Pesticide Illness and Injury Surveillance in Michigan 2013

December 2015

Division of Environmental Health
Michigan Department of Health and Human Services

Pesticide Illness and Injury Surveillance in Michigan: 2013

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Acknowledgements
The Occupational Pesticide Illness and Injury Surveillance Program wishes to acknowledge those who have contributed to the development and implementation of the surveillance program and this report:

Michigan Department of Agriculture and Rural Development
Brian Rowe, BS

National Institute for Occupational Safety and Health
Geoffrey Calvert, MD, MPH

Children's Hospital of Michigan Poison Control Center
Cynthia Aaron, MD

This publication was supported by a sub-award to MDHHS from MSU of grant number 2U60OH008466 from the U.S. Centers for Disease Control and Prevention – National Institute for Occupational Safety and Health (CDC-NIOSH). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC-NIOSH.

Contents

Summary

The Michigan Department of Health and Human Services (MDHHS)[1] has been conducting surveillance for acute work-related pesticide illnesses and injuries since 2001. MDHHS 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) and chemical poisoning (R325.71-R325.75). This is the eleventh annual report on pesticide-related illnesses and injuries in Michigan (MDHHS, 2001-3, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, and 2012).

From 2001 through 2013, there were 1,007 confirmed cases of occupational pesticide-related illnesses or injuries. Seventy-eight of those confirmed cases were reported in 2013.

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 used only in situations where their use was necessary.

Where activity of the exposed person was known, 37.0% 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 mixing incompatible products. The most common occupation was Building and Grounds Cleaning and Maintenance, comprising 20.5% of the confirmed cases in 2013. Of those, three-fifths were cleaners, housekeepers or maintenance workers and two-fifths were pest control operators.

From 2006 through 2013, there were 1,859 confirmed cases of non-occupational pesticide-related illnesses or injuries. Three hundred seventy-six of those confirmed cases were reported in 2013.

In 2013, disinfectants accounted for 50.0% 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, 69.2% of confirmed non-occupational cases were involved in applying the pesticide themselves. 'Bystander' exposure was also important, with 30.5% exposed inadvertently while doing normal activities, not involved in the application of pesticides.

Five events were referred to the Michigan Department of Agriculture and Rural Development (MDARD) in 2013. All of them were occupational exposures. There were two exposure events referred to the Michigan Occupational Safety and Health Administration (MIOSHA) in 2013, and four events (two occupational and two non-occupational) that met the National Institute of Occupational Safety and Health (NIOSH)'s priority reporting criteria. These reports were forwarded to the Environmental Protection Agency (EPA), the regulatory agency for pesticides registration and labeling. All these events are described on pages 17-18.

[1] In 2015 the Michigan Department of Community Health merged with the Michigan Department of Human Services and was named the Michigan Department of Health and Human Services.

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.[2]

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 (Roberts and Reigart, 2013). 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, 2007).

Pesticides are a category of chemicals that are used to kill or control insects, weeds, fungi, rodents, and microbes. There are over 16,000 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[3] 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 over 16,000 different pesticides registered for sale and use in Michigan. There are over 2,000 businesses licensed to apply pesticides and approximately 22,000 certified applicators in Michigan.

Recognizing the extent of pesticide use in Michigan, in 2001 MDHHS joined other NIOSH-funded states to institute an occupational pesticide illness and injury surveillance program. In 2006 MDHHS 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. MDHHS recognizes the need for data on pesticide exposures and adverse health effects in Michigan. 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.

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

Methods

Pesticide poisoning is reportable under the Public Health Code (Part 56 of Act 368 of 1978 as amended and R 325.71-5). These two parts of the public health code require health care providers (including Michigan's Poison Control Center), health care facilities, and employers to report information about individuals (including names) with known or suspected pesticide poisoning to the state. Originally (since 2001) MDHHS conducted occupational surveillance only. Beginning in 2006, non-occupational cases were included in the surveillance system. At that time, poison control began reporting the reason for exposure was coded "Unintentional – Environmental." To fully capture all environmental exposures, beginning in 2012 they began reporting cases with an exposure reason of "Unintentional – General", "Unintentional – Misuse" or "Unintentional – Unknown".

In addition to information from reports submitted under the Public Health Code, the surveillance system 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 coworkers and worker advocates.

The MDHHS 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 reports are not followed up on, 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 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.

