Pesticide Illness and Injury Surveillance in Michigan 2023

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Pesticide Illness and Injury Surveillance in Michigan: 2023

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Summary

Michigan has been conducting surveillance for acute work-related pesticide illnesses and injuries since 2001. In 2006, data on non-occupational cases were added. The Public Health Code grants Michigan the authority to track work-related conditions (PA 368 of 1978, Part 56, as amended) and chemical poisoning (R325.71-R325.75). This is the nineteenth report on pesticide-related illnesses and injuries in Michigan (2001-3, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015-16, 2017-18, 2019, 2020, 2021, 2022). These 19 reports include 23 years of data.

From 2001 through 2023 there were 1,605 confirmed cases of occupational pesticide-related illnesses or injuries. Seventy of those confirmed cases were reported in 2023. The number of reported cases peaked in 2008. Disinfectants were the cause of nearly half (46%) of the confirmed occupational cases from 2001-2023 and were the cause of 31% of confirmed occupational cases in 2023. Many of these cases would not have occurred if disinfectant containers were properly labeled, not mixed, and used only in situations where their use was recommended.

In 2023, where activity of the exposed person was known, 46% of confirmed occupational cases were exposed to pesticides inadvertently while doing their regular work that did not involve applying pesticides. The two most common contributing factors for confirmed occupational cases were spills or splashes and mixing incompatible products. When occupation was known, the most common occupations were sales and office, farming, and management, professional, and related occupations, each comprising 11% of the confirmed cases in 2023.

From 2006 through 2023, there were 3,059 confirmed cases of non-occupational pesticide-related illnesses or injuries. One hundred and seven of those confirmed cases were reported in 2023.

In 2023, disinfectants accounted for 60% of confirmed non-occupational cases while insecticides accounted for 14%.

In 2023, where activity of the exposed person was known, 70% of confirmed non-occupational cases occurred when the person involved was applying the pesticide themselves. ‘Bystander’ exposure was also important, with 27% of cases involving being exposed inadvertently while doing activities not involved in the application of a pesticide.

Background

Pesticide poisoning is a potential public health threat due to widespread pesticide use. According to the U.S. Environmental Protection Agency (EPA), more than 1.1 billion pounds of conventional (non-disinfectant) pesticides were used in the United States in 2012, the last year of published data (Atwood and Paisley-Jones, 2017).

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.

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

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).

Acting on concerns about acute occupational pesticide-related illness, NIOSH began collecting standardized information about acute occupational pesticide exposure from selected states in 1998 (Centers for Disease Control and Prevention (CDC), 2017) 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 a major industry in Michigan with 45,581 farms, 82,548 farm producers and 68,950 hired workers. Hired workers include full time and migrant workers (US Department of Agriculture, 2022). There are 16,069 different pesticide products registered for sale and use in Michigan (MDARD, 2023). There are 6,006 privately certified agricultural pesticide applicators (number overlaps with farm operators/workers above), another 13,870 commercially certified applicators, 1,622 registered applicators and 1,696 businesses licensed to apply pesticides in Michigan (MDARD, 2022; MDARD 2023).

Recognizing the extent of pesticide use in Michigan, in 2001 Michigan joined other NIOSH-funded states to institute an occupational pesticide illness and injury surveillance program. In 2006, non-occupational pesticide exposures were added to the surveillance program. 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; and
- Identify and refer cases to regulatory agencies for interventions.

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 Center and Michigan's emergency medical service response database), health care facilities, and employers to report to the state information about individuals (including names) with known or suspected pesticide poisoning. From 2001-2006 Michigan only conducted occupational pesticide illness and injury surveillance. Beginning in 2006, non-occupational cases were included in the surveillance system. At that time, the poison center began reporting cases in which the reason for exposure was coded "Unintentional – Environmental". To fully capture all environmental exposures, beginning in 2012 reporting included the exposure reasons of "Unintentional – General", "Unintentional – Misuse", and "Unintentional – Unknown". Due to limited resources, from 2014 onward, non-occupational cases were only included in the surveillance system if care from a medical provider was obtained.

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 the Michigan Department of Agriculture and Rural Development (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 pesticide poisoning surveillance system is a case-based system. A person who has been exposed to a known pesticide and develops two or more signs or symptoms after that exposure, that could be related to the exposure based on known toxicology, is considered a confirmed case. See Appendix I for more details of the case definition. An event is the incident where the case was exposed. More than one person may be exposed at an event. Data are collected according to standardized variable definitions in a database developed for NIOSH's SENSOR-Pesticide program.

Reported occupational cases are interviewed to determine the circumstances of the reported 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 interviewed, 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. All cases are classified as either definite, probable, possible, suspicious, unlikely, insufficient information, exposed but asymptomatic, or unrelated (Appendix I). Cases classified as definite, probable, possible, or suspicious (DPPS) are considered confirmed and included in all data analyses.

Confirmed cases are evaluated regarding the severity of the health effect: low; moderate; high; or 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 (CDC, 2001). See Appendix I for more details on the severity categories.

Occupation and industry were coded using the 2002 Census Industry Codes and the 2002 Census Occupation Codes. Industry was then grouped into the NIOSH industry sectors (CDC, 2013).

Practices where workers or the public may be at risk were identified. When appropriate, referrals were made to either the Michigan Occupational Safety and Health Administration (MIOSHA) (LEO) or MDARD, which have regulatory responsibility for worker health and/or pesticide use.

MIOSHA enforces state and federal workplace standards on exposure limits, education, and personal protective equipment (PPE) and performs training in safety and health in construction and general industry. MDARD enforces state and federal legal requirements for the sale and use of pesticides, including label violations and instances of human exposure and the federal EPA's Worker Protection Standard, which includes requirements to protect agricultural workers from adverse health effects of pesticides.

In addition, NIOSH was provided information about high priority events, both occupational and non-occupational. The criteria for defining high priority events were:

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.

NIOSH referred cases to the EPA as needed, identified clusters across states, and identified the need for national level interventions.

Finally, if appropriate, Michigan surveillance staff provided educational consultations to reported individuals and/or their employers about reducing hazards related to pesticide exposures.

Results

Section I. All Reports

From 2001 through 2023, 4,664 individuals with reported pesticide exposure and related illnesses and/or injuries met the criteria for confirmed cases. Approximately one-third of those cases were work-related (Table 1).

Table 1: Case Confirmation by Work-Relatedness, 2001-2023

Status	Occupational	Non-Occupational	Total
Definite Case	224	208	432
Probable Case	320	597	917
Possible Case	1033	2187	3220
Suspicious Case	28	67	95
Total	**1605**	**3059**	**4664**

Males and females of all ages were exposed to pesticides in confirmed cases (Table 2).

