*23*
	1212	**2852**	**4064**	**92**

The remainder of this report only includes people with a case status of Definite, Probable, Possible, or Suspicious (DPPS); i.e., the confirmed cases.

Age is not always known. When known, persons of all ages may be exposed to pesticides. Table 4 shows the age groups for all confirmed cases.

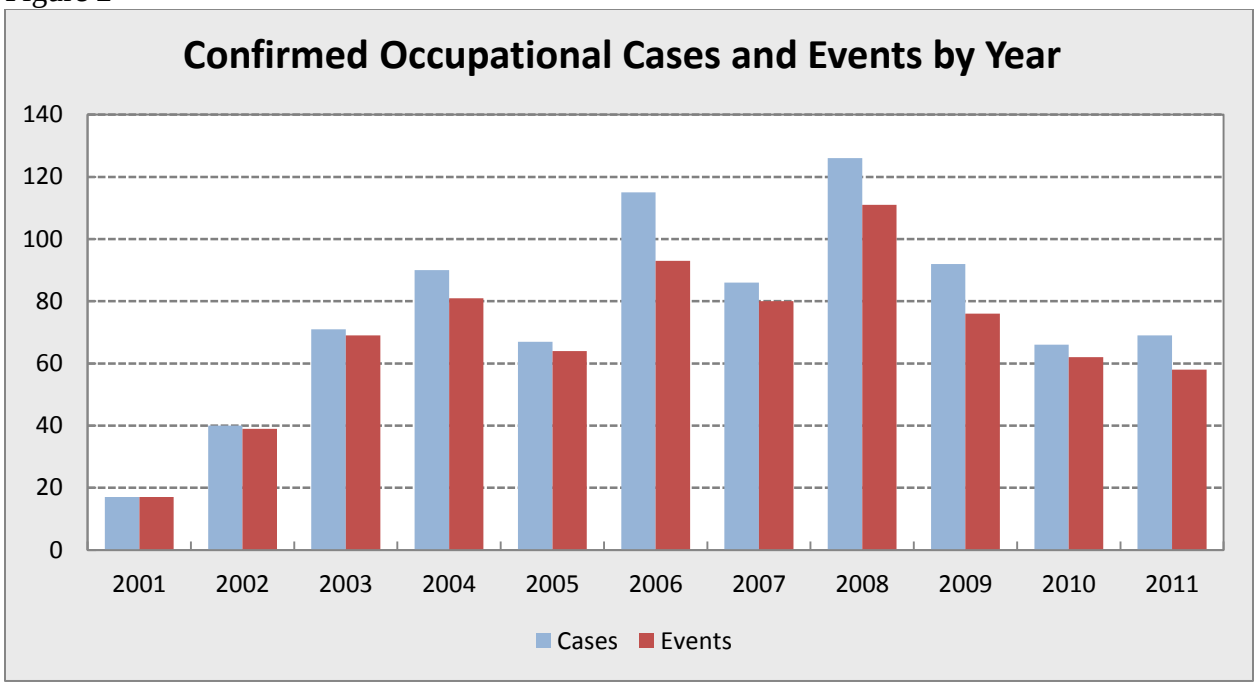
Table 4: Confirmed Cases by Age Group & Gender, 2001-2011 and 2011 separately

	Cumulative			2011		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
Unknown age	77	55	23	4	1	0
00-<1: Infants	2	2	1	0	0	1
01-02: Toddlers	18	16	0	3	3	0
03-05: Preschool	14	9	0	1	2	0
06-11: Child	48	29	0	2	3	0
12-17: Youth	39	45	1	5	8	0
18-64: Adult	720	665	0	109	122	0
65+: Senior	61	53	0	18	14	0
Total	**979**	**874**	**25**	**142**	**153**	**1**

Section II. Occupational Pesticide Illnesses and Injuries

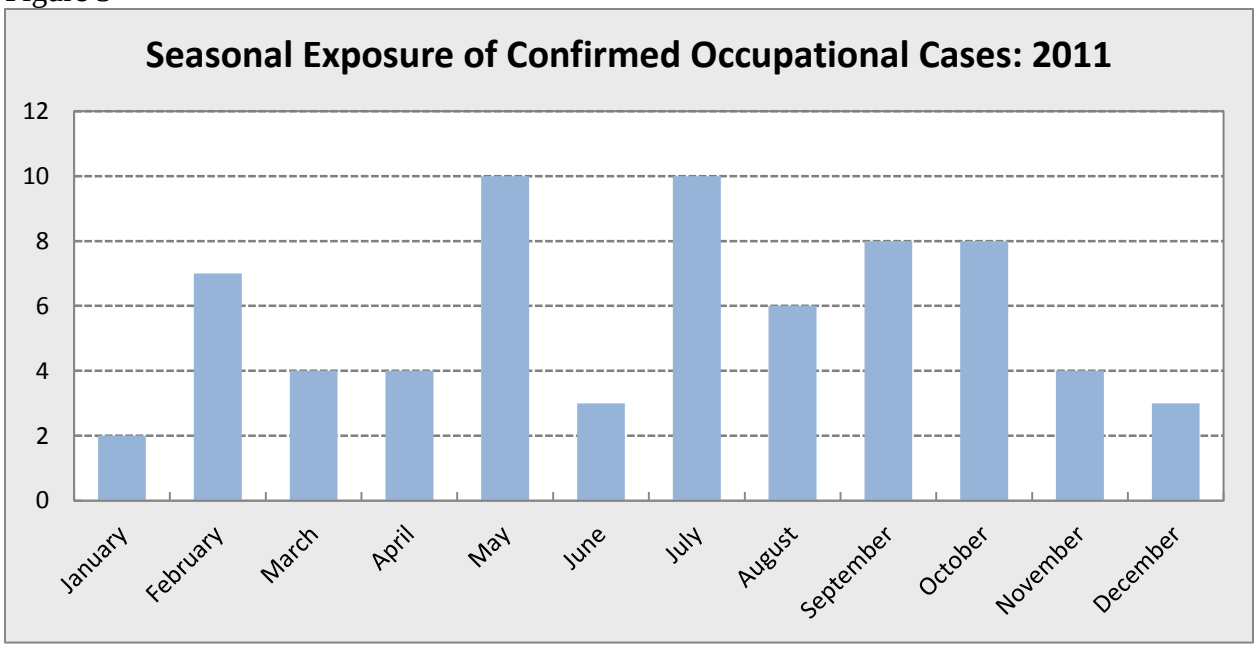
This section describes confirmed occupational cases. There were 69 cases from 58 events in 2011.

Figure 2



The chart below shows all confirmed occupational cases reported in 2011 by month of exposure.

Figure 3



Cases come from a variety of reporting sources. The Poison Control Center (PCC) remains the major source of reports. In 2011, 59 (85.5%) of the 69 occupational cases were first reported by PCC. Some exposures were reported by multiple sources; the table below shows the first source.

Table 5 : First Report Source, Confirmed Occupational Cases 2001-2011 and 2011 Separately

Report Source	Cumulative	Percent	2011	Percent
Poison control center	666	79.4%	59	85.5%
Other health care provider	64	7.6%	4	5.8%
State Health Department - HSEES	50	6.0%	0	0.0%
Department of Agriculture (MDARD)	13	1.5%	0	0.0%
Report/referral from governmental agency	12	1.4%	1	1.4%
Employer	6	0.7%	0	0.0%
Physician report	6	0.7%	1	1.4%
Co-worker report	6	0.7%	1	1.4%
Friend or relative report	5	0.6%	0	0.0%
Other	11	1.3%	3	4.3%
Total	**839**	**100.0%**	**69**	**100.0%**

Demographics

Pesticide exposures occur to people of all ages. In Michigan, men are more likely to have had an occupational exposure to pesticides than women and most cases are white, non-Hispanic.

Table 6: Confirmed Occupational Cases by Age Group and Gender, 2001-2011 and 2011 Separately

	Cumulative			2011		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
10-19	32	46	0	1	5	0
20-29	94	130	0	7	11	0
30-39	69	92	0	6	7	0
40-49	80	86	0	5	6	0
50-59	59	50	0	5	12	0
60-69	7	11	0	0	0	0
70+	2	4	0	1	1	0
Unknown	30	36	11	2	0	0
Total	**373**	**455**	**11**	**27**	**42**	**0**

A teenaged salesperson at a pool and spa store was lifting a case of pool chlorine to carry it to a customer's car. There had been a leak, and the box containing the four gallon containers had corroded. When he tried to pick it up, one of the gallons fell out of the box and broke, spilling on his legs and feet. His skin turned reddish brown, blistered, and was painful. He went to an urgent care and was diagnosed with a chemical burn. He missed four days of work.

Table 7 : Confirmed Occupational Cases by Race and Ethnicity, 2001-2011 and 2011 separately

	Cumulative			2011		
Race	**Hispanic**	**Not Hispanic**	**Unknown**	**Hispanic**	**Not Hispanic**	**Unknown**
American Indian/Alaskan	0	6	0	0	1	0
Asian/Pacific Islander	0	2	1	0	0	0
Black	0	27	19	0	1	5
White	10	295	70	0	31	4
Mixed	1	15	1	0	2	0
Unknown	38	0	353	3	0	23
Total	**49**	**346**	**444**	**3**	**34**	**32**

The table below shows the industry involved in occupational cases, based on NIOSH industry sectors.[7] 'Services' includes 'Services to Buildings and Dwellings' such as structural pest control or landscaping as well as 'Accommodation and Food Services' such as hotels and restaurants, where many disinfectant exposures occur.

Table 8: Confirmed Occupational Cases by NIOSH Industry Sectors, 2001-2011 and 2011 Separately

Industry Sector	**Cumulative**	**Percent**	**2011**	**Percent**
Agriculture, Forestry, Fishing	93	11.1%	5	7.2%
Construction	17	2.0%	1	1.4%
Healthcare & Social Assistance	114	13.6%	5	7.2%
Manufacturing	32	3.8%	5	7.2%
Public Safety	15	1.8%	2	2.9%
Services (exc. Public Safety)	330	39.3%	34	49.3%
Transportation, Warehousing, Utilities	27	3.2%	5	7.2%
Wholesale & Retail Trade	78	9.3%	8	11.6%
Unknown	133	15.9%	4	5.8%
Total	**839**	**100.0%**	**69**	**100.0%**

A blueberry farmer in his 50s mixed an organophosphate insecticide and a fungicide together. He was spraying his fields when he developed equipment problems. He took his sprayer apart and removed the obstruction without wearing the required gloves. Within minutes he developed dizziness, chest pain, a bad taste in his mouth, nausea, and numbness. He went to an emergency department.