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[4] http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef2003_revAPR2005.pdf page 1
[5] ibid, pages 2-3
[6] http://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sevindexv6.pdf

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, MDHHS surveillance staff provide educational consultations to reported individuals and/or their employers about reducing hazards related to pesticide exposures.

Results

Section I. All Reports

From 2001 through 2013, 2866 reports of pesticide-related illnesses and injuries met the criteria for confirmed cases. See Table 1.

Table1 : Case Confirmation by Work-Relatedness, 2001-2013

Status	Occupational	Non-Occupational	Total
Definite Case	106	29	135
Probable Case	244	304	548
Possible Case	642	1462	2104
Suspicious Case	15	64	79
Total	**1007**	**1859**	**2866**

Age is not always known. When known, persons of all ages may be exposed to pesticides. Table 3 shows the age groups for all confirmed cases.

Table 2: Confirmed Cases by Age Group & Gender, 2001-2013 and 2013 separately

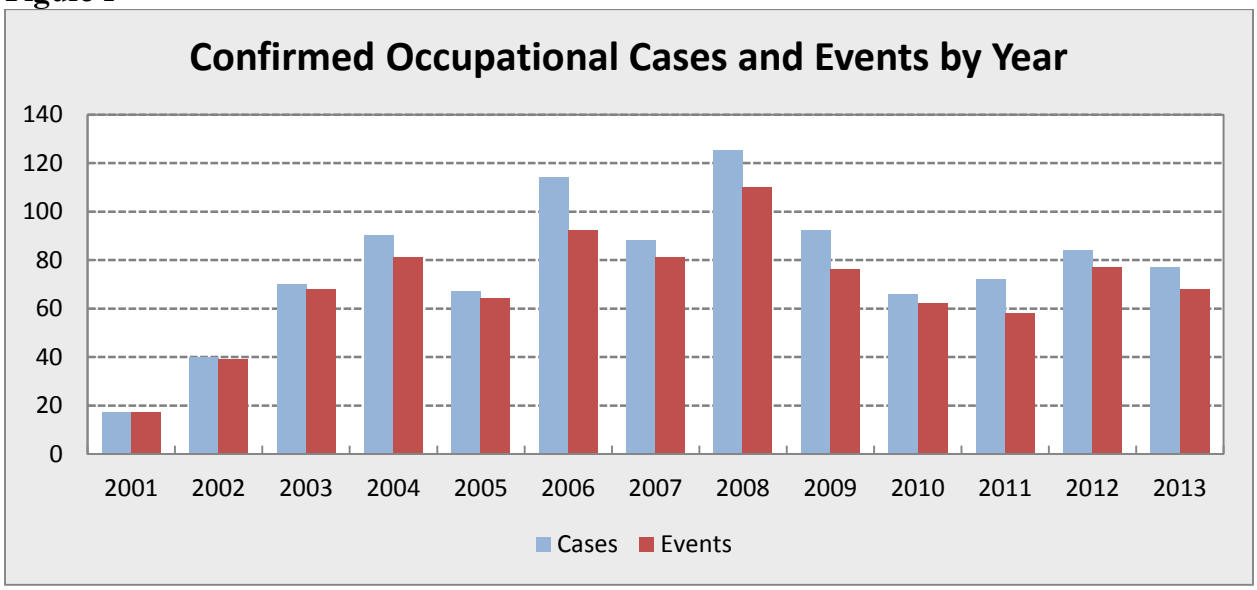
	Cumulative			2013		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
00-<1:Infants	4	11	1	1	3	0
01-02:Toddlers	22	36	0	3	15	0
03-05:PreSchool	29	39	0	5	12	0
06-11:Child	69	51	1	14	9	0
12-17:Youth	63	69	1	6	8	0
18-64:Adult	1088	997	0	168	155	0
65+:Senior	105	86	0	23	19	0
Unknown age	93	66	35	8	5	0
Total	**1473**	**1355**	**38**	**228**	**226**	**0**

A maintenance worker at a health club in his 60s checked on the pool room and discovered that the pump was leaking. He inhaled chlorine before putting on a respirator. He also got disinfectant on his hands while trying to clean it up. He developed difficulty breathing, a cough, and a sore throat. The building was evacuated and he and two members were taken to a hospital.

Section II. Occupational Pesticide Illnesses and Injuries

This section describes confirmed occupational cases only. Figure 1 shows the number of cases and events. There were 78 cases from 69 events in 2013.

