Pesticide Illness and Injury Surveillance in Michigan 2014

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Division of Environmental Health
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Pesticide Illness and Injury Surveillance in Michigan: 2014

Michigan Department of Health and Human Services, Division of Environmental Health
Abby Schwartz, MPH
Martha Stanbury, MSPH

Contributor
Kenneth Rosenman, MD
Michigan State University

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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 twelfth annual report on pesticide-related illnesses and injuries in Michigan (MDHHS, 2001-3, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, and 2014) including 14 years of data.

From 2001 through 2014, there were 1,066 confirmed cases of occupational pesticide-related illnesses or injuries. Fifty-nine of those confirmed cases were reported in 2014. There has been a general decline in the number of cases per year since 2008. Disinfectants continued to be the cause of about 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, 35.3 percent of confirmed occupational cases were exposed to pesticides inadvertently while doing their regular work that did not involve applying pesticides. The most common contributing factor for confirmed occupational cases was a spill or splash of liquid or dust. The most common occupation was Building and Grounds Cleaning and Maintenance, comprising 32.2 percent of the confirmed cases in 2014. Of those, almost two-thirds were cleaners, housekeepers or maintenance workers and a little more than one-third were pest control operators.

From 2006 through 2014, there were 2,013 confirmed cases of non-occupational pesticide-related illnesses or injuries. One hundred fifty-five of those confirmed cases were reported in 2014.

In 2014, disinfectants accounted for 47.1 percent 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, 76.8 percent of confirmed non-occupational cases were involved in applying the pesticide themselves. 'Bystander' exposure was also important, with 22.5 percent exposed inadvertently while doing normal activities, not involved in the application of pesticides.

Three events were reported to the National Institute of Occupational Safety and Health (NIOSH) and forwarded to the Environmental Protection Agency (EPA). An additional event was reported to the National Outbreak Reporting System (NORS). These events are described on page 17.

[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), more than 1.1 billion pounds of pesticides were used in the United States in 2007, the last year of published data.[2]

The term pesticide includes 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 this industry. Currently there are more than 16,000 different pesticides registered for sale and use in Michigan. There are more than 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; and

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

- Provide information for planning and evaluating intervention programs.

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 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 MDHHS pesticide poisoning surveillance system is a case-based system. A reported individual must meet the case definition established by NIOSH[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 and reporting them to NIOSH.

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

[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

pesticide use: the Michigan Occupational Safety and Health Administration (MIOSHA) in the Michigan Department of Licensing and Regulatory Affairs (LARA) and MDARD. MIOSHA enforces state and federal 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 2014, 3,079 reports of pesticide-related illnesses and injuries met the criteria for confirmed cases. See Table 1.

Table 1: Case Confirmation by Work-Relatedness, 2001-2014

Status	Occupational	Non-Occupational	Total
Definite Case	109	33	142
Probable Case	256	348	604
Possible Case	685	1568	2253
Suspicious Case	16	64	80
Total	**1066**	**2013**	**3079**

Age is not always known. When known, persons of all ages may be exposed to pesticides. Table 2 shows the age groups for all confirmed cases.

Table 2: Confirmed Cases by Age Group & Gender, 2001-2014 and 2014 separately

	Cumulative			2014		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
00-<1:Infants	4	11	1	0	0	0
01-02:Toddlers	24	42	0	1	6	0
03-05:PreSchool	29	42	0	1	4	0
06-11:Child	69	56	1	0	4	0
12-17:Youth	70	72	1	7	3	0
18-64:Adult	1180	1069	0	92	73	0
65+:Senior	114	96	1	9	10	1
Unknown age	94	68	35	1	2	0
Total	**1584**	**1456**	**38**	**228**	**226**	**0**