[7] http://www.cdc.gov/niosh/nora/sector.html

Table 9 shows the occupation of the exposed worker based on the 2002 Census Occupation Codes. The most common occupation is 'Building and Grounds Cleaning and Maintenance'. In 2011 this included seven cleaning personnel and twelve pest control operators.

Table 9: Confirmed Occupational Cases by Census Occupation 2001-2011 and 2011 Separately

Occupation	Cumulative	Percent	2011	Percent
Building and Grounds Cleaning and Maintenance	129	15.4%	19	27.5%
Sales and Related	41	4.9%	3	4.3%
Farming, Forestry, and Fishing	36	4.3%	1	1.4%
Food Preparation and Serving Related	32	3.8%	5	7.2%
Management	24	2.9%	5	7.2%
Production	20	2.4%	6	8.7%
Transportation and Material Moving	19	2.3%	4	5.8%
Healthcare Practitioners and Technical	17	2.0%	4	5.8%
Healthcare Support	16	1.9%	3	4.3%
Office and Administrative Support	15	1.8%	0	0.0%
Personal Care and Service	14	1.7%	0	0.0%
Protective Service	12	1.4%	2	2.9%
Education, Training, and Library	11	1.3%	0	0.0%
Construction and Extraction	8	1.0%	1	1.4%
Architecture and Engineering	7	0.8%	6	8.7%
Installation, Repair, and Maintenance	6	0.7%	0	0.0%
Other	4	0.5%	0	0.0%
Unknown	428	51.0%	10	14.5%
Total	**839**	**100.0%**	**69**	**100.0%**

A sales team leader at a farm and garden supply store saw a child in a cart reach out to grab a can of pyrethroid insecticide. She was unable to stop the child in time, and the can fell, hitting a lower shelf on the way down. The can was punctured and released its contents. She pushed the cart with the child out of the way and then carried the can outside, inhaling fumes on the way out. She developed a cough and sore throat and went to an emergency department. The sore throat lasted five to six days.

Exposures

Type of exposure describes how the exposure occurred. "Drift exposures" occur when an individual is exposed by the movement of pesticides away from the application site. "Targeted" indicates that the individual was exposed when a pesticide was released at the target site. "Indoor air" indicates that the individual was exposed to contaminated indoor air. "Surface" indicates that the individual was exposed via contact with pesticide residues on a treated surface or by entry into an outdoor treated area. "Leak/spill" indicates the individual was exposed to a leak or spill of pesticide material from any cause. Some individuals had more than one type of exposure.

Figure 4

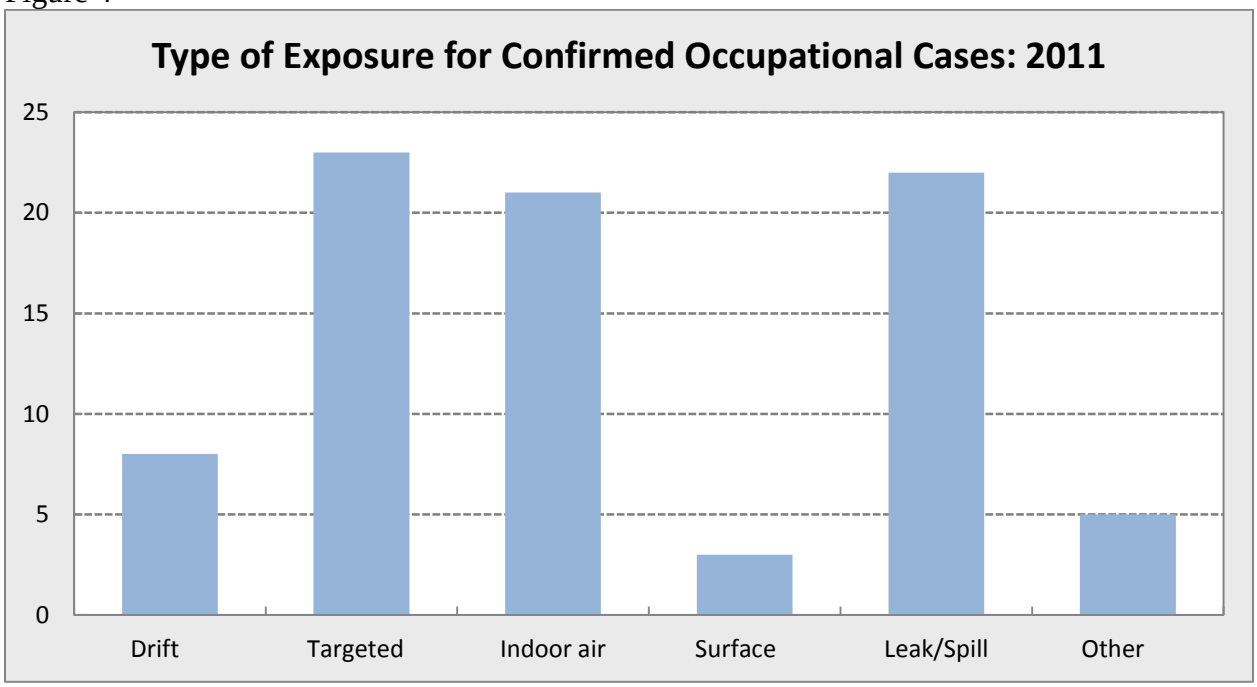


Table 10 shows the type of pesticide the person was exposed to. In 2011, the most common exposure was to disinfectants (51.7%), followed by insecticides (21.8%) and herbicides (17.2%). Some products contain more than one type of pesticide and some exposures involve more than one product so the number of types listed is greater than the number of exposures.

Table 10: Confirmed Occupational Cases by Pesticide Type, 2001- 2011 and 2011 Separately

Pesticide Type	Cumulative	Percent	2011	Percent
Insecticide	250	25.2%	19	21.8%
Herbicide	144	14.5%	15	17.2%
Fungicide	23	2.3%	2	2.3%
Fumigant	9	0.9%	0	0.0%
Rodenticide	14	1.4%	1	1.1%
Disinfectant	491	49.4%	45	51.7%
Insect Repellent	7	0.7%	2	2.3%
Insecticide and Fungicide	5	0.5%	0	0.0%
Insecticide and Other	15	1.5%	0	0.0%
Other	13	1.3%	2	2.3%
Multiple	11	1.1%	1	1.1%
Unknown	11	1.1%	0	0.0%
Total	**993**	**100.00%**	**87**	**100.00%**

Pesticide exposures occur in a wide range of establishments. The table below shows where occupational exposures in Michigan have taken place.

Table 11: Location of Exposure for Confirmed Occupational Cases, 2001-2011 and 2011 Separately

Location	Cumulative	Percent	2011	Percent
Service establishment	112	13.3%	9	13.0%
Farm	82	9.8%	9	13.0%
Retail establishment	75	8.9%	6	8.7%
Single family home	64	7.6%	4	5.8%
Hospital	64	7.6%	2	2.9%
Office/business	49	5.8%	2	2.9%
School	48	5.7%	3	4.3%
Multi-unit housing	25	3.0%	1	1.4%
Residential institution	22	2.6%	1	1.4%
Food process/manufacture facility	14	1.7%	0	0.0%
Other manufacturing/industrial	13	1.5%	2	2.9%
Pet care and veterinary services	13	1.5%	0	0.0%
Industrial facility	11	1.3%	4	5.8%
Golf course	10	1.2%	1	1.4%
Greenhouse	8	1.0%	0	0.0%
Mobile home	8	1.0%	0	0.0%
Park	8	1.0%	2	2.9%
Post-harvest crop prep facility	7	0.8%	0	0.0%
Nursery	6	0.7%	0	0.0%
Day care facility	6	0.7%	0	0.0%
Farm product warehouse/storage	6	0.7%	1	1.4%
Road/rail	6	0.7%	0	0.0%
Prison	5	0.6%	1	1.4%
Other	41	4.9%	10	14.5%
More than one site	13	1.5%	1	1.4%
Unknown	123	14.7%	10	14.5%

A lawn technician sprayed an insecticide throughout the day. The wind velocity was higher than usual, causing spray-back that got his pants wet. He wanted to finish all the lawns so he didn't stop to decontaminate. He developed blisters on his legs that lasted about 2 days. The blisters bled and he also had a burning sensation and swelling of his inner thighs. After the blisters healed his skin became dry and cracked. It took about a week and a half to heal completely. He called poison control.

Workers were exposed through applications to a wide variety of targets, as shown in table 12. When there is no targeted pest, for example when a product is knocked off a shelf, the target is coded as not applicable.

Table 12: Application Target for Confirmed Occupational Cases, 2001-2011 and 2011 Separately

Application Target	Cumulative	Percent	2011	Percent
Landscape/ornamentals	73	8.7%	7	10.1%
Forest trees/land	3	0.4%	0	0.0%
Veterinary - livestock	3	0.4%	0	0.0%
Veterinary - domestic animals	3	0.4%	0	0.0%
Building structure	12	1.4%	0	0.0%
Building surface	112	13.3%	3	4.3%
Building space treatment	47	5.6%	3	4.3%
Undesired plant	16	1.9%	0	0.0%
Aquatic - pond, stream, lake, canal	8	1.0%	1	1.4%
Pool, spa, hot tub, jacuzzi	28	3.3%	4	5.8%
Soil	1	0.1%	0	0.0%
Wood product	3	0.4%	0	0.0%
Small fruits	1	0.1%	1	1.4%
Tree fruits	20	2.4%	1	1.4%
Pome fruits	3	0.4%	0	0.0%
Stone fruits	1	0.1%	0	0.0%
Vegetable crops	2	0.2%	0	0.0%
Cucurbit vegetables	2	0.2%	0	0.0%
Fruiting vegetables	1	0.1%	0	0.0%
Root/tuber vegetables	1	0.1%	0	0.0%
Seed/pod vegetables	3	0.4%	0	0.0%
Grain/grass/fiber crops	2	0.2%	0	0.0%
Forage, fodder, silage, legumes	1	0.1%	0	0.0%
Cereal grain crops	1	0.1%	0	0.0%
Miscellaneous field crops	8	1.0%	0	0.0%
Oil crops	2	0.2%	0	0.0%
Application to seeds	1	0.1%	0	0.0%
Humans	1	0.1%	0	0.0%
Human - skin/hair	1	0.1%	0	0.0%
Human - skin/hair and clothing	2	0.2%	0	0.0%
Bait for rodent, bird, or predator	10	1.2%	1	1.4%
Community-wide application	1	0.1%	0	0.0%
Other	184	21.9%	21	30.4%
Not applicable	69	8.2%	10	14.5%
Unknown	213	25.4%	17	24.6%
Total	**839**	**100.0%**	**69**	**100.0%**

A worker was sweeping a barn and inhaled dust from a rodenticide. He developed a headache, nausea, vomiting, itchy throat, and chest tightness. He went to an emergency department.