Figure 1



People

Pesticide exposures occur to people of all ages. See Table 3. In 2013 men were more likely to have had an occupational exposure to pesticides than women (57.7% vs. 42.3%), and when race and ethnicity were known, most cases were white, non-Hispanic (87.1%).

Table 3: Confirmed Occupational Cases by Age Group and Gender, 2001-2013 and 2013 Separately

	Cumulative			2013		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
00-09	0	0	0	0	0	0
10-19	39	54	0	2	3	0
20-29	114	157	0	11	14	0
30-39	86	115	0	9	10	0
40-49	94	102	0	5	9	0
50-59	65	66	0	3	6	0
60-69	8	14	0	0	1	0
70-79	2	5	0	1	1	0
80+	1	0	0	0	0	0
Unknown	34	40	11	2	1	0
Total	**443**	**553**	**11**	**33**	**45**	**0**

Table 4: Confirmed Occupational Cases by Race and Ethnicity, 2001-2013 and 2013 Separately

Race	Cumulative			2013		
	Hispanic	Not Hispanic	Unknown	Hispanic	Not Hispanic	Unknown
American Indian/Alaskan	0	6	0	0	0	0
Asian/Pacific Islander	0	2	2	0	0	0
Black	0	32	25	0	3	2
White	12	349	91	0	27	7
Mixed	1	18	2	0	0	1
Other	1	0	0	1	0	0
Unknown	44	0	422	7	0	30
Total	**58**	**407**	**542**	**8**	**30**	**40**

Most (70.5%) cases in 2013 were of low severity. Twenty-one (26.9%) were moderate severity. There were two high severity cases in 2013. Both were caused by exposure to a disinfectant.

Exposures occurred to people in a wide variety of occupations working in a variety of industries. Table 5 shows the occupation of the exposed worker based on the 2002 Census Occupation Codes. In 2013, the most common occupation was 'Building and Grounds Cleaning and Maintenance' (20.5%). This included ten cleaning personnel and six pest control operators.

Table 5: Confirmed Occupational Cases by Census Occupation, 2001-2013 and 2013 Separately

Occupation	Cumulative	Percent	2013	Percent
Building and Grounds Cleaning and Maintenance	169	16.8%	16	20.5%
Farming, Forestry, and Fishing	51	5.1%	7	9.0%
Sales and Related	46	4.6%	3	3.8%
Food Preparation and Serving Related	42	4.2%	4	5.1%
Management	33	3.3%	6	7.7%
Transportation and Material Moving	31	3.1%	7	9.0%
Production	27	2.7%	5	6.4%
Office and Administrative Support	24	2.4%	5	6.4%
Healthcare Practitioners and Technical	21	2.1%	1	1.3%
Healthcare Support	21	2.1%	0	0.0%
Personal Care and Service	18	1.8%	2	2.6%
Protective Service	16	1.6%	0	0.0%
Construction and Extraction	13	1.3%	3	3.8%
Education, Training, and Library	11	1.1%	0	0.0%
Installation, Repair, and Maintenance	8	0.8%	2	2.6%
Architecture and Engineering	8	0.8%	0	0.0%
Other	8	0.8%	0	0.0%
Unknown	460	45.7%	17	21.8%
Total	1007	100.0%	78	100.0%

Table 6 below shows the industry involved in occupational cases, based on NIOSH industry sectors.[7] 'Services' includes 'Accommodation and Food Services' such as restaurants (6) and motels (2), where disinfectants are commonly used as well as 'Building Services' such as landscaping services (5) and janitorial services (2). It was the most common sector in 2013 (34.6%).

Table 6: Confirmed Occupational Cases by NIOSH Industry Sector, 2001-2013 and 2013 Separately

Industry Sector	Cumulative	Percent	2013	Percent
Agriculture, Forestry, Fishing	111	11.0%	11	14.1%
Construction	25	2.5%	5	6.4%
Healthcare & Social Assistance	134	13.3%	3	3.8%
Manufacturing	59	5.9%	13	16.7%
Public Safety	18	1.8%	0	0.0%
Services (excluding Public Safety)	391	38.8%	27	34.6%
Transportation, Warehousing, Utilities	33	3.3%	5	6.4%
Wholesale & Retail Trade	88	8.7%	5	6.4%
Unknown	148	14.7%	9	11.5%
Total	**1007**	**100.0%**	**78**	**100.0%**

Events

In 2013, when the person's activity at the time of exposure was known, most exposures (46 or 63.0%) occurred when a person was involved with pesticide application, such as mixing or applying a pesticide, cleaning or maintaining equipment, or some combination of these activities. Another 27 or 37.0% happened to bystanders who were doing routine work, not related to the application.