Table 2: Confirmed Cases by Age Group & Gender, 2001-2023 and 2023 Separately

	Cumulative			2023		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
<1 (Infants)	11	15	1	2	0	0
01-02 (Toddlers)	55	79	0	3	8	0
03-05 (Preschool)	39	64	0	2	1	0
06-11 (Child)	96	64	0	1	1	0
12-17 (Youth)	89	96	1	2	2	0
18-64 (Adult)	1798	1657	0	69	70	0
65+ (Senior)	184	187	0	6	10	0
Unknown age	111	74	43	1	0	0
Total	**2383**	**2236**	**45**	**86**	**92**	**0**

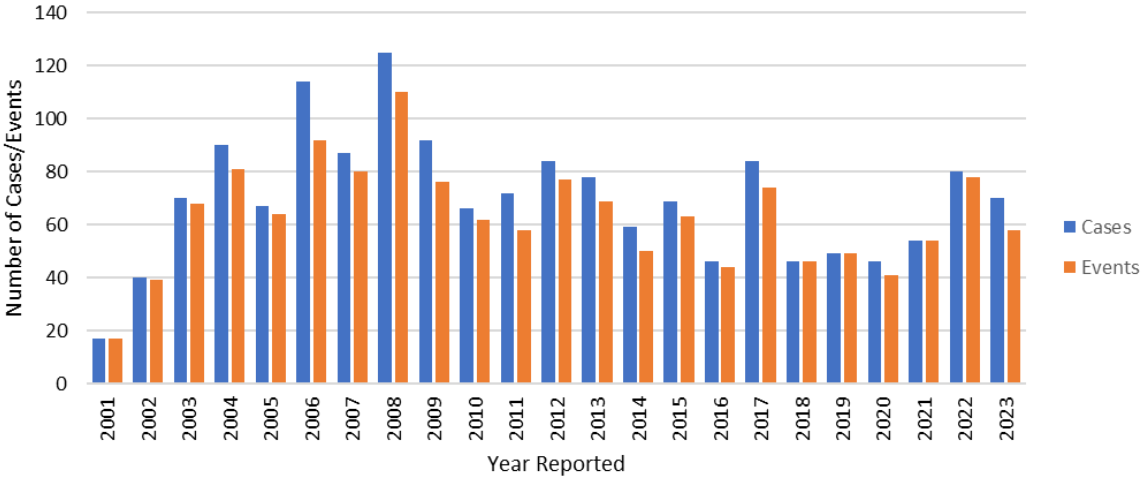
A male in his 20s was working as a cultivation manager of a cannabis growing company when he was filling a paint sprayer used to apply pesticides. The paint sprayer was on auto spray and the bactericide and fungicide splashed into his eye. His eye developed redness, irritation, excessive tearing, bradycardia, and his vision was blurred. He called the poison center and then sought medical attention at an emergency department where they prescribed him an antibacterial medication.

A female in her 20s was trying to remove a hair dye stain from the bathtub first with acetone and then with bleach without rinsing in between. She remained in the bathroom despite the fumes because she didn't want her roommates to see the stain. She developed shortness of breath, nausea, a scratchy throat, lightheadedness, a headache, and hypertension. She called EMS who transported her to the emergency department.

Section II. Occupational Pesticide Illnesses and Injuries

This section describes 1,605 confirmed occupational cases. In 2023, there were 70 cases from 58 events (Figure 1).

Figure 1: Confirmed Occupational Cases and Events by Year



People

Occupational pesticide cases occur in people of a wide variety of ages. In 2023, men (58.6%) were more likely to be confirmed occupational cases than women (41.4%) (Table 3).

Table 3: Confirmed Occupational Cases by Age Group & Gender, 2001-2023 & 2023 Separately

	Cumulative			2023		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
00-09	0	0	0	0	0	0
10-19	51	76	0	1	1	0
20-29	205	275	0	8	17	0
30-39	143	174	0	10	8	0
40-49	129	158	0	4	7	0
50-59	117	107	0	3	4	0
60-69	31	32	0	2	3	0
70-79	2	9	0	0	1	0
80+	0	0	0	0	0	0
Unknown	41	42	13	1	0	0
Total	**719**	**873**	**13**	**29**	**41**	**0**

In 2023, race was known for 72.9% of cases. When race was known, 72.5% were white and 21.6% were black. In 2023, ethnicity was known in 57.1% of the cases. When known, 92.5% were non-Hispanic while 7.5% were Hispanic (Table 4).

Table 4: Confirmed Occupational Cases by Race and Ethnicity, 2001-2023 and 2023 Separately

	Cumulative			2023		
Race	Hispanic	Not Hispanic	Unknown	Hispanic	Not Hispanic	Unknown
Indigenous American	0	8	0	0	1	0
Asian/Pacific Islander	0	3	4	0	0	1
Black	0	75	40	0	7	4
White	29	575	134	2	29	6
Mixed	3	25	2	0	0	0
Other	6	0	2	0	0	1
Unknown	62	0	637	1	0	18
Total	**100**	**686**	**819**	**3**	**37**	**30**

Confirmed cases were identified in a wide variety of occupations. In 2023, the most common occupations were sales and office, farming, and management, professional, and related each with six cases (Table 5). Cleaners/housekeepers/janitors, food preparation and service, lawn service, and construction each had five cases. These seven categories accounted for two thirds (66.7%) of cases where the occupation was known.

Table 5: Confirmed Occupational Cases by Occupation, 2001-2023 and 2023 Separately

	Cumulative		2023	
Occupation	Count	Percent	Count	Percent
Cleaners/Housekeepers/Janitors	187	11.7%	5	7.1%
Farming	102	6.4%	6	8.6%
Sales and Office	102	6.4%	6	8.6%
Production and Transportation	98	6.1%	4	5.7%
Management, Professional, and Related	91	5.7%	6	8.6%
Healthcare	83	5.2%	4	5.7%
Food Preparation and Service	79	4.9%	5	7.1%
Groundskeepers/Lawn Service	71	4.4%	5	7.1%
Pest Control Operators	71	4.4%	4	5.7%
Construction	35	2.2%	5	7.1%
Protective Services	35	2.2%	3	4.3%
Personal Care and Service	33	2.1%	2	2.9%
Installation, Maintenance, and Repair	17	1.1%	2	2.9%
Military	2	0.1%	0	0.0%
Unknown	599	37.3%	13	18.6%
Total	**1605**	**100.0%**	**70**	**100.0%**

Confirmed cases were identified in a wide variety of industries. 'Services' includes 'accommodation and food services' as well as 'building services' and was the most common sector in 2023, followed by healthcare and social assistance (Table 6).

Table 6: Confirmed Occupational Cases by Industry Sector, 2001-2023 and 2023 Separately

	Cumulative		2023	
Industry Sector	**Count**	**Percent**	**Count**	**Percent**
Services (excluding Public Safety)	598	37.3%	21	30.0%
Healthcare & Social Assistance	226	14.1%	9	12.9%
Agriculture, Forestry, Fishing	174	10.8%	7	10.0%
Wholesale & Retail Trade	121	7.5%	4	5.7%
Manufacturing	92	5.7%	4	5.7%
Construction	52	3.2%	7	10.0%
Transportation, Warehousing, Utilities	48	3.0%	3	4.3%
Public Safety	33	2.1%	5	7.1%
Unknown	261	16.3%	10	14.3%
Total	**1605**	**100.0%**	**70**	**100.0%**

Most (52.9%) cases in 2023 were of low severity, 45.7% were moderate severity, and 1.4% were high severity.

A male in his 40s was working for an electric services company when he was inside a house that was infected with bed bugs. He set off a bed bug fogger in an enclosed tent to get the bed bugs off himself and his clothing. He developed a cough, shortness of breath, and skin irritation. He sought medical attention at an employee health clinic and when symptoms did not subside, he sought care in the emergency department where they consulted with the poison center.

Events

In 2023, when the person's activity at the time of exposure was known, a similar percentage of cases occurred when the person was conducting routine work not involved with the application (46.3%) and when the person was involved with pesticide application (44.8%), such as mixing or applying a pesticide, transport or disposal of a pesticide, or some combination of these activities.

A female in her 20s was working as a sales associate in a zoo when a co-worker who was unaware of her bleach allergy brought bleach from home to disinfect at work. She inhaled the bleach fumes in the work office and developed shortness of breath, chest tightness, light headedness, and nasal congestion. She called EMS who transported her to the emergency department.