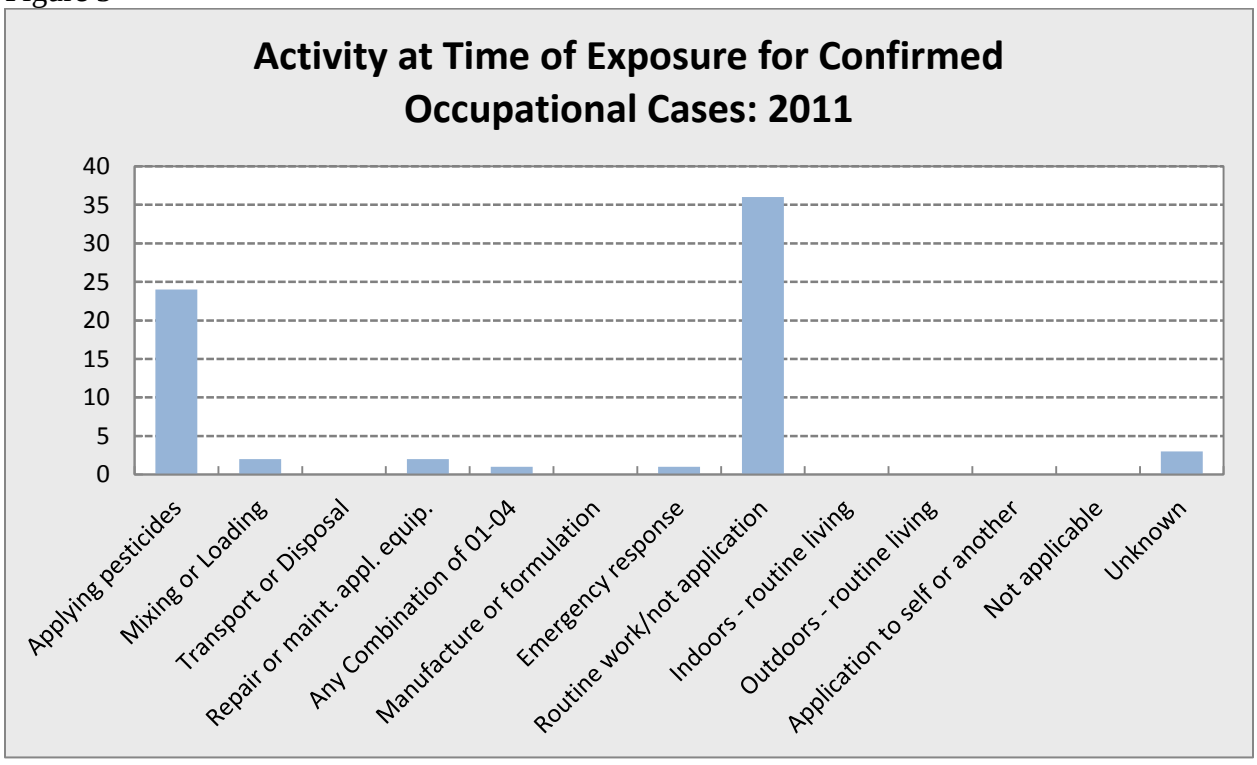
Type of equipment used to apply pesticides was known for 69.6% of the confirmed occupational cases in 2011. The most common type was 'other' which includes mops, buckets and pool shock tabs.

Table 13: Equipment Used in Confirmed Occupational Cases, 2001-2011 and 2011 Separately

Application Equipment	Cumulative	Percent	2011	Percent
Trigger pump/compressed air	57	6.8%	5	7.2%
Pressurized can	54	6.4%	8	11.6%
Ground sprayer, not classified elsewhere	31	3.7%	5	7.2%
Sprayer, backpack	23	2.7%	2	2.9%
Manual placement	20	2.4%	2	2.9%
Spray line, hand held	19	2.3%	2	2.9%
Total Release Fogger	12	1.4%	0	0.0%
Aerosol generator/fogger	8	1.0%	0	0.0%
Handheld granular/dust applicator	5	0.6%	0	0.0%
Other	195	23.2%	20	29.0%
More than one type of equipment	2	0.2%	0	0.0%
Not applicable	61	7.3%	4	5.8%
Unknown	352	42.0%	21	30.4%
Total	**839**	**100.0%**	**69**	**100.0%**

Activity at time of exposure was determined for 66 (95.7%) of the cases.

Figure 5



A private in the National Guard cleaned the shower in an armory. The private put an acid disinfectant down the drain and then used bleach on the floor. He turned on hot water which flushed the bleach down the drain where it combined with the acid to form chlorine fumes. He developed a cough, had difficulty taking a deep breath, and vomited. His sergeant, who was walking by, developed shortness of breath, a cough, and a headache. The sergeant called poison control.

Identification of factors contributing to the exposure assists with the development of prevention strategies. Up to five contributing factors were coded for each case. Spills and splashes were the most common contributing factor for occupational pesticide cases.

Table 14: Contributing Factors in Confirmed Occupational Cases, 2001-2011 and 2011 Separately

Contributing Factor	Cumulative	Percent	2011	Percent
Spill/Splash of liquid or dust (not equipment failure)	249	23.1%	16	17.6%
Mixing incompatible products	98	9.1%	9	9.9%
Label violations not otherwise specified	72	6.7%	8	8.8%
Application equipment failure	64	5.9%	5	5.5%
No label violation identified but person still exposed/ill	64	5.9%	2	2.2%
Required eye protection not worn or inadequate	60	5.6%	7	7.7%
Decontamination not adequate or timely	58	5.4%	9	9.9%
Drift contributory factors	58	5.4%	8	8.8%
Excessive application	40	3.7%	4	4.4%
Applicator not properly trained or supervised	31	2.9%	3	3.3%
People were in the treated area during application	26	2.4%	0	0.0%
Notification/posting lacking or ineffective	22	2.0%	1	1.1%
Required gloves not worn or inadequate	22	2.0%	5	5.5%
Within reach of child or other improper storage	18	1.7%	0	0.0%
Structure inadequately ventilated before re-entry	15	1.4%	1	1.1%
Early re-entry	11	1.0%	1	1.1%
Required respirator not worn or inadequate	10	0.9%	0	0.0%
Other required PPE not worn or inadequate	5	0.5%	1	1.1%
Other	34	3.2%	5	5.5%
Unknown	122	11.3%	6	6.6%
Total	**1079**	**100.0%**	**91**	**100.0%**

Health Effects

Most (66.7%) cases in 2011 were of low severity.

Table 15: Severity of Confirmed Occupational Cases, 2001-2011 and 2011 Separately

Severity	Cumulative	Percent	2011	Percent
Fatal	2	0.2%	0	0.0%
High	9	1.1%	1	1.4%
Moderate	159	19.0%	22	31.9%
Low	669	79.7%	46	66.7%
Total	**839**	**100.0%**	**69**	**100.0%**

The table below shows where the case first received medical care and whether they were hospitalized. Additional medical care may have been obtained after the first medical encounter. For example, a case may have been referred by poison control to an urgent care center, but that is not shown in the table.

Table 16: Confirmed Occupational Cases by First Care and Hospitalization, 2011

First Care	Not Hospitalized	Hospitalized	Total
Physician Office Visit/Urgent Care	8	0	8
Emergency Room	15	6	21
Advice of Poison Control Center	32	1	33
On site by EMT	1	1	2
Employee/Occupational Health Center	5	0	5
Total	**61**	**8**	**69**

A lawn care applicator was applying a mixture of herbicides for 6-8 hours without any respiratory protection. In addition, the tank in his van had leaked. The leak was fixed but he still smelled chemicals while driving. He developed aphasia, a headache, nausea, vomiting, dizziness, tunnel vision, and dilated pupils. His wife called poison control and took him to an emergency department where he was admitted to the hospital.

Section III. Non-occupational Pesticide Illnesses and Injuries

This section examines non-occupational cases. To provide a more complete characterization of the impact of pesticide use in Michigan, the MDCH pesticide surveillance program began collecting information about non-occupational exposures in 2006. Suicide attempts using pesticides are excluded from this report. The same case definition and report sources are used for occupational and non-occupational cases, but there is no follow-up for additional information with non-occupational cases. There were 227 confirmed cases from 222 events in 2011.