Table 7 shows the type of pesticide the person was exposed to. In 2013, the most common exposure was to disinfectants (56.8%), followed by insecticides (12.5%). 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 7: Confirmed Occupational Cases by Pesticide Type, 2001- 2013 and 2013 Separately

Pesticide Type	Cumulative	Percent	2013	Percent
Disinfectant	504	47.0%	50	56.8%
Insecticide	292	27.2%	11	12.5%
Herbicide	150	14.0%	8	9.1%
Other	113	10.5%	16	18.2%
Unknown	13	1.2%	3	3.4%
Total	**1072**	**100.0%**	**88**	**100.0%**

Identification of factors contributing to the exposure assists with the development of prevention strategies. Up to five contributing factors were coded for each case. In 2013, mixing incompatible products was the most common contributing factor (16.3%) for occupational pesticide cases.

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

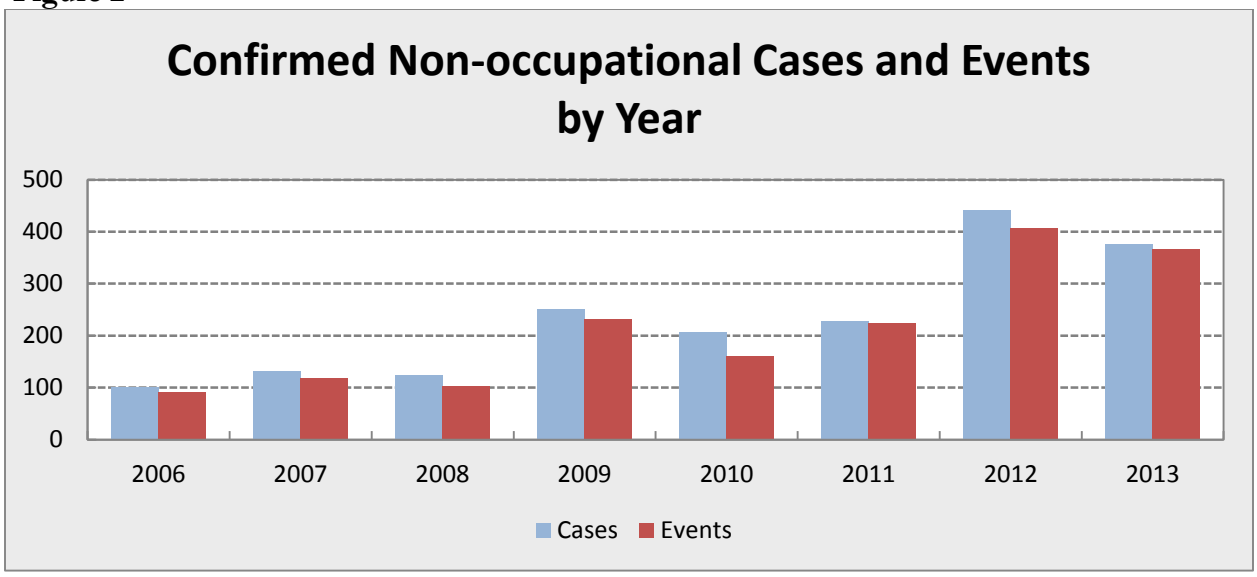
Table 8: Contributing Factors in Confirmed Occupational Cases, 2001-2013 and 2013 Separately

Contributing Factor	Cumulative	Percent	2013	Percent
Spill/Splash of liquid or dust (not equipment failure)	288	22.2%	15	14.4%
Mixing incompatible products	130	10.0%	17	16.3%
Label violations not otherwise specified	85	6.5%	5	4.8%
Application equipment failure	79	6.1%	8	7.7%
No label violation identified but person still exposed/ill	75	5.8%	5	4.8%
Required eye protection not worn or inadequate	72	5.5%	3	2.9%
Decontamination not adequate or timely	71	5.5%	5	4.8%
Drift contributory factors	65	5.0%	6	5.8%
Excessive application	59	4.5%	12	11.5%
People were in the treated area during application	38	2.9%	7	6.7%
Applicator not properly trained or supervised	32	2.5%	1	1.0%
Notification/posting lacking or ineffective	30	2.3%	6	5.8%
Required gloves not worn or inadequate	27	2.1%	1	1.0%
Structure inadequately ventilated before re-entry	19	1.5%	2	1.9%
Within reach of child or other improper storage	18	1.4%	0	0.0%
Early re-entry	15	1.2%	1	1.0%
Required respirator not worn or inadequate	11	0.8%	0	0.0%
Other required PPE not worn or inadequate	8	0.6%	0	0.0%
Intentional harm	4	0.3%	0	0.0%
Illegal pesticide used/Illegal dumping	1	0.1%	0	0.0%
Other	35	2.7%	1	1.0%
Unknown	137	10.5%	9	8.7%
Total	**1299**	**100.0%**	**104**	**100.0%**