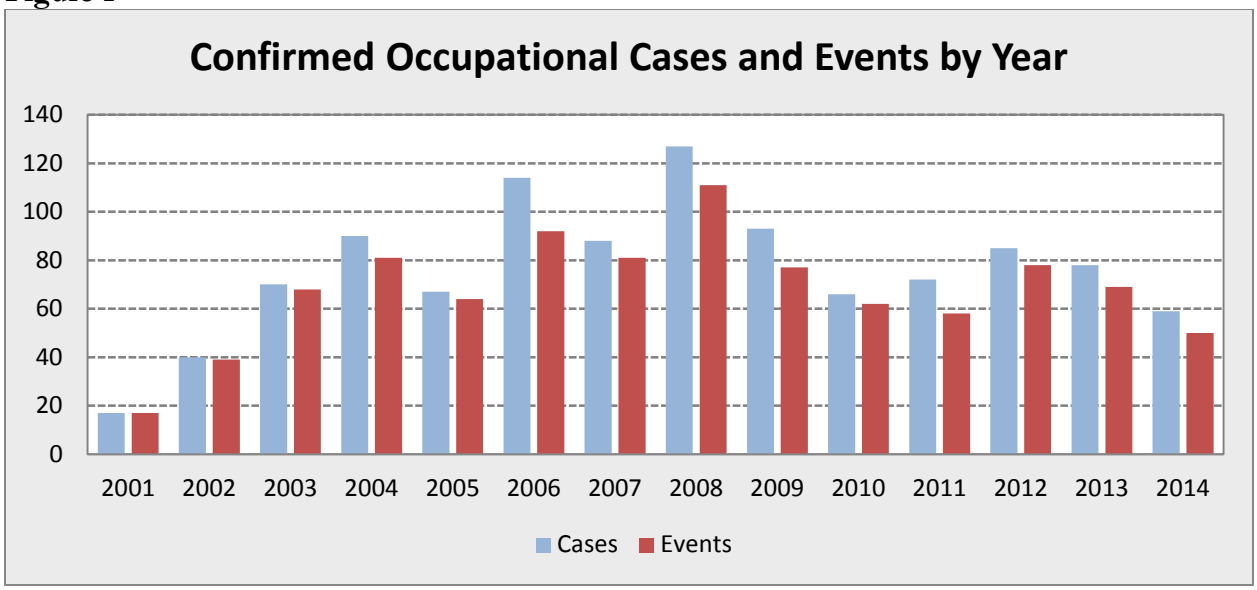
A farm hand in his 60s was spraying an insecticide in a soybean field and it blew back into his face. His eyes, face, and neck began to burn. His eyes were tearing and his vision was blurry. He went to an urgent care center.

A woman in her 40s was taking off her pool cover and inhaled the chlorine fumes. She developed difficulty breathing, coughing, rapid breathing, and wheezing. She went to an emergency department and was diagnosed with an acute asthma exacerbation and chemical bronchitis.

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 59 cases from 50 events in 2014.

Figure 1



People

Occupational pesticide cases occur in people of all ages. See Table 3. In 2014, unlike in previous years, women were more likely to be a confirmed occupational case than men (54.2% vs. 45.8%), and when race and ethnicity were known, most cases were white, non-Hispanic (71.4%).

Table 3: Confirmed Occupational Cases by Age Group & Gender, 2001-2014 & 2014 Separately

	Cumulative			2014		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
00-09	0	0	0	0	0	0
10-19	44	57	0	5	3	0
20-29	127	170	0	15	13	0
30-39	92	119	0	4	4	0
40-49	94	106	0	3	4	0
50-59	71	67	0	3	2	0
60-69	10	16	0	2	1	0
70-79	2	5	0	0	0	0
80+	1	0	0	0	0	0
Unknown	34	40	11	0	0	0
Total	**475**	**580**	**11**	**32**	**27**	**0**

Table 4: Confirmed Occupational Cases by Race and Ethnicity, 2001-2014 and 2014 Separately

	Cumulative			2014		
Race	**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	35	27	0	3	2
White	13	364	101	1	15	10
Mixed	2	19	2	1	1	0
Other	1	0	1	0	0	1
Unknown at this time	47	0	444	3	0	22
Total	**63**	**426**	**577**	**5**	**19**	**35**

Most (67.8%) cases in 2014 were of low severity. The remainder (32.2%) were moderate severity.

Confirmed cases were identified as people in a wide variety of occupations working in a variety of industries. Table 5 shows the occupation of the worker based on the 2002 Census Occupation Codes. In 2014, the most common occupation was 'Building and Grounds Cleaning and Maintenance' (32.2%). This included twelve cleaning personnel and seven pest control operators. In 2014 there were 11 life guards (10 from one event) who were confirmed cases in the "Protective Service" category.