Figure 6

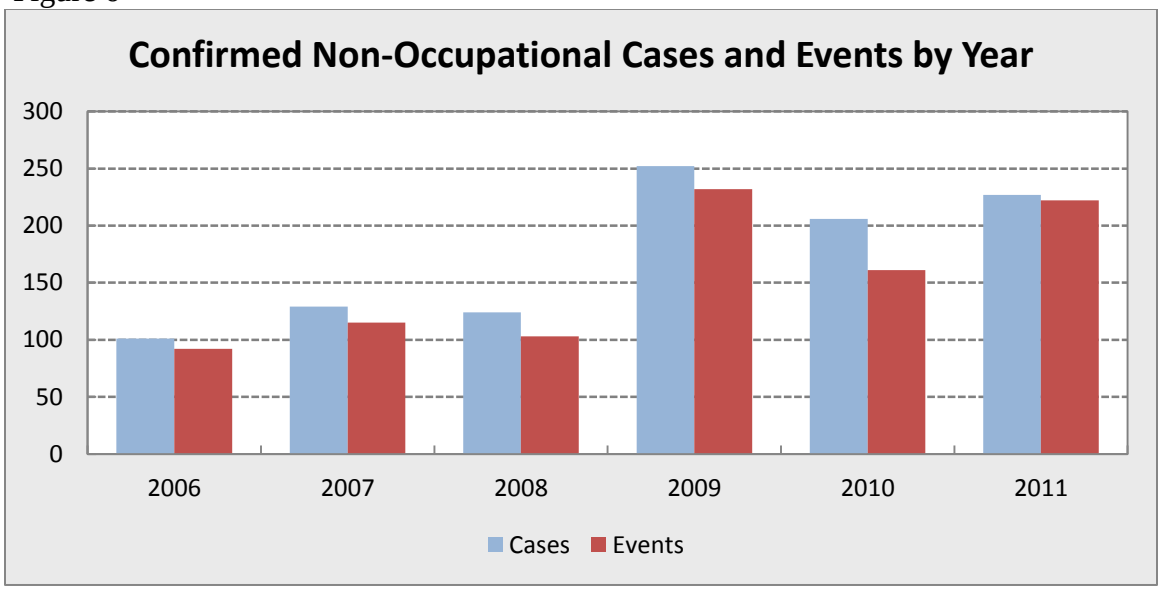
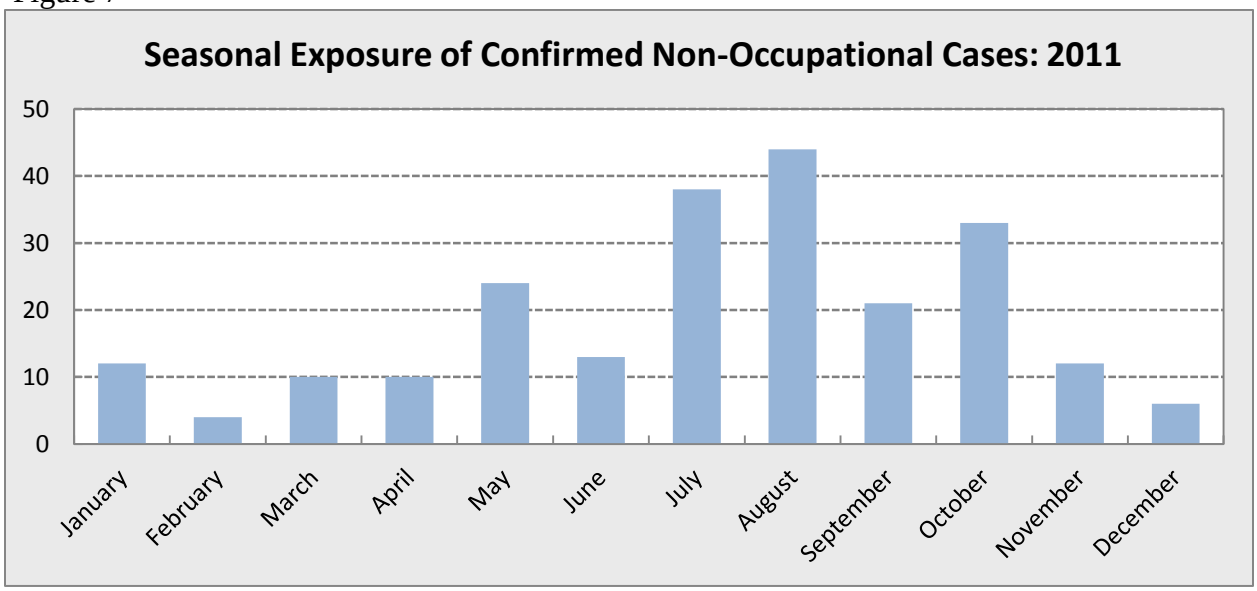


Figure 7 shows all confirmed non-occupational cases reported in 2011 by month of exposure.

Figure 7



The table below shows the first report source for non-occupational cases. Poison Control remains the primary source of non-occupational cases, as well as occupational cases. Some cases are reported by multiple sources; the first source is listed here.

Table 19 : First Report Source, Confirmed Non-occupational Cases 2006-2011 and 2011 Separately

Report Source	Cumulative	Percent	2011	Percent
Poison control center	697	67.1%	166	73.1%
Other health care provider	154	14.8%	57	25.1%
State Health Department - HSEES	113	10.9%	0	0.0%
Department of Agriculture (MDARD)	33	3.2%	3	1.3%
Report/referral from governmental agency	24	2.3%	0	0.0%
Obituary/news report	5	0.5%	0	0.0%
Other	13	1.3%	1	0.4%
Total	**1039**	**100.0%**	**227**	**100.0%**

Demographics

The table below shows non-occupational cases by age and gender. Many young children are exposed to pesticides each year, but remain asymptomatic and so are not confirmed cases.

Table 18: Confirmed Non-occupational Cases by Age Group and Gender, 2006-2011 and 2011 Separately

	Cumulative			2011		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
Unknown age	47	19	12	2	1	0
00-<1:Infants	2	2	1	0	0	1
01-02:Toddlers	18	16	0	3	3	0
03-05:PreSchool	14	9	0	1	2	0
06-11:Child	48	29	0	2	3	0
12-17:Youth	30	27	1	5	6	0
18-64:Adult	389	271	0	85	83	0
65+:Senior	58	46	0	17	13	0
Total	**606**	**419**	**14**	**115**	**111**	**1**

A man in his 80s sprayed a pyrethrin plus pyrethroid insecticide for about 30 seconds at about 11 PM. He could not sleep all night and had shortness of breath. He called poison control.

The next table shows the race and ethnicity of non-occupational cases. Race and ethnicity information is rarely available for non-occupational cases.

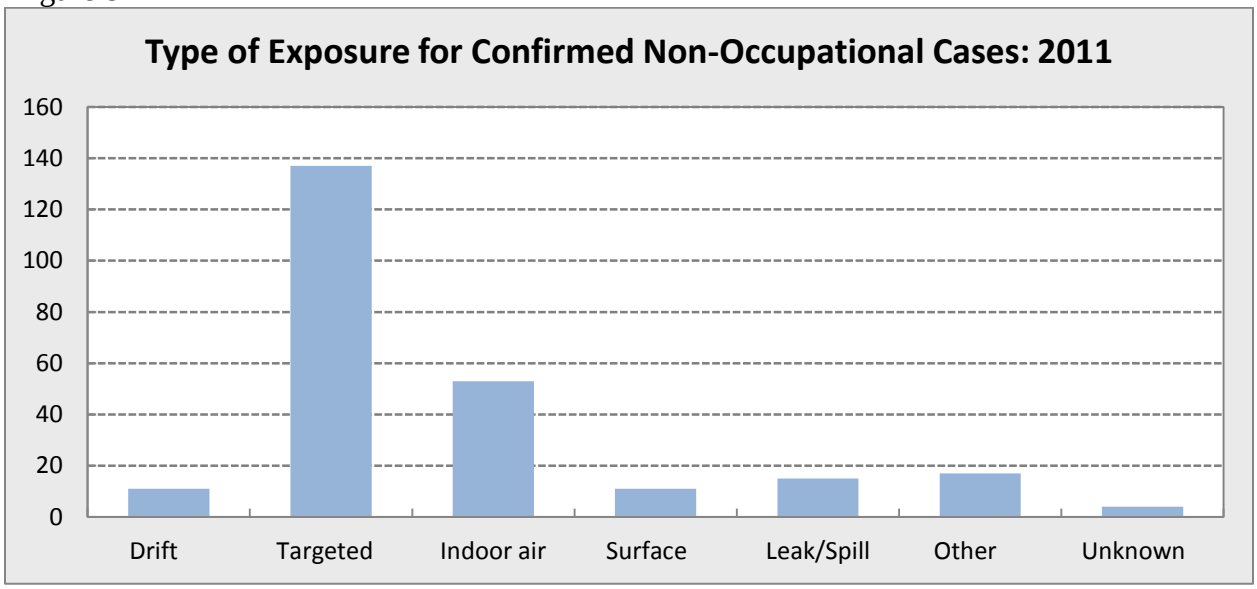
Table 19: Confirmed Non-occupational Cases by Race and Ethnicity, 2006-2011 and 2011 Separately

	Cumulative			2011		
Race	**Hispanic**	**Not Hispanic**	**Unknown**	**Hispanic**	**Not Hispanic**	**Unknown**
American Indian/Alaskan	0	0	2	0	0	0
Black	0	0	21	0	0	7
White	0	11	92	0	6	29
Other	0	0	1	0	0	1
Unknown	3	0	909	2	0	182
Total	**3**	**11**	**1025**	**2**	**6**	**219**

Exposures

The chart below shows the type of exposure for confirmed non-occupational cases in 2011. The most common type of exposure was targeted, followed by indoor air. Some individuals had more than one type of exposure.

Figure 8



A homeowner set off a pyrethroid total release fogger in her garage. She re-entered the garage after waiting the required two hours. She developed a headache and tingling and called poison control.

Some products contain more than one type of pesticide and some exposures involve more than one product so the number of types of products is greater than the number of exposures. In 2011, the most common exposure for non-occupational cases was to disinfectants (46.6%), followed by insecticides (34.4%).

Table 20: Confirmed Non-occupational Cases by Pesticide Type, 2006-2011 and 2011 Separately

Pesticide Type	Cumulative	Percent	2011	Percent
Insecticide	397	32.0%	96	34.4%
Herbicide	100	8.1%	13	4.7%
Fungicide	17	1.4%	1	0.4%
Rodenticide	13	1.0%	1	0.4%
Disinfectant	537	43.3%	130	46.6%
Insect Repellent	86	6.9%	14	5.0%
Insecticide and Fungicide	5	0.4%	0	0.0%
Insecticide and Other	45	3.6%	16	5.7%
Other	18	1.5%	4	1.4%
Multiple (not specified)	14	1.1%	1	0.4%
Unknown	9	0.7%	3	1.1%
Total	1241	100.0%	279	100.0%

Individuals are exposed through applications in a wide variety of locations and to a wide variety of targets, as shown in table 21 and 22 below.