In 2023, the most common pesticide exposure resulting in a case was to disinfectants (31.0%), followed by insecticides (25.3%) (Table 7). In Table 7, some products contain more than one type of pesticide and some cases involved more than one product, so the number of types listed is greater than the number of cases.

Table 7: Confirmed Occupational Cases by Pesticide Type, 2001- 2023 and 2023 Separately

	Cumulative		2023	
Pesticide Type	**Count**	**Percent**	**Count**	**Percent**
Disinfectant	812	46.3%	27	31.0%
Insecticide	413	23.5%	22	25.3%
Herbicide	207	11.8%	6	6.9%
Fungicide	57	3.2%	3	3.5%
Multiple types	68	3.9%	4	4.6%
Other	90	5.1%	2	2.3%
Unknown	108	6.2%	23	26.4%
Total	**1755**	**100.0%**	**87**	**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 2023, spill/splash of liquid or dust and mixing incompatible products were the most common contributing factors for occupational pesticide cases (Table 8).

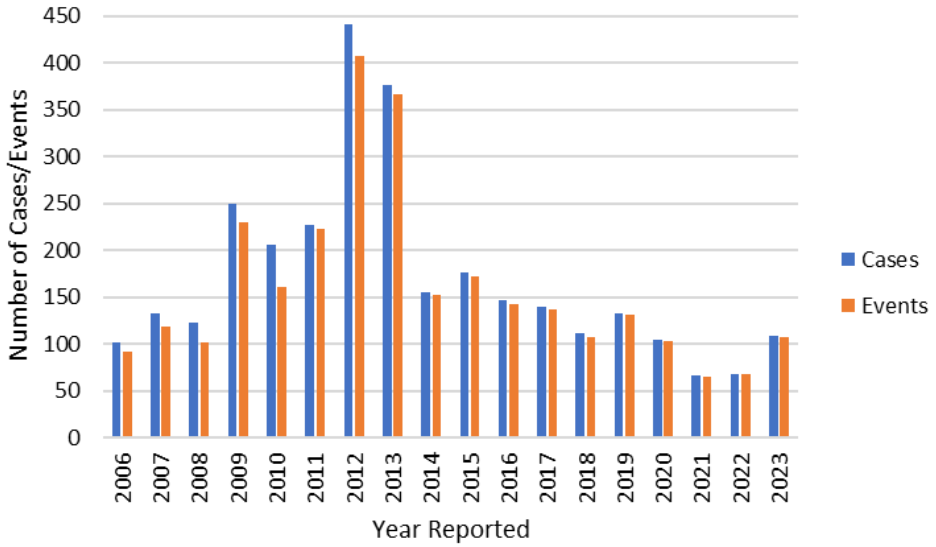
Table 8: Contributing Factors in Confirmed Occupational Cases, 2001-2023 & 2023 Separately

	Cumulative		2023	
Contributing Factor	**Cumulative**	**Percent**	**2023**	**Percent**
Spill/Splash of liquid or dust (not equipment failure)	428	21.0%	11	14.9%
Mixing incompatible products	226	11.1%	11	14.9%
Label violations not specified	135	6.6%	1	1.4%
No label violation identified but person still exposed/ill	128	6.3%	9	12.2%
Required eye protection not worn or inadequate	116	5.7%	2	2.7%
Excessive application	112	5.5%	4	5.4%
Application equipment failure	110	5.4%	2	2.7%
Decontamination not adequate or timely	106	5.2%	0	0.0%
Drift contributory factors	88	4.3%	3	4.1%
People were in the treated area during application	61	3.0%	9	12.2%
Required gloves not worn or inadequate	52	2.5%	3	4.1%
Notification/posting lacking or ineffective	49	2.4%	4	5.4%
Applicator not properly trained or supervised	45	2.2%	2	2.7%
Structure inadequately ventilated before re-entry	32	1.6%	1	1.4%
Early re-entry	30	1.5%	3	4.1%
Within reach of child or other improper storage	30	1.5%	1	1.4%
Required respirator not worn or inadequate	26	1.3%	2	2.7%
Other required PPE not worn or inadequate	13	0.6%	0	0.0%
Intentional harm	2	0.1%	0	0.0%
Illegal pesticide used/Illegal dumping	1	0.0%	0	0.0%
Other	78	3.8%	6	8.1%
Unknown	173	8.5%	0	0.0%
Total	**2041**	**100.0%**	**74**	**100.0%**

Section III. Non-occupational Pesticide Illnesses and Injuries

To provide a more complete characterization of the impact of pesticide use in Michigan, the pesticide surveillance program began collecting information about non-occupational exposures in 2006. The same case definition and report sources were used for occupational and non-occupational cases. In 2012, three additional non-occupational exposure categories from the poison center were added, but in 2014, because of limited resources, data entry was limited to cases who visited a health care provider, excluding non-occupational cases whose only medical contact was to call the poison center. There were 108 confirmed cases from 107 events entered into the database in 2023 (Figure 2). There were another 91 adults and 5 children (< 6 years of age) with confirmed non-occupational cases who had called the poison center with two or more symptoms and the pesticide was known but had not seen a provider and are therefore not included in this report. Suicide attempts using pesticides are also excluded from this report. There is no follow-up to collect additional information from non-occupational cases, so some cases may have been missed because we did not know there was more than one sign or symptom or because we did not identify the pesticide (both required for non-occupational case confirmation).

Figure 2: Confirmed Non-occupational Cases and Events by Year



A female in her 80s set off a bug fogger in her home. It tipped over and when she went to pick it up, she inhaled the fumes. She developed a cough, pain with breathing, and a sore throat. When symptoms continued the next morning, she went to the emergency department where they consulted with the poison center.

A male in his 50s was disinfecting his bathtub at home with bleach and then with an acid-based disinfectant. He developed shortness of breath, a cough, wheezing, and irritation to his lungs. He called EMS who transported him to the emergency department.

People

Non-occupational pesticide cases occurred among people of all ages. In 2023, females (52.8%) were slightly more likely than males (47.2%) to be exposed as a non-occupational pesticide case (Table 9). In 2023, race was known for 64.8% of cases. When race was known, 55.7% were white and 41.4% were black. Data regarding ethnicity were missing for 70.4% of non-occupational cases in 2023.

Table 9: Confirmed Non-occupational Cases by Age Group & Gender, 2006-2023 & 2023 Separately

	Cumulative			2023		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
<1 (Infants)	11	15	1	2	0	0
01-02 (Toddlers)	55	79	0	3	8	0
03-05 (Preschool)	39	64	0	2	1	0
06-11 (Child)	96	64	0	1	1	0
12-17 (Youth)	78	74	1	2	2	0
18-64 (Adult)	1140	869	0	42	31	0
65+ (Senior)	175	166	0	5	8	0
Unknown age	70	32	30	0	0	0
Total	**1664**	**1363**	**32**	**57**	**51**	**0**

Most (n=63; 58.3%) non-occupational cases in 2023 were of moderate severity and 45 (41.7%) were low severity. No cases were of high severity in 2023.

A male in his 60s was disinfecting at home when he mixed bleach and vinegar. He developed difficulty breathing and a cough. He called EMS who transported him to the emergency department.

Events

In 2023, most cases (71.3%) occurred when a person was involved with a pesticide application, such as mixing or applying a pesticide, transport or disposal of a pesticide, or some combination of these activities. Another 26.9% happened to bystanders and for 1.8% activity was unknown at the time of exposure.