Table 5: Confirmed Occupational Cases by Occupation, 2001-2014 and 2014 Separately

Occupation	**Cumulative**	**Percent**	**2014**	**Percent**
Building and Grounds Cleaning and Maintenance	188	17.6%	19	32.2%
Farming, Forestry, and Fishing	57	5.3%	6	10.2%
Sales and Related	46	4.3%	0	0.0%
Food Preparation and Serving Related	43	4.0%	1	1.7%
Management	39	3.7%	6	10.2%
Transportation and Material Moving	32	3.0%	1	1.7%
Production	28	2.6%	1	1.7%
Protective Service	27	2.5%	11	18.6%
Office and Administrative Support	24	2.3%	0	0.0%
Healthcare Support	23	2.2%	2	3.4%
Healthcare Practitioners and Technical	22	2.1%	1	1.7%
Personal Care and Service	20	1.9%	2	3.4%
Construction and Extraction	13	1.2%	0	0.0%
Education, Training, and Library	11	1.0%	0	0.0%
Installation, Repair, and Maintenance	9	0.8%	1	1.7%
Architecture and Engineering	8	0.8%	0	0.0%
Other	8	8.0%	0	0.0%
Unknown	468	43.9%	8	13.6%
Total	**1066**	**100.0%**	**59**	**100.0%**

Table 6 below shows the industry involved in occupational cases, based on NIOSH industry sectors.[7] 'Services' includes 'Accommodation and Food Services' as well as 'Building Services'. It was the most common sector in 2014 (50.8%).

Table 6: Confirmed Occupational Cases by Industry Sector, 2001-2014 and 2014 Separately

Industry Sector	Cumulative	Percent	2014	Percent
Agriculture, Forestry, Fishing	120	11.3%	9	15.3%
Construction	26	2.4%	0	0.0%
Healthcare & Social Assistance	146	13.7%	12	20.3%
Manufacturing	61	5.7%	3	5.1%
Public Safety	20	1.9%	2	3.4%
Services (excluding Public Safety)	421	39.5%	30	50.8%
Transportation, Warehousing, Utilities	33	3.1%	0	0.0%
Wholesale & Retail Trade	88	8.3%	0	0.0%
Unknown	151	14.2%	3	5.1%
Total	**1066**	**100.0%**	**59**	**100.0%**

A paramedic in her 20s was exposed to vomit and off-gassing while transporting a woman who had intentionally ingested an organophosphorous insecticide. The paramedic was decontaminated at the hospital but developed nausea and vomited later that day.

Events

In 2014, when the person's activity at the time of exposure was known, most exposures (33 or 64.7%) 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 18 or 35.3% 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 2014, the most common exposure was to disinfectants (50.0%), followed by insecticides (20.0%). 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- 2014 and 2014 Separately

Pesticide Type	Cumulative	Percent	2014	Percent
Disinfectant	539	47.7%	35	50.0%
Insecticide	306	27.1%	14	20.0%
Herbicide	156	13.8%	6	8.6%
Other	128	11.3%	15	21.4%
Total	**1129**	**100.0%**	**70**	**100.0%**

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

Ten lifeguards and 17 members of the public were taken to a hospital with symptoms including sore throat, shortness of breath, skin irritation, eye irritation, headache, high blood pressure, and/or nausea after being exposed to chlorine gas released at a waterpark. A valve supplying water to the pool was shut off for routine maintenance and the person performing the maintenance was called away and did not return to complete the maintenance. The chlorine and acid continued to be supplied, but were not diluted with water. The gas was first noticed at the shallow end of the pool. The lifeguards closed and evacuated the pool. The county HazMat team responded and MIOSHA conducted an investigation.

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 2014, spills and splashes (25.9%) were the most common contributing factor for occupational pesticide cases, followed by mixing incompatible products (21.0%).