Table 21: Location of Exposure for Confirmed Non-occupational Cases, 2006-2011 and 2011 Separately

Location	Cumulative	Percent	2011	Percent
Single Family Home	584	56.2%	107	47.1%
Private Residence, type not specified	210	20.2%	82	36.1%
Multi-unit housing	39	3.8%	11	4.8%
Park	34	3.3%	1	0.4%
School	33	3.2%	3	1.3%
Service Establishment	27	2.6%	3	1.3%
Mobile home	14	1.3%	1	0.4%
Farm	9	0.9%	0	0.0%
Private vehicle	7	0.7%	2	0.9%
Residential Institution	4	0.4%	0	0.0%
Retail Establishment	2	0.2%	0	0.0%
Greenhouse	1	0.1%	1	0.4%
Day care facility	1	0.1%	1	0.4%
Prison	1	0.1%	0	0.0%
Road/Rail	1	0.1%	0	0.0%
Golf Course	1	0.1%	0	0.0%
Other	12	1.2%	2	0.9%
Unknown	59	5.7%	13	5.7%
Total	**1039**	**100.0%**	**227**	**100.0%**

Table 22: Application Target for Confirmed Non-occupational Cases, 2006-2011 and 2011 Separately

Application Target	Cumulative	Percent	2011	Percent
Landscape/ornamentals	83	8.0%	13	5.7%
Veterinary - livestock	1	0.1%	1	0.4%
Veterinary - domestic animals	7	0.7%	2	0.9%
Building structure	17	1.6%	3	1.3%
Building surface	68	6.5%	9	4.0%
Building space treatment	198	19.1%	47	20.7%
Undesired plant	3	0.3%	0	0.0%
Aquatic - pond, stream, lake, canal	19	1.8%	1	0.4%
Pool, spa, hot tub, jacuzzi	97	9.3%	23	10.1%
Tree fruits	1	0.1%	1	0.4%
Pome fruits	4	0.4%	1	0.4%
Stone fruits	3	0.3%	0	0.0%
Flavoring/spice crops	1	0.1%	0	0.0%
Fruiting vegetables	1	0.1%	0	0.0%
Root/tuber vegetables	3	0.3%	0	0.0%
Seed/pod vegetables	3	0.3%	0	0.0%
Cereal grain crops	4	0.4%	1	0.4%
Miscellaneous field crops	5	0.5%	1	0.4%
Human - skin/hair	8	0.8%	0	0.0%
Human - clothing	1	0.1%	0	0.0%
Human - skin/hair and clothing	16	1.5%	3	1.3%
Bait for rodent, bird, or predator	7	0.7%	1	0.4%
Community-wide application	7	0.7%	0	0.0%
Other	127	12.2%	36	15.9%
Not applicable	62	6.0%	12	5.3%
Unknown	293	28.2%	72	31.7%
Total	**1039**	**100.0%**	**227**	**100.0%**

A homeowner poured pool chlorine granules into a bucket. He then added water and it 'exploded'. He was hosed down by his wife and took a shower. He began having difficulty breathing, eye irritation, and chemical burns on his torso, upper arms and face. His wife called poison control; he did not want to go to the emergency department. He continued to get worse and developed a rapid respiratory rate of 53. The fire department was called and he was taken to a hospital and admitted for 13 days. He had wheezing, crackles, ventilator-dependent respiratory failure, chemical pneumonitis, vocal cord ulceration, tachycardia, diaphoresis, conjunctivitis, and first and second degree burns over about 50% of his body. According to the label the product should be added to water, not water to the product.

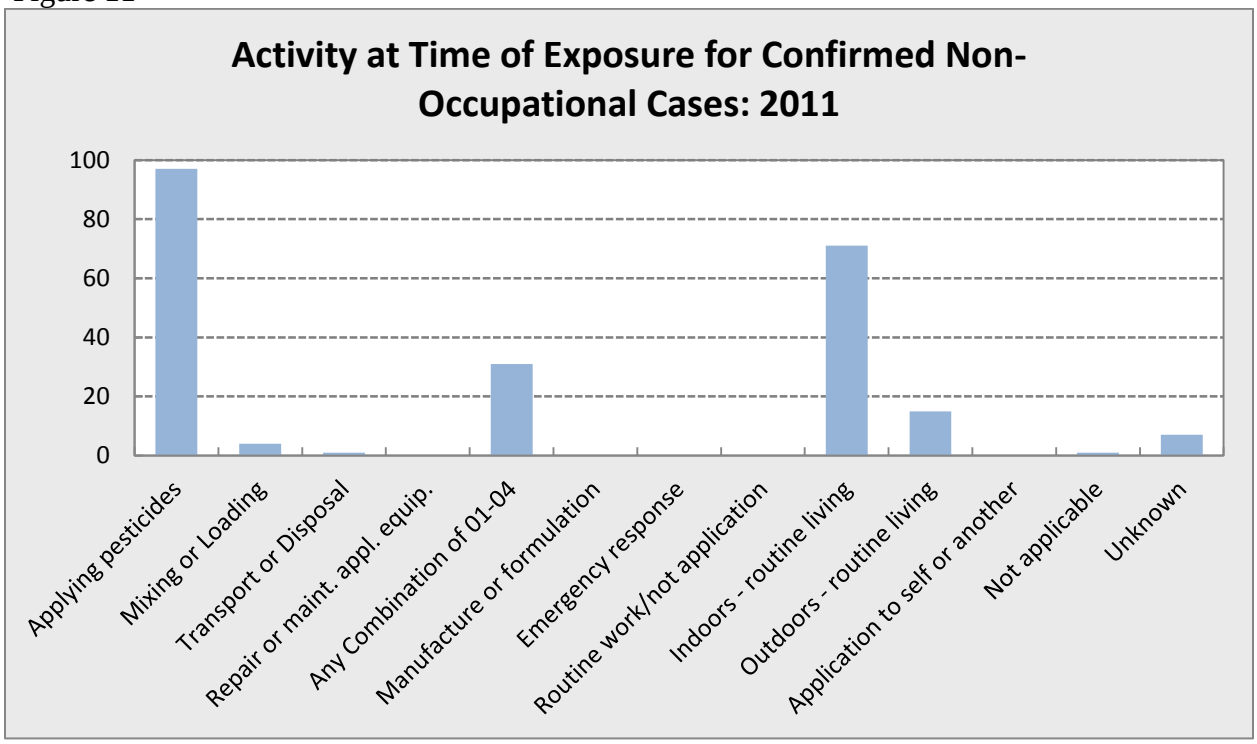
Type of equipment used in the pesticide application was known for 53.3% of the non-occupational cases in 2011. The most common types were pressurized cans and total release foggers (bug bombs).

Table 23: Equipment Used in Confirmed Non-Occupational Cases, 2006-2011 and 2011 Separately

Application Equipment	Cumulative	Percent	2011	Percent
Pressurized can	118	11.4%	27	11.9%
Total release fogger	92	8.9%	30	13.2%
Manual Placement	77	7.4%	19	8.4%
Trigger pump/compressed air	67	6.4%	14	6.2%
Spray line, hand held	11	1.1%	4	1.8%
Ground sprayer, not elsewhere classified	9	0.9%	1	0.4%
Aerial application equipment	8	0.8%	1	0.4%
Aerosol generator/fogger	6	0.6%	0	0.0%
More than one type of equipment	6	0.6%	4	1.8%
Handheld granular/dust applicator	3	0.3%	1	0.4%
Air blast sprayer	2	0.2%	0	0.0%
High pressure fumigator	1	0.1%	0	0.0%
Sprayer, backpack	1	0.1%	1	0.4%
Other	110	10.6%	16	7.0%
Not applicable	15	1.4%	3	1.3%
Unknown	513	49.4%	106	46.7%
Total	**1039**	**100.0%**	**227**	**100.0%**

The activity at time of exposure was determined for 220 (96.9%) of the confirmed cases.

Figure 11



Contributing factors provide additional information about the cases and assist with developing prevention strategies. Up to five contributing factors can be coded for each case.

Table 24: Contributing Factors in Confirmed Non-occupational Cases, 2006-2011 and 2011 Separately

Contributing Factor	Cumulative	Percent	2011	Percent
Mixing incompatible products	155	13.0%	44	16.8%
Label violations not otherwise specified	145	12.2%	43	16.4%
Excessive application	132	11.1%	26	9.9%
No label violation identified but person still exposed/ill	118	9.9%	29	11.1%
Spill/Splash of liquid or dust (not equipment failure)	82	6.9%	11	4.2%
Drift contributory factors	74	6.2%	8	3.1%
Within reach of child or other improper storage	55	4.6%	13	5.0%
People were in the treated area during application	51	4.3%	9	3.4%
Decontamination not adequate or timely	34	2.9%	13	5.0%
Structure inadequately ventilated before re-entry	30	2.5%	4	1.5%
Early re-entry	24	2.0%	6	2.3%
Notification/posting lacking or ineffective	22	1.9%	3	1.1%
Application equipment failure	16	1.3%	3	1.1%
Required gloves not worn or inadequate	6	0.5%	3	1.1%
Applicator not properly trained or supervised	6	0.5%	1	0.4%
Other	41	3.5%	8	3.1%
Unknown	197	16.6%	38	14.5%
Total	**1188**	**100.0%**	**262**	**100.0%**

Health Effects

Table 25 shows the severity of non-occupational cases, using the NIOSH standardized criteria for determining severity index. Most (74.0%) of confirmed non-occupational cases in 2011 were of low severity. Table 26 shows where the case first received medical care and whether they were hospitalized.

Table 25: Severity of Confirmed Non-occupational Cases, 2006-2011 and 2011 Separately

Severity	Cumulative	Percent	2011	Percent
High	25	2.4%	8	3.5%
Moderate	133	12.8%	51	22.5%
Low	881	84.8%	168	74.0%
Total	**1039**	**100.0%**	**227**	**100.0%**

Table 26: Confirmed Non-occupational Cases by First Care and Hospitalization, 2011

First Care	Not Hospitalized	Hospitalized	Total
Physician Office Visit/Urgent	8	0	8
Emergency Room	67	11	78
Advice of Poison Control Center	52	1	53
No Medical Care Sought	2	0	2
Other	12	1	13
Unknown	71	1	72
Total	**212**	**14**	**227**

Outreach, Education, and Prevention Activities

Publications, Presentations, and Other Outreach Activities
Staff members of Occupational Pesticide Illness and Injury Program used a variety of avenues to provide information about the program and pesticide safety to stakeholders and the general public. In 2011:

- A staff member of the surveillance program represented MDCH on the MDARD Pesticide Advisory Committee (PAC) and provided an activity report each quarter.

- MDCH staff presented information about the surveillance program and descriptions of individual incidents about how exposures occurred at an in-service for MSU Extension and MDARD staff.

- The MDCH Pesticide webpage provided links to over 100 other sites with information about pesticides and their safe use. This site received 253 hits in 2011. In addition, MDCH's educational booklet, "What You Need to Know about Pesticides and Your Health" received 1,119 hits. Previous annual reports received a total of 3,016 hits.

- Safety information was sent to cases and employers as needed.

- MDCH staff participated with the Michigan Primary Care Association's Migrant Health Network. Letters with information about pesticide safety and reporting were sent to the migrant health clinics in Michigan and about 550 migrant camp owners.

- MDCH staff chaired the pesticide coding committee of the SENSOR-Pesticides states, which worked on data quality assurance and made revisions to the standardized variable document.

- MDCH staff attended the annual conference of pesticide surveillance states.

- The MDCH surveillance program coauthored three MMWR articles: phosphine gas poisoning at veterinary facilities (Schwartz et al 2011); bed bugs (Jacobson et al, 2011); and swimming pool disinfectants (Mehler et al, 2011).

- The MDCH surveillance program coauthored an article about off-target drift in agricultural applications published in Environmental Health Perspectives. (Lee et al, 2011).

- MDCH surveillance program staff participated in Michigan's Bed Bug Working group.