A male in his 20s experienced a sewage leak in the basement of his rental home. The landlord sent someone to clean the spill and they mixed bleach with an ammonia-based disinfectant. He was exposed to the fumes for about 8 hours and developed a burning sensation to his eye, nose, throat, and lungs. He called EMS who transported him to the emergency department.

In 2023, the most common pesticide case was to disinfectants and insecticides (59.5% and 14.3%, respectively) (Table 10). In Table 10, some products contain more than one type of pesticide and some cases involved more than one product, so the number of types listed is greater than the number of cases.

Table 10: Confirmed Non-occupational Cases by Pesticide Type, 2006-2023 & 2023 Separately

	Cumulative		2023	
Pesticide Type	**Count**	**Percent**	**Count**	**Percent**
Disinfectant	1254	38.7%	75	59.5%
Insecticide	1015	31.3%	18	14.3%
Insect Repellent	218	6.7%	1	0.8%
Herbicide	217	6.7%	5	4.0%
Rodenticide	35	1.1%	1	0.8%
Fungicide	30	0.9%	1	0.8%
Multiple	218	6.7%	5	3.9%
Other	81	2.5%	4	3.2%
Unknown	175	5.4%	16	12.7%
Total	**3243**	**100.0%**	**126**	**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 2023, mixing incompatible products was the most common contributing factor for non-occupational pesticide cases, followed by excessive application (Table 11).

Table 11: Contributing Factors in Confirmed Non-occupational Cases, 2006-2023 & 2023 Separately

	Cumulative		2023	
Contributing Factor	**Count**	**Percent**	**Count**	**Percent**
Mixing incompatible products	523	15.1%	29	25.4%
Label violations not otherwise specified	443	12.8%	2	1.8%
Spill/Splash of liquid or dust (not equipment failure)	337	9.7%	11	9.6%
Excessive application	314	9.1%	21	18.4%
No label violation identified but person still exposed/ill	261	7.5%	9	7.9%
Within reach of child or other improper storage	258	7.4%	17	14.9%
People were in the treated area during application	175	5.0%	10	8.8%
Drift contributory factors	115	3.3%	1	0.9%
Structure inadequately ventilated before re-entry	113	3.3%	7	6.1%
Decontamination not adequate or timely	108	3.1%	4	3.5%
Early re-entry	97	2.8%	1	0.9%
Notification/posting lacking or ineffective	60	1.7%	0	0.0%
Application equipment failure	52	1.5%	0	0.0%
Required gloves not worn or inadequate	19	0.5%	0	0.0%
Required eye protection not worn or inadequate	18	0.5%	0	0.0%
Applicator not properly trained or supervised	10	0.3%	0	0.0%
Other required PPE not worn or inadequate	9	0.3%	0	0.0%
Intentional harm	3	0.1%	0	0.0%
Required respirator not worn or inadequate	2	0.1%	0	0.0%
Illegal pesticide used/Illegal dumping	2	0.1%	0	0.0%
Other	100	2.9%	2	1.8%
Unknown	448	12.9%	0	0.0%
Total	**3467**	**100.0%**	**74**	**100.0%**

Outreach, Education, and Prevention Activities

Publications, Presentations, and Other Outreach Activities
The 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 2023:

- Attended the 2023 SENSOR-Pesticides National Meeting in St. Augustine, Florida.

- The pesticide surveillance program coordinator provided case narratives to MDARD, who shared these narratives with stake holders who have an interest in pesticides.

- 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 150 other sites with information about pesticides and their safe use.

- Pesticide poisoning data from 2003-2020 can be found on the interactive MDHHS web site (https://www.michigan.gov/mdhhs/safety-injury-prev/environmental-health/topics/mitracking)

- One case was reported to NIOSH from cases reported in 2023.

  Eight male workers ages, one in their 60's, three in their 20's, two in their 30's and two in their 50'swere placing solar panels in a field at work when they were exposed to an insecticide (Tombstone by Loveland Products) and a fungicide (Miravis Neo) that drifted on them from an aerial application being sprayed on the crops in the neighboring field. One worker developed dizziness, nausea, a cough, red eyes, numbness to the mouth, and a headache. Four workers developed shortness of breath, chest tightness, dizziness, and nausea; one of whom also developed a cough, and one also developed a cough and itching on his skin. One worker developed a cough, shortness of breath, and a headache. One worker developed an itchy rash on his skin and a headache, and another developed a headache, muscle weakness, dizziness, a cough, and skin irritation. The workplace health and safety supervisor called the poison center. All of the workers sought medical attention in the emergency department the day of the exposure. One worker reported there may have been 25-30 exposed workers. One worker called EMS from the field he was working in seven days after the exposure due to continued difficulty breathing and coughing at work. Four of the workers sought medical attention from an occupational medicine physician. This case was referred to MDARD and NIOSH. As of this report, the MDARD investigation is still ongoing for this exposure.

- No cases were reported to MIOSHA from cases reported in 2023.

- Three cases were referred to MDARD from cases reported in 2023. One is the same as the NIOSH reported case above. The other two cases are as follows:

  Two females in their 30s and a female in her 40s were working in the licensing office at a religious charity center when they were exposed to an insecticide and miticide used to treat lice. The chemical was sprayed by the maintenance department in the conference room at the center of their offices after a client with lice had been in the building. They both developed a headache, dizziness, lightheadedness, and nausea. When symptoms were still getting worse at work fifteen days after the exposure, they both sought medical attention at an occupational health clinic. There is no evidence this product is safe for use indoors and this case has been referred to MDARD. Three violations were identified as a result of this inspection: applying a pesticide while employed without certification, applying a pesticide in a manner inconsistent with its label, and not maintaining application records.

  A male in his 20s was working as a flower room manager at a cannabis production facility when he inhaled a single product used as a fungicide, bactericide, and algaecide. The product was diluted and used in a humidifier while he was in the room. He developed a cough, shortness of breath, and chest pain. He called the poison center. This case was referred to MDARD for potential violation of the re-entry time regulations. Two violations were identified as a result of this inspection: agriculture employers not providing Worker Protection Standards training to workers within the last 12 months when entering an area of pesticide use and agriculture employers not notifying workers of all entry restrictions as specified by the pesticide label.

Discussion

Surveillance Data

There were 70 confirmed occupational cases reported in 2023. This is consistent with the range from previous years of surveillance (17-125), and the average (70). The number of confirmed occupational cases peaked in 2008.

There were 108 confirmed non-occupational cases in 2023. This is higher than the number of cases for 2020 (n=104), 2021 (n=66), and 2022 (n=67). However, it is on the lower end of the range from previous years of surveillance (66-441) and lower than the average number of cases for those years (170). There was an increase in non-occupational cases in 2012 and 2013 because the coding of cases we reviewed from the poison center exposure reasons was expanded to capture all non-occupational cases. The number went down again in 2014 because, due to the limited resources of the pesticide surveillance program, only non-occupational cases who sought additional medical care beyond the poison center were entered into the database and included in this report.

The number and proportion of confirmed cases related to disinfectant exposures remained high and continued to be an area of ongoing concern. In 2023, 31.0% of occupational cases and 59.5% of non-occupational cases were exposed to a disinfectant. It is likely that some of these cases would not have occurred if the disinfectants had been used only in situations where their use was recommended (Rosenman et al., 2020). The calls to the Michigan Poison Center about adverse health effects from disinfectants have increased since the onset of the COVID-19 pandemic (Rosenman et al., 2021). Ongoing education is needed to provide guidance about how to use disinfectants safely when their use is recommended.