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 MDHHS 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 were used for occupational and non-occupational cases until 2012 when three additional non-occupational exposure categories from poison control were added. There is no follow-up for additional information with non-occupational cases. There were 376 confirmed cases from 366 events in 2013, slightly fewer than 2012 but greater than preceding years (Figure 2).

Figure 2



People

> A woman in her 60s was cleaning her house with bleach and water. She said she used a "pretty strong ratio" of bleach to water. She went to sleep in the area that she had cleaned. She woke up the next morning with shortness of breath and a cough. Her symptoms worsened and she went to an emergency room three days after her initial exposure. She was admitted to the hospital with a diagnosis of pneumonitis.

Table 9 shows confirmed non-occupational cases by age and gender. In 2013 women were more likely to have a non-occupational pesticide exposure than men (51.9% vs 48.1%). Race and ethnicity information is rarely available for non-occupational cases.

Table 9: Confirmed Non-occupational Cases by Age Group and Gender, 2006-2013 and 2013 Separately

	Cumulative			2013		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
00-<1:Infants	4	11	1	1	3	0
01-02:Toddlers	22	36	0	3	15	0
03-05:PreSchool	29	39	0	5	12	0
06-11:Child	69	50	1	14	9	0
12-17:Youth	49	49	1	6	8	0
18-64:Adult	697	515	0	138	112	0
65+:Senior	101	76	0	22	18	0
Unknown age	59	26	24	6	4	0
Total	**1030**	**802**	**27**	**195**	**181**	**0**

Most (67.8%) cases in 2013 were of low severity. An additional 28.7% were moderate severity. There were 13 (3.5%) high severity cases in 2013. Eleven were caused by exposure to a disinfectant and two by insecticides.

Events

In 2013, when the person's activity at the time of exposure was known, most exposures (256 or 69.2%) occurred when a person was involved with a pesticide application, such as mixing or applying a pesticide, disposing of a pesticide, or some combination of these activities. Another 114 or 30.8% happened to bystanders.

Table 10 shows the type of pesticide the person was exposed to. 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 2013, the most common exposure for non-occupational cases was to disinfectants (50.0%), followed by insecticides (23.7%).

Table 10: Confirmed Non-occupational Cases by Pesticide Type, 2006-2013 and 2013 Separately

Pesticide Type	**Cumulative**	**Percent**	**2013**	**Percent**
Disinfectant	814	41.6%	198	50.0%
Insecticide	612	31.3%	94	23.7%
Insect Repellent	164	8.4%	42	10.6%
Herbicide	143	7.3%	22	5.6%
Insecticide and Other	88	4.5%	16	4.0%
Fungicide	21	1.1%	1	0.3%
Rodenticide	17	0.9%	3	0.8%
Other	51	2.6%	10	2.5%
Multiple (not specified)	24	1.2%	1	0.3%
Unknown	21	1.1%	9	2.3%
Total	**1955**	**100.0%**	**396**	**100.0%**

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 22: Contributing Factors in Confirmed Non-occupational Cases, 2006-2013 and 2013 Separately

Contributing Factor	Cumulative	Percent	2013	Percent
Mixing incompatible products	324	15.3%	83	19.6%
Label violations not otherwise specified	290	13.7%	48	11.3%
Excessive application	204	9.6%	34	8.0%
Spill/Splash of liquid or dust (not equipment failure)	203	9.6%	49	11.6%
No label violation identified but person still exposed/ill	152	7.2%	17	4.0%
Within reach of child or other improper storage	129	6.1%	35	8.3%
Drift contributory factors	93	4.4%	7	1.7%
People were in the treated area during application	80	3.8%	14	3.3%
Decontamination not adequate or timely	71	3.4%	26	6.1%
Structure inadequately ventilated before re-entry	67	3.2%	7	1.7%
Early re-entry	49	2.3%	13	3.1%
Notification/posting lacking or ineffective	39	1.8%	6	1.4%
Application equipment failure	30	1.4%	4	0.9%
Required gloves not worn or inadequate	11	0.5%	3	0.7%
Required eye protection not worn or inadequate	10	0.5%	3	0.7%
Applicator not properly trained or supervised	8	0.4%	2	0.5%
Other	51	2.4%	7	1.7%
Unknown	305	14.4%	65	15.4%
Total	**2116**	**100.0%**	**423**	**100.0%**