- Data on six cases were reported to the CDC waterborne illness surveillance program.

- Information about pesticides and the surveillance program was distributed at the Michigan Safety Conference and the Michigan Farmworker, Service Provider, and Grower conference.

- MDCH surveillance program staff participated in Michigan Birth Defects Steering Committee meetings.

MDARD Referrals

Seven cases were referred to MDARD in 2011, five occupational and two non-occupational. In one, an untrained teenage worker was spraying an herbicide in a lake, wearing a chemical suit. The herbicide sprayed back on him due to wind and rain, and went through the suit. After two to three hours he took off the suit and his legs had blotchy red spots. No decontamination was available, so he went to a fast food restaurant to wash off. His supervisor told him to put aloe cream on his legs. The burns on his legs became worse and he went to an emergency department where he was diagnosed with first and second degree burns. He was transferred to another hospital and admitted to a burn unit for three days. The case was referred to MDARD and the company received a warning letter.

A certified applicator for a landscaping company treated residential and commercial lawns with a glyphosate herbicide. Her backpack sprayer leaked when she bent over to pick weeds. In addition, she said she was told to under-dilute the concentrate because it wasn't killing weeds with one application. Her arms and legs were red, swollen and tingling, she was dizzy, had blurry vision, shortness of breath, chest pain and nausea. She went to an urgent care facility and was taken by ambulance from there to an Emergency Department. The case was referred to MDARD and the company received a warning letter.

In another workplace, a stock mover and a warehouse worker were exposed to a phenolic disinfectant that was sprayed into the air in and around the bathrooms as an air freshener. The stock mover was dizzy, had throat irritation, and a burning or numb tongue. The other worker felt dizzy, nauseous, coughed, and had a bad taste in his mouth. MDARD investigated and issued a warning letter.

An electrician was working in a warehouse when a room next door to him was fogged with a pyrethrin insecticide. He developed anxiety, confusion, dizziness, pain in his eyes, face, and arms, tearing, headache, fatigue and tremors. He went to an emergency room three times. The case was referred to MDARD.

A cemetery grounds worker worked outside the day after the cemetery had been sprayed with two herbicides. She developed nausea, vomiting, and shortness of breath. The case was referred to MDARD and the application company received a warning letter.

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

A homeowner living near a cornfield complained that she had a variety of symptoms, including feeling tired and confused, muscle weakness, headache and trouble breathing from herbicide applications to the cornfield. MDARD did not find any indication of drift.

MIOSHA Referrals

The employer where an electrician was exposed to an insecticide in a warehouse (see above MDARD referral) was also referred to MIOSHA. One other-than-serious citation was issued for a violation of the Hazard Communication Standard Training requirements.

NIOSH Reports

In 2011 four occupational and six non-occupational events met NIOSH's priority reporting criteria. These reports are forwarded to EPA, the regulatory agency for pesticides registration and labeling.

A teenage worker was exposed to an herbicide while spraying a lake, resulting in burns on his legs (see above MDARD referral).

A pharmacist at a retail store was present when the floor was mopped with undiluted bleach. She inhaled the fumes and became lightheaded and nauseated and later developed a headache. Three coworkers were also exposed and became lightheaded.

Five survey crew workers were in a field next to a farm that was sprayed with a glyphosate herbicide. They all developed headaches, nausea, burning eyes, nose and throat, and a metallic taste in their mouths.

A mill operator was cleaning a tank that had been flushed with chlorine and water. He went into the tank and inhaled fumes. He developed shortness of breath, a cough and a tickle in his throat. He became nauseated and vomited. He went to an emergency department and was admitted to the hospital. He was discharged the next day.

A man added water to pool chlorine, rather than the other way around, and it 'exploded'. He began having difficulty breathing, eye irritation, and chemical burns on his torso, upper arms and face. He continued to get worse and became tachypnic, had wheezing, rales, ventilator-dependent respiratory failure, chemical pneumonitis, vocal cord ulceration, tachycardia, diaphoresis, conjunctivitis, and first and second degree burns. He was hospitalized for 13 days. Because a similar case was reported in 2012, EPA and NIOSH were contacted again about this problem. MDCH staff observed that on many of these pool chlorine products the label instructions to not add water to chlorine granules but only add granules to water is not conspicuous. Thus it is easy to understand why a consumer might mix the chlorine and water incorrectly. EPA was asked to reassess the product labels. MDCH staff are also planning some educational interventions.

A woman entered her garage two hours after setting off a total release fogger, in accordance with the label instructions. She developed tingling and a headache.

A man sprayed an insecticide briefly in the evening, in accordance with the label. He could not sleep all night and had shortness of breath.

A woman sprayed an insecticide in the kitchen on floor, around stove, under sink at night. She followed the label instructions but woke up the next morning feeling dizzy, lightheaded and with shortness of breath.

Two people re-entered their apartment two hours after setting off a total release fogger, in accordance with the label. One person developed respiratory irritation and the other became nauseous, was coughing and had difficulty breathing.

A woman sprayed one of three bedrooms in her home with an insecticide. After ten minutes of spraying she was seeing rainbow colors in her vision and her vision was blurry. She had read and followed the label directions.

Discussion

Surveillance Data
There were a similar number of confirmed cases in 2011 compared to 2010; 69 occupational cases vs. 66 and 227 non-occupational cases vs. 206.

The number of disinfectant cases remained high and continues to be an area of ongoing concern. Occupational disinfectant cases were similar to cases in 2010 in both in number and percent [45 (51.7%) vs. 47 (57.3%)]. Non-occupational disinfectant cases increased over 2010 [130 (46.6%) vs. 71 (30.5%)]. In spite of the absence of evidence that hand contact with "contaminated surfaces" causes infectious diseases, the widespread use of disinfectants in homes, schools, and other non-healthcare locations has been promoted. Evidence-based recommendations are needed regarding the use of cleaning agents, particularly disinfectants. Education is needed to provide guidance about how to clean and when disinfectants/pesticides are recommended, and how to use them properly.

When looking at factors contributing to the pesticide exposure, spills and splashes were the most common factor for confirmed occupational cases (17.6%). Mixing incompatible products was the most common contributing factor for non-occupational exposures (16.8%) followed by label violations not otherwise specified, for example spraying into the wind (16.4%). Better education and additional PPE requirements might help to reduce the number of exposures.

Most confirmed cases were reported by poison control (85.5% of occupational and 73.1% of non-occupational cases). Most confirmed cases were considered low severity (66.7% of occupational and 74.0% of non-occupational cases).

More than a third of the confirmed occupational cases in 2011 were "bystanders", i.e., engaged in work activities not related to the pesticide application. Better education of users of pesticides on safe pesticide application is needed to prevent inadvertent workplace exposures.

Interventions
MDCH continued to refer cases to MDARD and MIOSHA for investigation of possible safety violations. MDCH also worked to improve pesticide education for individuals, health care providers, and other stakeholder groups through the distribution of brochures and presentations listed in the results section. In particular MDCH contributed to a day-long training for MSU Extension and MDARD regional staff members, providing information they can use to educate applicators. Education must remain a priority for both certified and non-certified pesticide applicators, since both groups are at high risk for exposing themselves or others if the products are not handled properly.

Challenges to Surveillance
Pesticide poisoning is a complex condition for surveillance. 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. Pesticides have a range of toxicity, from practically nontoxic (no signal word required) through slightly toxic (signal word: Caution), moderately toxic (signal

word: Warning) and most toxic (signal word: Danger). Pesticide products are often mixtures including one or more active ingredients, as well as other "inert" ingredients that have no effect on the target pest but may have adverse human health effects. 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 allergies, acute conjunctivitis, or acute gastrointestinal illness, among other conditions. In addition, health care providers receive limited education in the recognition and diagnosis of the toxic effects of pesticides and the role of pesticides may be overlooked. Besides problems in recognition by health care providers, patients may not seek medical care (Calvert, 2004). Migrant workers face additional barriers such as language difficulties, lack of access to care, and fear of job loss or deportation if they are not legal residents. Finally, even when diagnosed, pesticide-related illnesses and injuries may not be reported due reluctance on the part of workers and their health care providers to involve state agencies or lack of knowledge of the public health code reporting requirements. (Calvert et al, 2001).

More outreach is needed to educate health care providers on the importance of recognizing and reporting instances of occupational pesticide illnesses and injuries. Over eight-five percent of confirmed occupational cases in 2011 were reported by the State's poison control center, with relatively few reports (only 5.8%) from health care providers.

Like data from other occupational injury and illness surveillance systems, (Azaroff et al, 2002) the Michigan occupational pesticide surveillance data are probably 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. (Washington Department of Health, 2004). 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 challenges due to the time lag between the occurrence and the reporting of the incident from hospital and MDARD 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 for 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, including follow-up prevention activities. In addition, the surveillance system has expanded to include non-occupational cases and follow-up on laboratory reports of cholinesterase test results, more than doubling the cases evaluated.

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Additional Resources

MDCH Division of Environmental Health pesticide information: www.michigan.gov/mdch-toxics

NIOSH occupational pesticide poisoning 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: http://www.cdc.gov/niosh/docs/2006-102/

MDARD Pesticide and Plant Pest Management Division (for information on licensing and registration for pesticide application businesses, credentials for certified technicians, and laws and regulations for pesticide application):
http://www.michigan.gov/mdard/0,4610,7-125-1572_2875-8324--,00.html

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

Information on pesticide products registered for use in Michigan:
http://state.ceris.purdue.edu/

EPA Pesticide Product Label System:
http://oaspub.epa.gov/apex/pesticides/f?p=PPLS:1

Extoxnet Pesticide Information Profiles: http://extoxnet.orst.edu/pips/ghindex.html

Information on the federal Worker Protection Standard (worker exposure to pesticides in agriculture):
http://www.epa.gov/pesticides/health/worker.htm

Recognition and Management of Pesticide Poisonings, Fifth Edition:
http://www.epa.gov/oppfead1/safety/healthcare/handbook/handbook.pdf

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

Appendix

Case Narratives, 2011 Confirmed Occupational Cases

Below are descriptions of the confirmed occupational cases reported in 2011. The narratives are organized by pesticide type and include a description of the signs and symptoms that resulted from the exposure and medical care received. Where known, age range, gender, industry, and occupation are included. In addition, more specific information about the product such as chemical class or the signal word for acute toxicity assigned by the EPA, is provided when known. The signal word is assigned based on the highest hazard of all possible routes of exposure. "Caution" means the product is slightly toxic if eaten, absorbed through the skin, or can cause slight eye or skin irritation. "Warning" means the product is moderately toxic if eaten, absorbed through the skin, or can cause moderate eye or skin irritation. "Danger" means the product is highly toxic, is corrosive, or causes severe burning to the eye or skin that can result in irreversible damage.