When looking at factors contributing to pesticide cases in 2023, spill/splash of liquid or dust and mixing incompatible products were the most common factors for confirmed occupational cases (14.9% each), followed by no label violation identified but person still exposed/ill (12.2%). The most common factors contributing to non-occupational cases were mixing incompatible products (25.4%), followed by excessive application (18.4%) and the product being improperly stored or within reach of a child (14.9%). Better education, storage and reading product labels might help to reduce the number of cases.

Many confirmed cases in 2023 were “bystanders”, that is, engaged in work or living activities not related to the pesticide application (46.3% of occupational cases and 27.4% of non-occupational cases when activity was known). Better education on safe pesticide application is needed to prevent inadvertent exposures, as well as the exposures to applicators.

Interventions

Pesticide surveillance staff continued to work with other state and federal agencies. Pesticide program surveillance staff also worked to improve pesticide education for individuals,

employers, health care providers, and other stakeholder groups through the distribution of fact sheets and presentations.

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 low toxicity (no signal word required by EPA) through slightly toxic (EPA signal word: Caution), moderately toxic (EPA signal word: Warning) and most toxic (EPA 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 signs and symptoms of pesticide toxicity can be the same as those that occur with common conditions such as allergies, acute conjunctivitis, or acute gastrointestinal illness. Health care providers receive limited education in the recognition and diagnosis of the toxic effects of pesticides and the role of pesticides may not be considered when evaluating patients with signs/symptoms that can be caused by common medical conditions. 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 (Pardo et al., 2017). 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, the busy work schedules of providers or lack of knowledge of the public health code reporting requirements (Calvert et al., 2009).

Continued outreach is needed to educate health care providers on the importance of recognizing and reporting pesticide illnesses and injuries. In 2023, 62.9% of confirmed occupational cases and 30.6% of the non-occupational cases were reported by the State's poison center. Additionally, 18.6% of confirmed occupational cases and 46.3% of the non-occupational cases were reported by the State's emergency medical service response database.

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 if they did, they might lose their jobs. That study also found that only 20-30% 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. The poison center reports are received promptly from Michigan's Poison Center, but do not always contain enough information to allow contact with the exposed individual. Lack of information for follow-up often results in a case classification of "insufficient information" and an inability to refer cases to regulatory agencies in a timely manner.

Notwithstanding these limitations, the Michigan pesticide surveillance system is receiving and investigating reports of occupational pesticide illness and injury, including follow-up prevention activities. We are heartened by the downward trend in this decade and will continue to conduct surveillance to monitor this trend.

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Additional Resources

MDHHS Division of Environmental Health pesticide information: www.michigan.gov/mdhhs/safety-injury-prev/environmental-health/topics/pesticides

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: 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): 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: www.npirs.org/state/

EPA Pesticide Product Label System: ordspub.epa.gov/ords/pesticides/f?p=PPLS:1

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

Information on the federal Worker Protection Standard (worker exposure to pesticides in agriculture): www.epa.gov/pesticide-worker-safety

Recognition and Management of Pesticide Poisonings, Sixth Edition: www2.epa.gov/pesticide-worker-safety/recognition-and-management-pesticide-poisonings

To report occupational pesticide exposures in Michigan: www.oem.msu.edu/index.php/work-related-injuries/report-occupational-exposure

Appendix I

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

Clinical Description
This surveillance case definition refers to any acute adverse health effect resulting from exposure to a pesticide product (defined under the Federal Insecticide Fungicide and Rodenticide Act [FIFRA]1) including health effects due to an unpleasant odor, injury from explosion of a product, inhalation of smoke from a burning product, and allergic reaction. Because public health agencies seek to limit all adverse effects from regulated pesticides, notification is needed even when the responsible ingredient is not the active ingredient.

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

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

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

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

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

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

Laboratory criteria for diagnosis
If available, the following laboratory data can confirm exposure to a pesticide:

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

Classification Criteria

Reports received and investigated by state programs are scored on the three criteria provided below (criteria A, B and C). Scores are either 1, 2, 3, or 4, and are assigned based on all available evidence. The classification matrix follows the criteria section (Table 1). The matrix provides the case classification categories and the criteria scores needed to place the case into a specific category. Definite, probable, possible and suspicious cases (see the classification matrix) are reportable to the national surveillance system. Additional classification categories are provided for states that choose to track reports that do not fit the criteria for national reporting. Appendix II of "Pesticide-Related Illness and Injury Surveillance: A How-To Guide for State-Based Programs" lists the characteristic signs and symptoms for several pesticide active ingredients and classes of pesticides.

A) *Documentation of Pesticide Exposure*

1) Laboratory, clinical or environmental evidence corroborate exposure (at least one of the following must be satisfied to receive a score of A1):
    a) analytical results from foliage residue, clothing residue, air, soil, water or biologic samples;
    b) observation of residue and/or contamination (including damage to plant material from herbicides) by a trained professional [Note: a trained professional may be a plant pathologist, agricultural inspector, agricultural extension agent, industrial hygienist or any other licensed or academically trained specialist with expertise in plant pathology and/or environmental effects of pesticides. A licensed pesticide applicator not directly involved with the application may also be considered a trained professional.];
    c) biologic evidence of exposure (e.g., response to administration of an antidote such as 2-PAM, Vitamin K1, Vitamin E oil preparation, or repeated doses of atropine);
    d) documentation by a licensed health care professional of a characteristic eye injury or dermatologic effects at the site of direct exposure to a pesticide product known to produce such effects (these findings must be sufficient to satisfy criteria B.1 under documentation of adverse health effect);
    e) clinical description by a licensed health care professional of two or more postexposure health effects (at least one of which is a sign) characteristic for the pesticide as provided in Appendix II.

2) Evidence of exposure based solely upon written or verbal report (at least one of the following must be satisfied to receive a score of A2"):
   a) report by case;
   b) report by witness;
   c) written records of application;
   d) observation of residue and/or contamination (including damage to plant material from herbicides) by other than a trained professional;
   e) other evidence suggesting that an exposure occurred.

3) Strong evidence that no pesticide exposure occurred.

4) Insufficient data.

B) <u>Documentation of Adverse Health Effect</u>

1) Two or more new post-exposure abnormal signs and/or test/laboratory findings reported by a licensed health care professional.

2) At least one of the following must be satisfied to receive a score of B2:
   a) Two or more new post-exposure abnormal symptoms were reported. When new post-exposure signs and test/laboratory findings are insufficient to satisfy a B1 score, they can be used in lieu of symptoms toward satisfying a B2 score.
   b) Any new illness or exacerbation of pre-existing illness diagnosed by a licensed physician, but information on signs, symptoms and/or test findings are not available or insufficient for a B1 or B2a score.

3) No new post-exposure abnormal signs, symptoms, or test/laboratory findings were reported.

4) Insufficient data (includes having only one new post-exposure abnormal sign, symptom, or test/laboratory finding).