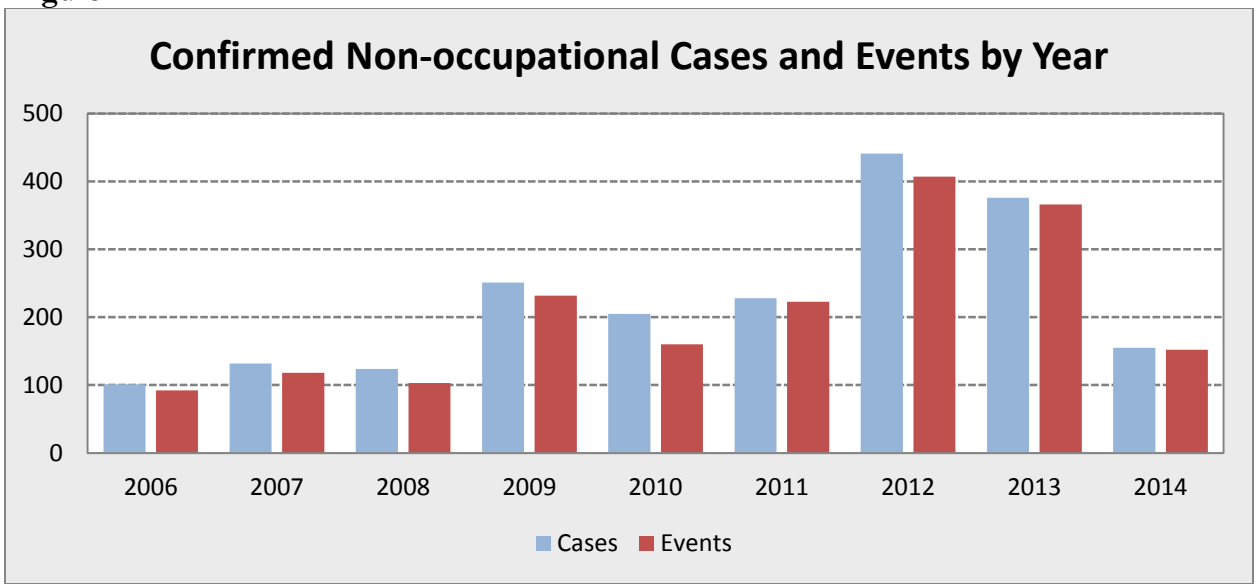
Table 8: Contributing Factors in Confirmed Occupational Cases, 2001-2013 & 2013 Separately

Contributing Factor	Cumulative	Percent	2014	Percent
Spill/Splash of liquid or dust (not equipment failure)	309	22.4%	21	25.9%
Mixing incompatible products	147	10.7%	17	21.0%
Label violations NOS	91	6.6%	6	7.4%
Application equipment failure	83	6.0%	4	4.9%
Required eye protection not worn or inadequate	80	5.8%	8	9.9%
Decontamination not adequate or timely	75	5.4%	4	4.9%
No label violation identified but person still exposed / ill	75	5.4%	0	0.0%
Drift contributory factors	66	4.8%	1	1.2%
Excessive application	61	4.4%	2	2.5%
People were in the treated area during application	39	2.8%	1	1.2%
Applicator not properly trained or supervised	32	2.3%	0	0.0%
Notification/posting lacking or ineffective	30	2.2%	0	0.0%
Required gloves not worn or inadequate	29	2.1%	2	2.5%
Structure inadequately ventilated before re-entry	19	1.4%	0	0.0%
Within reach of child or other improper storage	19	1.4%	1	1.2%
Early re-entry	17	1.2%	2	2.5%
Required respirator not worn or inadequate	13	0.9%	2	2.5%
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	40	2.9%	5	6.2%
Unknown	142	10.3%	5	6.2%
Total	**1380**	**100.0%**	**81**	**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. The same case definition and report sources were used for occupational and non-occupational cases. In 2012, three additional non-occupational exposure categories from poison control were added, but in 2014 data entry was limited to cases who visited a health care provider because of limited resources. An additional 170 confirmed non-occupational cases who had not seen a provider would have been included had data entry resources been available. Suicide attempts using pesticides are also excluded from this report. There is no follow-up for additional information with non-occupational cases so some cases may be missed because we did not know that there was more than one sign or symptom or because we did not identify the pesticide. There were 155 confirmed cases from 152 events entered into the database in 2014 (Figure 2).