Insecticides

MI02365 – A medical assistant in her 50s had a pyrethrin insecticide (signal word Caution) in her desk drawer because they had ants in the office. She put her purse in the drawer and it hit the nozzle, causing it to spray in her face. Some got in the corner of her eye. She rinsed her eye at an eye wash station, but it became red and she had a headache. She called poison control. She thinks a safety lock on the nozzle would be good idea.

MI02375 - A warehouse worker in his 40s was exposed to a pyrethrin insecticide (signal word: Caution) when he entered and began working in a treated building. He developed shortness of breath and muscle pain. EMS was called and he was taken to an emergency department. He was diagnosed with Chemical pneumonitis and admitted to the hospital. He lost one week of work. He was one of four workers exposed (see MI02356, MI02357 and MI02358). The incident was referred to MDARD and NIOSH.

MI02445 – A firefighter in her 30s was exposed to a pyrethroid insecticide (signal word: Caution) that had been thrown away in a dumpster that caught fire. She inhaled fumes from the dumpster and developed shortness of breath, tachycardia, a headache, and vomited three times. She went to an emergency department. Four other firefighters were on the other side of the dumpster and were asymptomatic.

MI02456 – A paramedic in his 50s transported a patient to a hospital. The patient smelled of a licorice odor, and had been exposed to a lice treatment with a pyrethroid insecticide (signal word: Caution). The paramedic developed a headache, nausea, erythema, and a rash after transporting the patient. He went to an emergency department.

MI02460 – A sales team leader in her 50s at a farm and garden supply store saw a child in a cart reach out to grab a can of pyrethroid insecticide (signal word: Caution). She was unable to stop

the child in time, and the can fell, hitting a lower shelf on the way down. The can was punctured and released its contents. She pushed the cart with the child out of the way and then carried the can outside, inhaling fumes on the way out. She developed a cough and sore throat and went to an emergency department. The sore throat lasted five to six days.

MI02480 – A pesticide applicator in his 20s was cleaning out the tank of a sprayer that had been winterized but previously contained a pyrethroid insecticide. He wore gloves but his arms came into contact with the inside of the tank. He became dizzy and his skin and the inside of his mouth became hypersensitive to heat, cold, pressure, wind, etc. He called poison control.

MI02493 – An apartment complex housekeeper in his 50s was using two pyrethroid insecticides (both with signal word: Caution) to control roaches and bedbugs. He had no training in pesticide handling. He developed parasthesia and fell at work. He also had pain, edema, and ataxia. He went to an emergency department and lost two weeks of work. This was the same apartment complex as MI02502.

MI02502 – An apartment complex housekeeper in her 40s has been using/exposed to pyrethroid insecticides (signal word: Caution) to treat bed bugs in the apartments for about four years. She has developed wheezing, chest tightness, shortness of breath, sinus problems, and tearing. She went to a health clinic. This was the same apartment complex as MI02493.

MI02506 – A contract worker in his 20s was assembling a grill for display in a Home Depot when a customer stood on a bottom shelf to reach a container of a carbaryl insecticide (signal word: Caution). It hit the metal shelf and broke, spilling on the person assembling the grill. The customer cleaned up the spill. The exposed contractor developed a sore throat, cough, headache, nausea, congestion, and exacerbation of his asthma. He went to his doctor and was diagnosed with sinusitis and bronchiolitis. He missed 3-4 days of work and several months later his asthma was still worse than prior to the exposure. The case was referred to the State’s asthma surveillance program.

MI02512 – A blueberry farmer in his 50s mixed an organophosphate insecticide (signal word: Warning) and a fungicide (signal word: Danger) together. He was spraying his fields when he developed equipment problems. He took his sprayer apart and removed the obstruction without wearing the required gloves. Within minutes he developed dizziness, chest pain, a bad taste in his mouth, nausea, and numbness. He went to an emergency department.

MI02536 – A lawn technician in his 20s sprayed an insecticide (signal word: Caution) all day. The wind velocity was higher than usual, causing spray back that got his pants wet. He wanted to finish all the lawns so he didn't stop to decontaminate. He developed blisters on his legs that lasted about 2 days. The blisters bled and he also had a burning sensation and swelling of his inner thighs. After the blisters healed his skin became dry and cracked. It took about a week and a half to heal completely. He called poison control.

MI02537 – A worker in his 40s was applying a pyrethroid insecticide (signal word: Caution) to a golf course. He may have had some on his gloves when he rubbed his face for an itch. He developed a red, irritated cheek and contacted poison control.

MI02597 – An adult worker was exposed to a pyrethroid insecticide (signal word: Caution). She developed nausea, vomiting and shakiness. She called poison control. (Same workplace as MI02598 and MI02599.)

MI02598 – An adult worker was exposed to a pyrethroid insecticide (signal word: Caution). She developed nausea, vomiting and shakiness. Poison control was called. (Same workplace as MI02597 and MI02599.)

MI02599 – An adult worker was exposed to a pyrethroid insecticide (signal word: Caution). She developed nausea, vomiting and shakiness. Poison control was called. (Same workplace as MI02597 and MI02598.)

MI02603 – A rental property owner in his 70s was spraying overhead with a pyrethroid insecticide (signal word: Caution). He was wearing goggles but they slipped and mist got in his eyes. They became red and irritated. He went to an emergency department.

MI02607 – An electrician in his 40s was working in a warehouse when a room next door to him was fogged with a pyrethrin insecticide (signal word: Caution). He developed anxiety, confusion, dizziness, pain in his eyes, face, and arms, tearing, headache, fatigue and tremors. He went to an emergency room three times.

Herbicides

MI02495 – A lawn care applicator in his 30s was applying a mixture of herbicides for 6-8 hours without any respiratory protection (none was required). In addition, the tank in his van had leaked and the leak was fixed but he still smelled chemicals when he was driving. He developed aphasia, a headache, nausea, vomiting, dizziness, tunnel vision, and dilated pupils. He called poison control, went to an emergency department and was admitted to the hospital.

MI02497 – A landscaper in his 20s sprayed an herbicide as part of his job on Friday. He woke up the next day dizzy, nauseated, short of breath, with pain on deep breathing. That evening he developed additional symptoms of emesis and sweating. He went to an emergency department on Sunday and was diagnosed with right sided interstitial pneumonitis.

MI02500 – An applicator in his 20s was applying herbicides to a pond when the ‘gun’ broke and some splashed in his eye. He developed conjunctivitis, corneal abrasion, and swollen eyelids. He went to an occupational health clinic.

MI02503 – An adult worker in a multi-business structure was exposed to a chlorophenoxy herbicide (signal word: Caution) that was stored in the same room as the air intake for the air conditioner. He developed irritated eyes, a scratchy throat, cough, tingling and numbness of his fingers, toes and lips, and dermatitis. He contacted poison control and went to his primary care physician.

MI02507 – An untrained teenage worker was spraying an herbicide (signal word: Danger) in a lake, wearing a chemical suit. The herbicide sprayed back on him due to wind and rain, and went through the suit. After two to three hours he took off the suit and his legs had blotchy red spots. No decontamination was available, so he went to a fast food restaurant to wash off. His supervisor told him to put aloe cream on his legs. The burns on his legs got worse and he went to an emergency department where he was diagnosed with first and second degree burns. He was transferred to another hospital and admitted to a burn unit for three days. The case was referred to MDARD and reported to NIOSH.

MI02510 – A certified applicator for a landscaping company in her 40s treated residential and commercial lawns with a glyphosate herbicide (signal word: Caution). Her backpack sprayer leaked when she bent over to pick weeds. Her arms and legs became red, swollen and tingling, she was dizzy, had blurry vision, shortness of breath, chest pain and nausea. She went to an urgent care and was taken by ambulance from there to an Emergency Department. She noted that, under instructions from the company, she had under-diluted the concentrate because it wasn't killing weeds with one application. The case was referred to MDARD.

MI02525 – An applicator for a landscaping company in his 30s sprayed for 1 1/2 hours with an herbicide (signal word: Caution). He wore gloves but some leaked over his gloves onto his hands. He rinsed with water and then put some chew in his mouth. He did not wear a mask. Gloves and mask were not required. That evening he developed nausea, diarrhea, stomach cramps, difficulty breathing, muscle cramps, headache and leg twitching. The temperature was in the 90s, and the next day he had a heat rash. He called poison control and went to an emergency department.

MI02608 – A survey crew worker in her 20s was in a field next to a farm that was sprayed with a glyphosate herbicide (signal word: Warning). She developed a headache, nausea, burning eyes, nose and throat, and a metallic taste in her mouth. Her supervisor called poison control. (See MI02609, MI02610, MI02611, and MI02612.)

MI02609 – A survey crew worker in her 20s was in a field next to a farm that was sprayed with a glyphosate herbicide (signal word: Warning). She developed a headache, nausea, burning eyes, nose and throat, and a metallic taste in her mouth. Her supervisor called poison control. (See MI02608, MI02610, MI02611, and MI02612.)

MI02610 – A survey crew worker in her 20s was in a field next to a farm that was sprayed with a glyphosate herbicide (signal word: Warning). She developed a headache, nausea, burning eyes, nose and throat, and a metallic taste in her mouth. Her supervisor called poison control. (See MI02608, MI02609, MI02611, and MI02612.)

MI02611 – A survey crew worker in her 20s was in a field next to a farm that was sprayed with a glyphosate herbicide (signal word: Warning). She developed a headache, nausea, burning eyes, nose and throat, and a metallic taste in her mouth. Her supervisor called poison control. (See MI02608, MI02609, MI02611, and MI02612.)

MI02612 – A survey crew worker in her 20s was in a field next to a farm that was sprayed with a glyphosate herbicide (signal word: Warning). She developed a headache, nausea, burning eyes, nose and throat, and a metallic taste in her mouth. Her supervisor called poison control. (See MI02608, MI02609, MI02610, and MI02611.)

MI02613 – A cemetery groundsworker in her 50s was working outside the day after it had been sprayed with two herbicides. When she worked outside she could smell and taste the herbicides. She developed nausea, vomiting, and shortness of breath and called poison control.

MI02732 – A teenaged worker was exposed to an herbicide (signal word: Caution) mist when some blew into his face while he was applying the product. He flushed briefly but had red, stinging eyes. He called poison control.

Disinfectants

MI01978 – A jail trustee in his 50s washed pots for four months either without gloves or with gloves that easily tore. He was using a sodium hypochlorite disinfectant (signal word: Danger). He developed numb, itchy hands and his skin peeled. He went to an emergency department.