C) <u>Evidence Supporting a Causal Relationship Between Pesticide Exposure and Health Effects</u>

1) Where the findings documented under the Health Effects criteria (criteria B) are:
   a) characteristic for the pesticide as provided in Appendix II, and the temporal relationship between exposure and health effects is plausible (the pesticide refers to the one classified under criteria A), and/or;
   b) consistent with an exposure-health effect relationship based upon the known toxicology (i.e., exposure dose, symptoms and temporal relationship) of the putative agent (i.e., the agent classified under criteria A) from commonly available toxicology texts, government publications, information supplied by the manufacturer, or two or more case series or positive epidemiologic studies published in the peer-reviewed literature;

2) Evidence of exposure-health effect relationship is not present. This may be because the exposure dose was insufficient to produce the observed health effects. Alternatively, a temporal relationship does not exist (i.e., health effects preceded the exposure or occurred too long after exposure). Finally, it may be because the constellation of health effects is not consistent based upon the known toxicology of the putative agent from information in 25 commonly available toxicology texts, government publications, information supplied by the manufacturer, or the peer-reviewed literature;

3) Definite evidence of non-pesticide causal agent;

4) Insufficient toxicologic information is available to determine causal relationship between exposure and health effects. (This includes circumstances where minimal human health effects data is available, or where there are less than two published case series or positive epidemiologic studies linking health effects to the particular pesticide product/ingredient or class of pesticides.)

Case Classification Matrix:

Classification Categories[1]											
Classification Criteria	Definite Case	Probable Case		Possible Case	Suspicious Case	Unlikely Case	Insufficient Information		Asymptomatic[2]	Unrelated[3]	
A. Exposure	1	1	2	2	1 or 2	1 or 2	4	-	-	3	
B. Health Effects	1	2	1	2	1 or 2	1 or 2	-	4	3	-	
C. Causal Relationship	1	1	1	1	4	2	-	-	-	-	3

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

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

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

Severity Index for Acute Pesticide-Related Illness and Injury Cases Reportable to the National Public Health Surveillance System

A brief description of each of the four severity categories is as follows:

S-1 Death
This category describes a human fatality resulting from exposure to one or more pesticides.

S-2 High severity illness or injury
The illness or injury is severe enough to be considered life threatening and typically requires treatment. This level of effect commonly involves hospitalization to prevent death. Signs and symptoms include, but are not limited to, coma, cardiac arrest, renal failure and/or respiratory depression. The individual sustains substantial loss of time (> 5 days) from regular work (this can include assignment to limited/light work duties) or normal activities (if not employed). This level of severity might include the need for continued health care following the exposure event, prolonged time off of work, and limitations or modification of work or normal activities. The individual may sustain permanent functional impairment.

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

S-4 Low severity illness or injury
This is the category of lowest severity. It is often manifested by skin, eye or upper respiratory irritation. It may also include fever, headache, fatigue or dizziness. Typically, the illness or injury resolves without treatment. There is minimal lost time (<3 days) from work or normal activities.

Appendix II

Case Narratives, 2023 Confirmed Occupational Cases

Below are descriptions of the confirmed occupational cases reported in 2023. The narratives are organized by pesticide type and occupation. They 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.

Insecticides/Insect Repellents/Insect Growth Regulators

Agriculture

MI05962 – A male farmer in his 40s was planting soybean seeds that were mixed with a powder insecticide. He filled the tractor by hand and used the seeder over three days. He developed a headache, irritation in his throat, an open sore in his mouth, hypertension, tingling in his arms, and he vomited. Six days after his last exposure he sought medical care in the emergency department where they consulted with the poison center.

Healthcare

MI05904 – A female in her 40s who works as a medical assistant was exposed to an aerosol bed bug killer that had been sprayed in her workplace about an hour before she arrived. She developed shortness of breath, a headache, lightheadedness, and nausea. She sought medical care at an occupational medicine clinic where they consulted with the poison center.

Pest Control

MI05952 – A male in his 40s was working for a pest control company when he was spraying a broad application outdoor mosquito repellent and despite wearing a respirator, developed numbness and itching in his face and itching in his eyes. He called the poison center.

MI05966 – A male in his 20s was being trained for residential mosquito control when a co-worker was spraying an insecticide nearby and it blew into his face. He developed nausea, chest pain, a headache, and watery eyes. Two days after the exposure when his symptoms had not subsided, he sought medical attention in the emergency department where they consulted with the poison center.

MI06030 – A male in his 30s was working as a pesticide applicator for a pest management company when he was exposed to a mosquito insecticide through his respirator. He developed nausea, dizziness, tremors, and confusion. He sought medical advice from the poison center.

Retail

MI05967 – A male in his 20s was stocking shelves at his job at a general retail department store when cans of an insect repellent fell from the shelf and broke open. He inhaled the fumes and developed light headedness, confusion, dry mouth, nausea, a headache, and he fainted. His manager took him to employee urgent care where EMS was called to transport him to the emergency department. The ED nurse consulted with the poison center.

Services

MI05926 – A male in his 20s was working at a cook in a fast-food restaurant where there was fruit fly bait. He was exposed to the fumes of the fruit fly bait for 6 hours a day for a week and developed a headache, a cough, chest tightness, and vomited. He sought medical advice from his primary care physician and the poison center.

MI05951 – A male in his 50s was working as a service department manager for an HVAC company when he was attempting to determine a scent in a client's vacation home that was thought to be a furnace leak. However, the scent was coming from a leaking bottle of insecticide. He developed a burning sensation in his eyes. He called the poison center.

MI05968 – A male in his 40s was working for an electric services company when he was inside a house that was infected with bed bugs. He set off a bed bug fogger in an enclosed tent to get the bed bugs off of himself and his clothing. He developed a cough, shortness of breath, and skin irritation. He sought medical attention at an employee health clinic and when symptoms did not subside, he sought care in the emergency department where they consulted with the poison center.

MI06025, MI06026, & MI06027 – A male firefighter in his 20s and a female paramedic in her 30s were responding to a 911 call to a residence with an insecticide fogger being released in the home. The 20-year-old resident stayed in the home while the fogger was being released. They were all exposed to the fumes of the fogger. The male responder developed a cough, chest pain, nose and throat irritation, nausea, vomiting, and a headache. The female responder developed shortness of breath, a cough, nausea, and dizziness. The female resident developed a cough, shortness of breath, a headache, nausea, and vomiting. They sought medical attention in the emergency department where they consulted with the poison center. MI06027 is a non-occupational case.

MI06029 – A female in her 30s worked as a mail carrier for a postal service. Her delivery vehicle was sprayed with a wasp spray the night before and when she got into the vehicle the following morning she developed nausea, sweating, numbness to her fingers and lips, tremors, and hives. She sought medical advice from the poison center and later went to the emergency department.

Office and Sales

MI05912, MI05913 & MI05924 – Two females in their 30s and a female in her 40s were working in the licensing office at a religious charity center when they were exposed to an insecticide and miticide used to treat lice. The chemical was sprayed by the maintenance department in the conference room at the center of their offices after a client with lice had been in the building. They both developed a headache, dizziness, lightheadedness, and nausea. When symptoms were still getting worse at work fifteen days after the exposure, they both sought medical attention at an occupational health clinic. There is no evidence this product is safe for use indoors and this case was referred to MDARD.

Miscellaneous/unknown
MI05971 – A male who is over 19 years old was at work using an insecticide to fumigate and inhaled the fumes when the wind blew it back in his face. He developed blurry vision, nausea, and vomiting. He sought medical attention at an urgent care where they consulted with the poison center.

MI06009 – A male in his teens was at work when an insecticide was spilled on him. The next day he developed fatigue and dizziness and called the poison center for advice.

MI06021 & MI06072 – A male and a female correctional officer in their 30s in a county jail inhaled the smoke when a prisoner smoked an envelope that was soaked in an insecticide. One correction officer developed dizziness, confusion, and tachypnea and the other dizziness, nausea, shortness of breath, wheezing, and chest tightness. They both sought medical attention in the emergency department, which consulted with the poison center.