Figure 2



People

A toddler got insecticide on her arm and then rubbed her right eye. Her eye was irritated and tearing. She was taken to urgent care, where her eye was flushed, and checked for abrasion, which was not found. The next day her eye was swollen shut and she had a fever. On reexamination at an emergency department she was diagnosed with a corneal abrasion.

A toddler ingested crabgrass killer left outside in an unlabeled container. He developed diarrhea and vomiting. He had elevated arsenic in his blood and urine.

Table 9 shows confirmed non-occupational cases by age and gender. In 2014, women and men were almost equally likely to have a non-occupational pesticide exposure (51.0% and 49.0%, respectively). Race and ethnicity information is rarely available for non-occupational cases.

Table 9: Confirmed Non-occupational Cases by Age Group & Gender, 2006-2014 & 2014 Separately

	Cumulative			2014		
Age Groups	**Female**	**Male**	**Unknown**	**Female**	**Male**	**Unknown**
00-<1:Infants	4	11	1	0	0	0
01-02:Toddlers	24	42	0	1	6	0
03-05:PreSchool	29	42	0	1	4	0
06-11:Child	70	55	0	0	4	0
12-17:Youth	54	51	1	5	2	0
18-64:Adult	759	563	0	62	48	0
65+:Senior	110	85	0	9	10	0
Unknown age	60	28	24	1	2	0
Total	**1110**	**877**	**26**	**79**	**76**	**0**

Most (54.2%) cases in 2014 were of low severity. An additional 43.9% were moderate severity. There were three (1.9%) high severity cases in 2014.

A man in his 80s applied an insecticide inside a garbage container. He had his head close to the fumes while applying. He developed difficulty breathing and tachycardia.

Events

In 2014, when the person's activity at the time of exposure was known, most exposures (109 or 76.8%) 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 32 or 22.5% happened to bystanders.

A man in his 40s cleaned his basement after it flooded, using bleach in one area and ammonia in another. The basement was not well ventilated. His wife, in her 30s, and their teenage daughter remained upstairs. They all developed symptoms including difficulty breathing, pain with deep breathing, eye and throat irritation, and cough. They all went to an emergency department and were all diagnosed with chemical pneumonitis.

Table 10 shows the types 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 2014, 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, 2006-2014 & 2014 Separately

Pesticide Type	Cumulative	Percent	2014	Percent
Disinfectant	889	42.07%	75	47.17%
Insecticide	664	31.42%	48	30.19%
Insect Repellent	169	8.00%	5	3.14%
Herbicide	152	7.19%	9	5.66%
Fungicide	22	1.04%	1	0.63%
Rodenticide	21	0.99%	5	3.14%
Other	49	2.32%	2	1.26%
Multiple	125	5.92%	13	8.18%
Unknown	22	1.04%	1	0.63%
Total	**2113**	**100.00%**	**159**	**100.00%**

A man in his 40s set off a fogger in a room and went back to close a window. He developed shortness of breath, coughing, wheezing, nausea, vomiting, eyes watering, drooling, and dizziness. He went to an emergency department.

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, 2006-2014 & 2014 Separately

Contributing Factor	Cumulative	Percent	2014	Percent
Mixing incompatible products	360	15.7%	36	20.6%
Label violations not otherwise specified	314	13.7%	24	13.7%
Spill/Splash of liquid or dust (not equipment failure)	227	9.9%	24	13.7%
Excessive application	216	9.4%	12	6.9%
No label violation identified but person still exposed/ill	160	7.0%	8	4.6%
Within reach of child or other improper storage	140	6.1%	11	6.3%
Drift contributory factors	96	4.2%	3	1.7%
People were in the treated area during application	87	3.8%	7	4.0%
Decontamination not adequate or timely	78	3.4%	7	4.0%
Structure inadequately ventilated before re-entry	68	3.0%	1	0.6%
Early re-entry	52	2.3%	3	1.7%
Notification/posting lacking or ineffective	41	1.8%	2	1.1%
Application equipment failure	34	1.5%	4	2.3%
Required eye protection not worn or inadequate	14	0.6%	4	2.3%
Required gloves not worn or inadequate	11	0.5%	0	0.0%
Applicator not properly trained or supervised	8	0.3%	0	0.0%
Other	62	2.7%	12	6.9%
Unknown	322	14.1%	17	9.7%
Total	**2290**	**100.0%**	**175**	**100.0%**

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 2014:

- 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.