MI02364 – A nurse in her 50s got a disinfectant (signal word: Danger) on her eyelid. It became swollen, red, and irritated. She called poison control.

MI02370 – A pharmacist in her 30s at a retail store was present when the floor was mopped with undiluted bleach. She inhaled the fumes and became lightheaded and nauseated and later developed a headache. A coworker called poison control.

MI02376 – A lab technician at a manufacturing facility had a disinfectant on his glove and reached up to move a light. Some dripped in his eye, which became red and painful. He went to an emergency department.

MI02414 – A school custodian in her 40s was filling a squirt bottle. She had added a quaternary ammonium disinfectant (signal word Danger) and was adding water. The bottle slipped out of her hands into the sink. Some splashed up into her eye, face, and nose. She rinsed her eye for 20 minutes, and then went to an occupational health clinic where it was rinsed again. It was red and painful.

MI02415 – A Certified Nursing Assistant in her 20s was carrying a bucket containing a solution of diluted quaternary ammonium disinfectant (signal word Danger) to the other side of the room. The bucket slipped from her hand, which was slippery, and fell to the floor. Some of the solution splashed up on her clothes and face. She was not wearing required eye protection and her eye was red and burning. She rinsed it and went to the emergency department where she was diagnosed with corneal abrasion, corneal burn, and chemical conjunctivitis.

MI02416 – A water park lifeguard in her 20s was exposed to over-chlorinated water. Her eyes became red and puffy, she developed a cough, and she vomited once. Her husband called poison control.

MI02419 – A relief operator at a chemical manufacturing plant was present when machinery malfunctioned and released bromine into the air. (See MI2420.) He was wearing "protective apparatus"; he did not know how long or what concentration the exposure was. He didn't realize he was exposed until he developed symptoms. He had red, painful eyes and throat irritation. He was taken by ambulance to an emergency department. MIOSHA investigated and agreed with the recommendations from the plant's internal investigation. No violations were cited.

MI02420 – A tablet machine operator at a chemical manufacturing plant was present when machinery malfunctioned and released bromine into the air. (See MI2419.) He was wearing a self-contained breathing apparatus, but the seal was not good because he was using the hood of his sweatshirt to protect himself from the water from the automatic sprinkler system. He developed eye and throat irritation, shortness of breath and a cough. He was taken by ambulance to an emergency department. MIOSHA investigated and agreed with the recommendations from the plant's internal investigation. No violations were cited.

MI02438 – A packer at a chemical manufacturing plant in her 30s was putting caps on bottles of a phenolic disinfectant (signal word: Danger). There were machine problems causing the bottles to overfill and product got on her hands. Gloves were available but she did not wear them. Her skin was burning and her hands turned white. Poison control was called.

MI02450 – A private in the National Guard in his 20s cleaned the shower in an armory. He put an acid disinfectant (signal word: Danger) down the drain and then used bleach on the floor. He turned on hot water which flushed the bleach down the drain where it combined with the acid to form chlorine fumes. He developed a cough, had difficulty taking a deep breath, and vomited. His sergeant called poison control.

MI02451 – A sergeant in the National Guard in his 50s walked by when a private (see MI02450) was cleaning the shower in an armory. The private had put an acid disinfectant (signal word: Danger) down the drain and then used bleach on the floor. He had turned on hot water which flushed the bleach down the drain where it combined with the acid to form chlorine fumes. The sergeant developed shortness of breath, a cough, and a headache. He called poison control.

MI02462 – A teenage temporary laborer was cleaning tubing in a fast food children's play area for a couple of hours using a sodium hypochlorite disinfectant (signal word: Danger). He did not wear required gloves or mask. He developed a cough, headache, throat irritation and swollen hands. He saw his doctor and called poison control.

MI02470 – A pizzeria cook in his 20s used a toilet that had been cleaned with bleach. The bleach was left standing in the toilet and when he urinated into it fumes were released. He said it was the worst smell he'd ever smelled in his life. His eyes burned, and he had a bad taste in his mouth and was dizzy all day. He called poison control.

MI02494 – A fast food crew member in her 40s was washing dishes. Someone had filled the sanitizer sink with hot water rather than cold, causing more of the quaternary ammonium disinfectant (signal word Danger) fumes to be present. The label does not specify using cold

water for dilution. She developed a cough, scratchy throat, trouble breathing and her asthma was exacerbated. She called poison control and went to an emergency department.

MI02501 – A teenaged salesperson at a pool and spa store was lifting a case of pool chlorine (signal word: Danger) to carry to a customer's car. There had been a leak, and the box containing the four gallon containers had corroded. When he tried to pick it up, one of the gallons fell out of the box and broke, spilling on his legs and feet. His skin turned reddish brown, blistered, and was painful. He went to an urgent care and was diagnosed with a chemical burn. He missed four days of work.

MI02504 – A water park employee in her 20s was exposed to chlorine fumes for three days due to a broken ventilation system. She developed shortness of breath, chest pain, congestion, and wheezing. She went to an emergency department.

MI2505 – A dental assistant in her 30s was using a disinfectant (signal word: Caution) to clean dentures. When rinsing one off under water, some splashed in her eye and face. Eye protection was not required and not worn. Her eye became red and irritated and she had blurry vision and photophobia. She went to an urgent care center.

MI02513 – An ice cream shop worker in his 20s was exposed to chloramine fumes when a coworker mixed bleach and ammonia. He developed a cough and a sore throat. He called poison control and had a chest X-ray, which was normal.

MI02522 – A school maintenance worker in her 50s picked up a plastic jug of pool chlorine (signal word: Danger) and the handle broke off. The jug fell down, hit a pallet, and chlorine splashed up in her eye. She was not wearing the required eye protection (now she wears a face shield). She rinsed her eye for a few minutes. It was burning and sensitive to light and her vision was blurry. She went to an occupational health clinic was diagnosed with a corneal abrasion.

MI02529 – A utility company employee in his 50s was present when someone started to dump a truck full of bleach into a tank of hydrofluosilicic acid. He was exposed to the resultant fumes for 2-3 minutes and developed throat irritation and weakness. He went to an emergency department and was admitted for observation overnight. MIOSHA was called in to consult with the utility company. (See MI02530 and MI02531)

MI02530 – A truck driver in his 50s delivered bleach to a water production plant. He hooked the truck full of bleach to a tank of hydrofluosilicic acid. He was exposed to the fumes for 2-3 minutes and developed a cough, sore throat and difficulty breathing. He went to an emergency department via ambulance and was admitted for observation overnight. MIOSHA was called in to consult with the utility company. (See MI02529 and MI02531)

MI02531 – A shift supervisor in her 50s for a utility company was called to a water production plant when someone started to dump a truck full of bleach into a tank of hydrofluosilicic acid. She was originally told to open the doors of the building to air it out, but then the reaction continued and gas continued to come out so she was told to close the doors. She used a Self-Contained Breathing Apparatus (SCBA) mask to close the doors, but the first mask she tried was

too big. She was exposed to the fumes for 2-3 minutes and developed burning eyes, nose, and throat. Her chest felt constricted and she had difficulty breathing. She went to an emergency department and was admitted for observation overnight. MIOSHA was called in to consult with the utility company. (See MI02529 and MI02530)

MI02563 – A mill operator in his 50s was cleaning a tank. It had been flushed with chlorine and water. There was still some chlorine in the bottom of the tank. He went into the tank and inhaled fumes. He developed shortness of breath, a cough and a tickle in his throat. He became nauseated and vomited. He went to an emergency department and was admitted to the hospital. He was discharged the next day. This was reported to NIOSH

MI02567 – An animal caretaker on a dairy farm in his teens was cleaning buckets and accidently mixed bleach with acid. His throat burned, he had a headache, a cough, and pain with deep breathing. An ambulance took him to an emergency room.

MI02585 – A general manager of a fast food restaurant in her 20s was changing the quaternary ammonia sanitizer at the dishwashing area. She unscrewed the top of the gallon of concentrate and then put it on the ground. Some splashed in her face; she did not wipe it off. When she got home her face was swollen, red and painful. She called poison control and two days later went to her doctor. She was diagnosed with a second degree burn.

MI02586 – A physical therapist in her 40s was washing walls, getting her room ready for the start of a new school year. She put a quaternary ammonia disinfectant (signal word: Danger) in a bowl with water, and used a rag to wash. Some solution sloshed into her eye. She did not wear required goggles or face shield. She went to an urgent care facility and was diagnosed with chemical conjunctivitis and corneal abrasion.

MI02595 – A teenager was cleaning tables in a mall with a quaternary ammonia disinfectant (signal word: Danger). She had a spray bottle in her pocket and the nozzle was loose. Some disinfectant spilled on her leg, soaking through her jeans and she developed a red, itchy, burning area on her thigh. She went to an emergency department.

MI02600 – A dock worker at a thrift store in his 20s mixed a capful of bleach and capful of ammonia with 32 oz of water in a spray bottle, to clean the bathroom. His eyes, nose, and throat began to burn and his eyes teared. He called poison control.

MI02601 – A stock mover in his 50s was exposed to a phenolic disinfectant (signal word Danger) that was sprayed into the air in and around the bathrooms as an air freshener. He became dizzy, had throat irritation, and a burning or numb tongue when he smelled the product. He called poison control. This was referred to MDARD. (See MI02604)

MI02604 – A warehouse worker in his 50s was exposed to a phenolic disinfectant (signal word Danger) that was sprayed into the air in and around the bathrooms as an air freshener. He felt dizzy, nauseous, coughed, and had a bad taste in his mouth when he smells the product. He called poison control. This was referred to MDARD. (See MI02601)

MI02606 – A bartender in her 30s got a mixture of disinfectants splashed in her eye. She went to an occupational health clinic and an emergency department.

Other

MI02579 – A worker in his 30s was sweeping a barn and inhaled dust from a rodenticide (signal word: Caution). He developed a headache, nausea, vomiting, itchy throat, and chest tightness. He went to an emergency department.

Mixtures

MI02521 – A sprayer in his 30s on a fruit farm sprayed four products over four days. He had no specific exposure incident, but developed a red rash that was sensitive to touch and then blistered. His eyes were sensitive to light. He was not a certified applicator and did not have constant supervision. He went to an urgent care center and was diagnosed with contact dermatitis.

MI02526 – A landscaper in his 20s had been working in the heat for several days, using a chlorophenoxy herbicide and a pyrethroid insecticide. He developed muscle cramps and aches, was sluggish, and had bradycardia. He went to an emergency department.