Herbicides
Landscaping
MI06011 – A male in his 40s was working as a groundskeeper for a township parks department where he would spray park areas and landscaping with an herbicide. Over the course of two years, each time he sprayed, he would develop redness, a rash, and swelling on his skin as well as throat irritation, nausea, and muscle weakness. He sought medical attention from his primary care physician who eventually diagnosed him with glyphosate intolerance and advised him to no longer spray herbicides.

Service
MI06008 – A female in her 20s was spraying an invasive species along a roadside with an herbicide at work. A gust of wind blew the herbicide back into her face and she developed dizziness and shortness of breath. She sought medical attention in the emergency department where they consulted with the poison center.

MI06032 – A male in his 60s was working as a manager at an auto repair shop when he used an herbicide. He developed shortness of breath, a cough, chest tightness, and wheezing that continued for months when he went into work. He sought continued medical care with his physician.

Miscellaneous/unknown
MI05965 – A male in his 30s was spraying an herbicide at work over the course of two days. On the first day he had an inhalation exposure to the product and the second day the product came in contact with his hands. He developed fatigue, chest pain, abdominal pain, and tachypnea. The day after the second day of exposure, he sought medical attention in the emergency department where they consulted with the poison center.

Disinfectants

Agriculture

MI05899 – A male in his 30s who works at a tree farm was exposed to a disinfectant. He developed a headache, nausea, vomiting, throat irritation, and lightheadedness and called the poison center.

MI05960 & MI05961 – Two females in their 20s were working for a cannabis growing facility, one as an integrated pest management specialist and the other as the fertigation lead, when an acid-based disinfectant was added to a mop bucket that already contained bleach. The mixture was then poured down the drain of a small room. The integrated pest management specialist went in the room to set up a fan and developed nausea, a headache, a cough, burning sensation in her eyes, throat irritation, chest tightness, and lightheadedness. The fertigation lead developed chest tightness and irritation in her throat. They sought medical attention at urgent care who consulted with the poison center.

Cleaner/housekeeper/janitor/custodian

MI05930 – A male in his 40s inhaled bleach fumes while cleaning chairs in a church with bleach. He developed shortness of breath, wheezing, a cough, tachycardia, and tachypnea. He called EMS who transported him to the emergency department.

MI05946 & MI05950 – A female in her 40s and a female in her 20s were working as a housekeeping supervisor and a housekeeper at a resort golf course cleaning the men's bathroom. Unknown to these two employees, an employee in the engineering department poured an unknown substance down the urinal in attempt to get it to flush properly. The housekeeping supervisor poured bleach into the urinal, and it began to foam. She also used bleach to clean an unknown substance on the floor. When the bleach came into contact with the urinal and the floor it began to foam. She became faint, hot, and lightheaded and developed nausea, difficulty breathing, a cough, and chest pain. Her co-worker developed shortness of breath, a cough, nausea and could taste the bleach. They called EMS who transported them to the hospital.

MI05953 – A female in her 20s was working as a housekeeper in a residential home when she mixed bleach and an ammonia-based product to clean the bathroom. She became lightheaded and developed shortness of breath, a headache, and blurry vision. She called EMS who transported her to the emergency department.

MI06023 – A male in his 20s was working as a supervisor at an apartment complex cleaning an apartment for the next tenants. He mixed an acid-based disinfectant with a bleach-based disinfectant and inhaled the fumes. He developed difficulty breathing, a cough, chest pain, a headache, nausea, and dizziness. He called EMS who transported him to the emergency department.

MI06031 – A male in his 70s was working as housekeeper in the jail in which he was an inmate when he inhaled bleach fumes. He developed shortness of breath, wheezing, and chest pain. EMS was called and transported him to the emergency department.

MI06071 – A male in his 30s was training as a custodian at a retirement home when he was disinfecting a stove. He mixed bleach with an acid-based disinfectant. There was a strong odor after mixing so he dumped the mixture out. He then mixed bleach with a hydrogen peroxide-based disinfectant. He developed chest tightness, shortness of breath, a cough, and a headache. He called EMS who transported him to the emergency department.

Healthcare

MI06020 – An adult female of unknown age was working at a hospital when she used a high-level disinfectant in a poorly ventilated room. She inhaled the fumes and developed a cough, shortness of breath, and chest tightness. She sought medical attention in the emergency department of the hospital where she worked, and the staff consulted the poison center.

MI06070 – A female in her 50s was working at a hospital when she sprayed an ammonia-based disinfectant on the white board and droplets splashed back onto her. It got into her eyes, and they became red, irritated, and teary. She called the poison center for advice.

Office and sales

MI06022 – A female in her 20s was working as a sales associate in a zoo when a co-worker who was unaware of her bleach allergy brought bleach from home to disinfect at work. She inhaled the bleach fumes in the work office and developed shortness of breath, chest tightness, light headedness, and nasal congestion. She called EMS who transported her to the emergency department.

Manufacturing

MI05940 – A male in his 40s was exposed to an aerosolized disinfectant while working at a foundry/steel castings manufacturer. A new chemical was used in a machine at work that fired at a lower temperature than the previous chemical and the machine was not calibrated correctly. He developed chest pain, wheezing, shortness of breath, lightheadedness, a headache, tachycardia, and high blood pressure. A week after symptoms began, he was still experiencing symptoms and sought medical attention in the emergency department where they consulted with the poison center. He was prescribed an inhaled bronchodilator and a corticosteroid. He sought medical care from his primary care doctor who referred him back to the emergency department. He was seen in the emergency department on four separate occasions and found to have elevated carbon monoxide levels. He was diagnosed with chemical pneumonitis.

MI06034 – A female in her 50s was working as a crew leader for a pickle company where she would mix bleach with vinegar to disinfect the processing rooms. When she used this combination at work she would develop shortness of breath, a cough, and chest tightness. She sought medical treatment from a pulmonologist who diagnosed her with occupational asthma.

Retail

MI05910 – A female in her 50s was working at a retail furniture store when a customer assaulted her by throwing approximately 16 oz of bleach in her face. She developed pain and redness in her eyes, a cough, shortness of breath, and congestion in her sinuses. She sought medical attention from EMS who transported her to the emergency department where she was diagnosed with chemical conjunctivitis.

MI05915 – A female in her 30s was pulling a disinfectant bottle down from a shelf while she was working as a general manager at a retail store when the bottle broke, and the disinfectant splashed onto her face and into her eyes. Her eyes became red and developed excessive tearing. Her co-worker called the poison center.

MI05996 – A female in her 30s was filling the hand sanitizer dispenser while working at a grocery store when the sanitizer spilled into a sink with bleach in it. She developed shortness of breath, high blood pressure, and began feeling lightheaded. She sought medical attention in the emergency department where they consulted with the poison center.

Services

MI05901 – A male in his 40s was disinfecting a walk-in cooler at work with bleach. He developed a cough, nausea, and difficulty breathing. The next day he sought medical care in the emergency department where he was diagnosed with acute chemical bronchitis.

MI05969 – A male in his 20s was cleaning the kitchen of a restaurant where he works as a cook when he reached below the dishwasher for a bucket. The bucket got stuck on the hose connecting to the sanitizer and the hose came loose and splashed him in the eyes and face. He developed pain in his eyes and pain and redness on his face. He sought medical attention in the emergency department.

MI05970 – An 18-year-old female was working as a barista at a coffee shop when she was reaching into the cabinet and sanitizer fell onto her. She developed pain in her eyes and on her face. She called the poison center and sought medical attention in the emergency department where they also consulted with the poison center.