A man in his 40s was spraying an insecticide (signal word: Caution) in a closed room. He was in the room for a few minutes and began to feel short of breath, was dizzy, nauseated, and vomited. He had chest tightness and a sore throat as well. He went to an emergency department. He was tachycardic and tachypneic. He was decontaminated and his signs and symptoms improved.

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 2013:

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

- The MDHHS Pesticide Information webpage provided links to all previous annual reports, a pesticide education booklet, "What You Need to Know about Pesticides and Your Health", several fact sheets, and over 100 other sites with information about pesticides and their safe use.

- New fact sheets on home pesticide and disinfectant safety and on pool chemical safety were developed and added to the web page.

- A press release was about recreational water safety was provided to the MDHHS communications officer for release before the Memorial Day weekend.

- Safety information was sent to cases and employers.

A recycling center worker in his 20s was exposed to insecticide dust when packing a bag into tote to send to hazardous waste. He developed a stomach ache, nausea and diarrhea. This was not a confirmed case because the exact insecticide was not identified. Nonetheless, the recycling center was contacted and given safety information and resources.

- MDHHS staff participated with the Michigan Primary Care Association's Migrant Health Network. Letters with information about pesticide safety and reporting were sent to the community health centers that care for migrant farmworkers in Michigan.

- MDHHS 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.

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

- MDHHS staff coauthored an article with NIOSH and other states about the characteristics and magnitude of acute pyrethrin and pyrethroid exposures. (Hudson et al, 2013).

- MDHHS staff coauthored an article with NIOSH and other states about acute illnesses associated with the use of pest strips. (Tsai et al, 2014)

- One event was 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.

MDARD Referrals
Five events were referred to MDARD in 2013. All of them were occupational exposures.

- MI03337 – A customer service call center employee in his 20s was present when chairs were sprayed with alcohol to kill bed bugs. He became dizzy, developed chest and stomach pains, eye irritation, and difficulty breathing. He called poison control and used his inhalers. This case was referred to MDARD, which issued a warning letter to the application firm for not being licensed and not using certified applicators.

- MI03490 – A farmworker was cleaning grapevines in a field while another field about 50 feet away was being sprayed with a fungicide (signal word: Caution). He developed shortness of breath and later that night had diarrhea. He called poison control. The case was referred to MDARD. They were unable to prove or disprove that a worker exposure to pesticides occurred, but did initiate regulatory action against the farm to bring the farm into compliance with the Worker Protection Standards.

- MI03624 – A worker sprayed for bugs with an insecticide (signal word: Caution) in a motel, and some sprayed back in and around his eyes. His eyes and skin were irritated. He called poison control. This case was referred to MDARD.

- MI03695-98 – Four workers in a greenhouse were exposed to a fungicide (signal word: Caution), which was sprayed while they were picking cucumbers. They developed nausea, vomiting, headache, and/or difficulty breathing. EMS was called and they were taken to an emergency department. This case was referred to MDARD and they initiated regulatory action for violations including: having workers in the area before the greenhouse was ventilated or the restricted entry interval expired; not keeping workers out of areas during an application; not training workers; not notifying workers of a pesticide application; and not posting pesticide information.

- MI03731 – A maintenance company laborer in his teens sprayed an herbicide (Signal word: Caution) on the grounds of a shopping mall. The wind picked up and blew the herbicide into his mouth and eyes. He developed shortness of breath, chest tightness, burning eyes and blurry vision. He went to an emergency department. This case was referred to MDARD and they initiated regulatory action for violations including having an uncertified applicator making an application, failure of the applicator to wear PPE, record keeping violations, and not having a business license to apply pesticides.

MIOSHA Referrals
There were two exposure events referred to MIOSHA in 2013.