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

- The PI of the pesticide surveillance program presented "Work-Related Injuries and Illnesses of Farm Workers" to the Migrant Child Task Force, a subcommittee of the Michigan Interagency Migrant Services Committee.

- The PI of the pesticide surveillance program presented "Pesticide Toxicity and Work-Related Injuries and Illnesses of Farm Workers" to Medicine Grand Rounds at Sparrow Medical Center.

- Safety information was sent to occupational cases and employers.

- 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 NIOSH sponsored meeting of pesticide surveillance states.

- The MDHHS staff coauthored an article with NIOSH and other states about the characteristics and magnitude of acute pyrethrin and pyrethroid exposures. (Hudson et al, 2014).

- MDHHS staff coauthored an article 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.

NIOSH Reports
In 2014, two events (one occupational and one non-occupational) met NIOSH's priority reporting criteria.

This event was reported because four or more persons became ill.

- Event MI03478 - Ten lifeguards and 17 members of the public were taken to a hospital with symptoms including sore throat, shortness of breath, skin irritation, eye irritation, headache and/or nausea after being exposed to chlorine gas released at a waterpark. A valve was closed while the pump was left on causing the release into the air. The county HazMat team responded and decontaminated people on site. MIOSHA investigated the release.

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

- MI04049 – An adult male put a Revenge Rodent smoke bomb EPA# 9086-4 in the ground and "it blew up". Smoke burned his shin and he inhaled smoke.

This next case, which did not qualify for a priority report, was sent to NIOSH and EPA because the person had suggestions to make total release foggers less likely to tip over when used. Her ideas were distributed within the EPA pesticide safety group.

- MI03979 – A city park manager in her 60s set off an insecticide fogger (signal word: Caution) in a restroom because it was infested with flies. The fogger fell over, so she picked it up. It was facing her, so she inhaled a large amount. She developed a cough that lasted for days, a burning sensation in her throat, chest tightness, difficulty breathing, a headache, and eye irritation. She called poison control. MDHHS sent her safety information and integrated pest management information.

One waterborne illness event was reported to the National Outbreak Reporting System (NORS)

- A family of five went to a hotel to swim on New Year's Eve. They noticed a strong chlorine smell and began to develop symptoms while in the pool. One child vomited after returning to their room. Other symptoms included nausea, vomiting, and skin irritation. They did not seek medical care other than calling poison control.

Discussion

Surveillance Data

There were fewer confirmed acute pesticide poisonings in 2014 than in 2013; 59 vs. 78 occupational cases and 155 vs. 376 non-occupational cases. The decrease in confirmed non-occupational cases was largely due to not including cases that did not seek medical care. There has been a general decrease in the number of confirmed occupational cases since 2008.

The number and proportion of confirmed cases related to disinfectant exposures remained high and continued to be an area of ongoing concern. In 2014, 50.0% of occupational cases and 47.2% of non-occupational cases were exposed to a disinfectant. We have long advocated limiting the use of disinfectants to where and when there is evidence that their use prevents the spread of infections.

Recently, the U.S. Food and Drug Administration (FDA) issued a final rule establishing that over-the-counter consumer antiseptic wash products containing any of a list of 19 disinfectants can no longer be marketed. Companies will no longer be able to market antibacterial washes with these active ingredients because manufacturers did not demonstrate that the ingredients are both safe for long-term daily use and more effective than plain soap and water in preventing illness and the spread of certain infections. Manufacturers will have a year to provide data on the safety and effectiveness of three additional disinfectants. See Appendix 2 for more details and a list of the active ingredients.

Although not covered by the new FDA regulations concern have been raised about the overuse of disinfectants in both non-health care and health care settings. Even in healthcare settings there are questions about how disinfectants are used and whether their use in certain areas such as hallway floors is effective in preventing disease. NIOSH convened a committee to review the use of disinfectants in health care and made multiple recommendations regarding their use and the need for further documentation of their effectiveness (Quinn et al, 2015). Evidence-based recommendations/regulations are still needed regarding the use of cleaning products containing disinfectants in healthcare non-healthcare and food establishments. In addition, 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 pesticide exposures, spills/splashes were the most common factor for confirmed occupational cases (25.9%), followed by mixing incompatible products (21.0 %). The most common factors contributing to non-occupational exposures were similar, with mixing incompatible products (20.6%) as the leading cause, followed by spills and splashes (13.7%) and label violations not otherwise specified, for example spraying into the wind, (13.7%). Better education and labeling might help to reduce the number of exposures.