MI05980 – A male in his 50s with a known bleach allergy was working as a health officer at a summer camp when he came into contact with a bleach containing product. He developed shortness of breath, chest tightness, tightness in his throat, swelling in his hands, a skin rash, and itchiness. The next day, when his symptoms were not improving, he called EMS who transported him to the emergency department.

MI06010 – A female in her 20s was exposed to bleach fumes while working at a daycare. She developed shortness of breath, throat irritation, tachypnea, and dizziness. She called EMS who transported her to the emergency department.

MI06024 – A male in his 20s was working at a restaurant in an airport when he went to the bathroom that was being disinfected with a mix of bleach and water. He developed a burning sensation in his chest and wheezing. He called EMS who assessed him and released him against medical advice.

MI06028 – A female in her 30s was disinfecting her at home salon in attempts to rid it of bugs when she mixed accidentally mixed bleach and ammonia in a container. She spilled the mixture and cleaned the floor while being exposed to the fumes. She developed a cough, chest tightness, pain in the back of her throat, a runny nose, and watery eyes. She sought medical attention in the emergency department.

MI06081 – A male in his 60s was working at a fast-food restaurant where he was cleaning the kitchen and accidentally mixed bleach with an acid-based disinfectant. He developed difficulty breathing, tachypnea, wheezing, chest tightness, tachycardia, and dizziness. He called EMS who transported him to the emergency department.

Wholesale

MI05933 – A male in his 20s was working for a food products supplier when he was moved to a new station where he worked with bleach for approximately three hours. He developed shortness of breath, wheezing, and chest pain. He called EMS who transported him to the emergency department.

Miscellaneous/Unknown

MI05919 – A female in her 60s was at work when a disinfectant splashed into her eye. She developed irritation, tearing, and a corneal abrasion. She was seen at an employee health clinic who consulted with the poison center and referred her to the hospital.

MI05922 – A male in his 30s was working at the residential institution where he lived when he mistook a cup of bleach for a beverage cup. He accidentally ingested the bleach then vomited and developed a burning sensation in his stomach. He called EMS who transported him to the emergency department for medical attention.

MI05931 – A female in her 40s was disinfecting a part at work with an industrial cleaner degreaser when she developed shortness of breath, chest tightness, a cough, a headache, and nasal congestion. Two days later she was still being exposed to the chemical and still experiencing shortness of breath, so she sought medical attention in the emergency department where they consulted with the poison center.

MI05939 – A female in her 50s mixed bleach with laundry detergent while at work. She developed a cough and difficulty breathing. She went home and called EMS from home. Upon EMS's arrival, her symptoms had subsided, so she was not transported to a medical facility.

MI05997 – A female in her 20s was at work when a co-worker sprayed a disinfectant used for instrument sterilization into the air. She developed chest tightness, wheezing, and

hypertension. She sought medical attention at an urgent care where they consulted with the poison center.

Fungicide

Services

MI06006 – A male in his 20s was working for a landscaping service as a pesticide applicator when he was exposed to a fungicide via drift during application. He was exposed intermittently over the course of three months. After each exposure he would develop a headache, watering eyes, a burning sensation in his lungs, and skin and sinus irritation. He sought medical attention in the emergency department.

Rodenticide

Retail

MI05905 & MI05906 – A female in her 30s and a female in her 50s had inhalation exposure to a powder rodenticide while working as cashiers at a retail store. The powder was applied by a pesticide company while the business was closed. The female in her 30s was exposed over the course of several workdays and developed light headedness, fatigue, difficulty breathing, a cough, and a rash on her feet. She called the poison center. The female in her 50s was exposed during one workday and developed a headache, dizziness, nausea, vomiting, shortness of breath, and a cough. She sought medical attention in the emergency department where they consulted with the poison center.

Multiple Pesticides

Agriculture

MI05914 – A male in his 20s was working as a cultivation manager of a cannabis growing company when he was filling a paint sprayer used to apply pesticides. The paint sprayer was on auto spray and the bactericide and fungicide splashed into his eye. His eye developed redness, irritation, excessive tearing, bradycardia, and his vision was blurred. He called the poison center and then sought medical attention at an emergency department where they prescribed him antibacterial medication.

MI05932 – A male in his 50s who was working as an applicator for an agrochemical supplier was splashed in his eyes and face while setting up to spray an insecticide and herbicide mix. He developed pain in his eyes. He had high blood pressure in the emergency department where they consulted with the poison center.

MI05941 – A male in his 30s was working as a self-employed farmer of an apple orchard. While making a mechanical fix to his tractor ground sprayer that contained a mixture of insecticide and fungicide, the spray line still had pressure in it and sprayed in his face and eyes. He developed a burning and tingling sensation as well as redness on his face and eyes. He called the poison center.

MI05945 – A female in her 60s was driving an open cab tractor on the road alongside her farm when she was exposed to drift from an aerial application of a fungicide and insecticide to a

neighboring corn farm. The plane flew within about 30 feet of her while spraying. She developed skin irritation and redness as well as confusion. She contacted the poison center and MDARD to test the oats she was hauling. MDARD confirmed pesticide exposure from the drift on her headband she was wearing as well as the oats she was hauling behind her tractor.

MI05963 – A male in his 20s was working as a flower room manager at a cannabis production facility when he inhaled a single product used as a fungicide, bactericide, and algaecide. The product was diluted and used in a humidifier while he was in the room. He developed a cough, shortness of breath, and chest pain. He called the poison center. This case was referred to MDARD for potential violation of the re-entry time regulations.

Pest Control

MI05964 – A 19-year-old male was working as a residential landscaper for a landscaping company when he inhaled and had dermal and ocular exposure to an insecticide and two herbicides over the course of three or four months. He also had a specific exposure where the hose was leaking, and the insecticide got on his hand and into his eye. He developed nausea, vomiting, diarrhea, and irritation and redness on his hand. The day after the specific exposure, he talked with his primary care doctor and the poison center who referred him to the emergency department.

Construction

MI05982, MI05983, MI05984, MI05985, MI05986, MI05987, MI05988, MI06033 – Eight male workers ages, one in their 60's, three in their 20's, two in their 30's and two in their 50'swere placing solar panels in a field at work when they were exposed to an insecticide (Tombstone by Loveland Products) and a fungicide (Miravis Neo) that drifted on them from an aerial application being sprayed on the crops in the neighboring field. One worker developed dizziness, nausea, a cough, red eyes, numbness to the mouth, and a headache. Four workers developed shortness of breath, chest tightness, dizziness, and nausea; one of whom also developed a cough, and one also developed a cough and itching on his skin. One worker developed a cough, shortness of breath, and a headache. One worker developed an itchy rash on his skin and a headache, and another developed a headache, muscle weakness, dizziness, a cough, and skin irritation. The workplace health and safety supervisor called the poison center. All of the workers sought medical attention in the emergency department the day of the exposure. One worker reported there may have been 25-30 exposed workers. One worker called EMS from the field he was working in seven days after the exposure due to continued difficulty breathing and coughing at work. Four of the workers sought medical attention from an occupational medicine physician. This case was referred to MDARD and NIOSH.

<u>Unknown Pesticide</u>

Services

MI05900 – A male in his 20s was working as a laborer for a landscaping company when his face brushed against a bush that had been treated with an unknown pesticide. He developed itching and irritation in his eyes as well as a burning sensation on his lips. He sought medical care from the emergency department where he was diagnosed with acute chemical conjunctivitis.