- MI03421 – A manager of a racquet club in his 40s was replacing some tubing from a chlorine tank to a pump when a valve broke. He was wearing PPE, but some chlorine leaked into his glove as he tried to prevent the leak while waiting about 20 minutes for responders. He developed first and second degree burns and went to an urgent care center. The incident was referred to MIOSHA. The MIOSHA investigation found seven serious and one 'other' violation. The racquet club was fined $6,500.

- MI03675-80 – In August 2013 the chlorine dioxide levels in a machine that washed empty cans in a fruit processing plant were elevated. EMS was called and 6 people were taken to an emergency department with shortness of breath, cough, eye irritation, and/or high blood pressure. The incident was referred to MIOSHA which investigated and found one serious violation. The company was fined $1,000.

NIOSH Reports

In 2013 four events (two occupational and two non-occupational) met NIOSH's priority reporting criteria. These reports were forwarded to EPA, the regulatory agency for pesticides registration and labeling.

These events were reported because four or more persons became ill.

- MI03412-15 – A family of four moved into a new home. They all developed headaches, stuffiness, nasal irritation, and decreased appetite. The two children also developed diarrhea. After a week they found and discarded a package of moth balls. The smell was still in the home when they called poison control nine days after they moved. They left the house and felt better, but symptoms returned when they returned to the house. Two days later the family reported back to poison control that they ventilated the house for 36 hours. The smell was gone and they were feeling better.

- MI03675-80 – This event was referred to NIOSH as well as MIOSHA (see above).

- MI03695-98 – This event was referred to NIOSH as well as MDARD (see above).

This event was reported because the product was used according to the label but the person became ill.

- MI03483 – An adult male used an herbicide (signal word: Caution) in his yard without gloves, but did use a scoop to distribute. Gloves were not required. He immediately washed hands following the application but may have touched some of the treated plants. His right forearm became itchy and he developed blisters on it.

Waterborne Illness Reports to the National Outbreak Reporting System (NORS)

- MI03508-9 – Two people were in a hotel hot tub and had symptoms of itchy, burning skin, and shortness of breath.

Discussion

Surveillance Data
There were fewer confirmed acute pesticide poisonings in 2013 than in 2012; 78 vs. 85 occupational cases and 376 vs. 441 non-occupational cases.

The number and proportion of cases related to disinfectant exposures remained high and continues to be an area of ongoing concern. In 2013, 50 (57.5%) occupational cases and 198 (50%) of non-occupational cases were exposed to a disinfectant. The widespread use of disinfectants in homes, schools, and other non-healthcare locations continues to be promoted although there is no clear evidence that this prevents infectious diseases more effectively than simple hand washing. Evidence-based recommendations are needed regarding the use of cleaning agents, particularly disinfectants. Education is needed to provide guidance about how to clean, when disinfectants/pesticides are recommended, and how to use them properly.

When looking at factors contributing to the pesticide exposure, mixing incompatible products was the most common factor for confirmed occupational cases (16.3%), followed by spills and splashes (14.4 %) and excessive application (11.5%). The most common factors contributing to non-occupational exposures were similar, with mixing incompatible products (19.6%) as the leading cause, followed by spills and splashes (11.6%) and label violations not otherwise specified, for example spraying into the wind, (11.3%). Better education and labeling might help to reduce the number of exposures.

Almost a third of all (occupational and non-occupational) confirmed cases in 2013 were "bystanders", i.e., engaged in work or living activities not related to the pesticide application. Better education on safe pesticide application is needed to prevent inadvertent exposures.

Interventions
MDHHS continued to refer cases to MDARD and MIOSHA for investigation of possible safety violations. MDHHS also notified NIOSH of events that met the criteria for high priority reporting. These reports are forwarded to the EPA and are considered during re-registration evaluations. MDHHS also worked to improve pesticide education for individuals, employers, health care providers, and other stakeholder groups through the distribution of fact sheets and through presentations listed in the results section.

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, 2009).

More outreach is needed to educate health care providers on the importance of recognizing and reporting instances of occupational pesticide illnesses and injuries. Over 50% of confirmed occupational cases in 2013 were reported by the State's poison control center, and over 60% of the non-occupational cases were reported by poison control.

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, more than doubling the cases evaluated.

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Additional Resources

MDHHS 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, Sixth Edition:
http://www2.epa.gov/pesticide-worker-safety/recognition-and-management-pesticide-poisonings

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

Appendix

Case Narratives, 2013 Confirmed Occupational Cases

Below are descriptions of the confirmed occupational cases reported in 2013. 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 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/insect repellents

MI03312 – A general manager at a railroad company was called (see MI03313) in to work because of a smell coming from a rail car. She saw the HazMat placard and left, but inhaled organophosphorous insecticide leaking from improperly sealed gaskets. Her eyes, nose, and lungs were irritated; she had difficulty breathing; and was dizzy. She was transported by ambulance to an emergency room. MIOSHA investigated that day. (Event MI02927)

MI03313 – A worker at a railroad company was doing an inventory of containers and noted a strong smell from an empty car that had had an organophophorous insecticide in it. She left the area and called in her supervisor. Her eyes and nose were irritated, she had difficulty breathing, and was dizzy. She was transported by ambulance to an emergency room. MIOSHA investigated that day. (Event MI02927)

MI03337 – A customer service call center employee in his 20s was present when chairs were sprayed with alcohol to kill bed bugs. He became dizzy, developed chest and stomach pains, eye irritation, and difficulty breathing. He called poison control and used his inhalers. This case was referred to MDARD, which issued a warning letter to the application firm for not being licensed and not using certified applicators.

MI3348 – A greenhouse employee in her 40s was exposed to an insecticide (signal word: Warning). She developed a red, irritated, rash on her arms and poison control was called.

MI03449 – A worker in his 30s for a State agency inhaled some insect repellent (signal word: Caution) he was spraying at a campground. He had a persistent bad taste in his mouth, a burning sensation in his nose, and a stomach ache. He called poison control.

MI03624 – A worker sprayed for bugs with an insecticide (signal word: Caution) in a motel and some sprayed back in and around his eyes. His eyes and skin were irritated. He called poison control.

MI03693 – A bank worker in her 20s was exposed to an insecticide fogger (signal word: Caution) set off in an adjacent room. The door was closed, but the ventilation system was on. She developed a headache and sore throat and called poison control.

MI03714 – A repair technician in his 30s was inspecting a furnace in a motor home where three total release foggers had been set off just before his arrival. He began to feel "woozy" and developed a cough, shortness of breath, nausea, vomiting, and a headache. He went to an emergency department the next day.

MI03715 – An auto parts store salesperson in his teens was spraying an insecticide (signal word: Caution) for spiders. The hose came out of the bottle and insecticide blew back into his eyes and on his arms. He developed eye irritation, itchy arms, nausea, throat and nose irritation and shortness of breath. He called poison control and went to an emergency department the next day.

Herbicides

MI03333 – A landscape worker in his 20s poured an herbicide (signal word: Caution) into a hopper. The wind picked up and powder blew into his face. He developed shortness of breath, nausea, vomiting, numbness, and muscle twitching. He called an ambulance which took him to an emergency department.

MI03423 – The owner of a lawn care and snow removal company in his 20s was spraying with two herbicides. He wore all the required PPE and also wore an organic vapor respirator, which was not required. He could smell the herbicides and developed a cough which lasted about two months, sinusitis, headache, nausea, vomiting, muscle twitches in his face, and a metallic taste in his mouth. He called poison control and went to an urgent care center.

MI03520 – A farmer in his 70s used an herbicide (signal word: Caution). He developed a cough and sore throat. He called poison control and went to his doctor.

MI03616 – A groundskeeper for a landscaping company in his 30s was spraying an herbicide (signal word: Caution) when a cracked lid resulted in some of the herbicide being splashed in his face and up his nose. He developed a red, irritated, nose and went to an emergency department the next day.

MI03631 – A ditch digger in his 20s used an herbicide to kill weeds on a front lawn before installing a sprinkler system. He got herbicide on his hands when he was refilling the sprayer and did not wash his hands. He lost his appetite and developed nausea, diarrhea, stomach ache, vomiting, headache, and a fever. He called poison control.

MI03690 – An applicator for a lawn care service in his 20s was spraying an herbicide (signal word: Caution). The hose came off and herbicide sprayed in his face. He was wearing sunglasses, but herbicide got in his eyes. He rinsed his eyes on site for five minutes with bottled water. His eyes were burning, red, and tearing. He went to an eye doctor the next day.

MI03708 – A landscape worker in his 50s had skin exposure to an herbicide that a co-worker had mixed incorrectly to make it stronger than recommended. He had given his mask and gloves to the coworker. His hands were red, swollen, and painful. He felt tired and had swollen lymph nodes. He called poison control.