Many confirmed cases in 2014 were "bystanders", i.e., engaged in work or living activities not related to the pesticide application (35.3% of occupational cases and 22.5% of non-occupational cases). Better education on safe pesticide application is needed to prevent inadvertent exposures, as well as the exposures to applicators.

Interventions
MDHHS continued to refer cases to other state and federal agencies as appropriate. MDHHS also worked to improve pesticide education for individuals, employers, health care providers, and other stakeholder groups through the distribution of fact sheets and the presentations listed above.

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. Almost three-quarters (74.6%) of confirmed occupational cases in 2014 were reported by the State's poison control center, and 61.9% 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" and an inability to refer cases to regulatory agencies in a timely manner.

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. We are heartened by the downward trend in this decade and will continue to conduct surveillance to monitor this trend.

References

Alarcon WA, Calvert GM, Blondell JM, Mehler LN, Sievert J, Propeck M, Tibbetts DS, Becker A, Lackovic M, Soileau SB, Das R, Beckman J, Male DP, Thomsen CL, Stanbury M. Acute illnesses associated with pesticide exposures at schools. *JAMA* 2005; 294: 455-565.

Azaroff LS, Levenstein C, Wegman D. Occupational injury and illness surveillance: Conceptual filters explain underreporting. *Am J Public Health* 2002. 92:1421-1429.

Calvert GM. Health effects from pesticide exposure. *American Family Physician* 2004; 69:1613-4,1616.

Calvert GM, Plate DK, Das R, Rosales R, Shafey O, Thomsen C, Male D, Beckman J, Arvizu E, Lackovic M. Acute occupational pesticide-related illness in the US, 1998-1999: surveillance findings from the SENSOR-pesticides program. *Am. J. Ind. Med* 2004; 45:14-23.

Calvert GM, Mehler LN, Alsop J, DeVries A, Besbelli N. Surveillance of Pesticide-Related Illness and Injury in Humans. In: Krieger R, editor. H*ayes' Handbook of Pesticide Toxicology*. 3rd ed. Elsevier Inc; 2009. p. 1313-1369.

Hudson NL, Kasner EJ, Beckman J, Mehler L, Schwartz A, Higgins S, Bonnar-Prado J, Lackovic M, Mulay P, Mitchell Y, Larios L, Walker R, Waltz J, Moraga-McHaley S, Roisman R, Calvert GM. Characteristics and Magnitude of Acute Pesticide-Related Illnesses and Injuries Associated With Pyrethrin and Pyrethroid Exposures—11 States, 2000–2008. *Am. J. Ind. Med.* 9999:1–16, 2014

Jacobson J, Wheeler K, Hoffman R, Mitchell Y, Beckman J, Mehler L, Mulay P, Schwartz A, Langley R, Diebolt-Brown B, Prado JB, Newman N, Calvert GM, Hudson N. Acute Illnesses Associated With Insecticides Used to Control Bed Bugs — Seven States, 2003–2010. *MMWR 2011;* 60(37): 1269-1274

Kasner EJ, Keralis JM, Mehler L, Beckman J, Bonnar-Prado J, Lee S-J, Diebolt-Brown B, Mulay P, Lackovic M, Waltz J, Schwartz A, Mitchell Y, Moraga-McHaley S, Roisman R, Gergely R, Calvert GM. Gender Differences in Acute Pesticide-Related Illnesses and Injuries Among Farmworkers in the United States, 1998–2007. *Am. J. Ind. Med.* 2012;55:571–583

Lee SJ, Mulay P, Diebolt-Brown B, Lackovic M, Mehler L, Beckman J, Waltz J, Prado J, Mitchell Y, Higgins S, Schwartz A, Calvert GM. Acute illnesses associated with exposure to fipronil – surveillance data from 11 states in the United States, 2001–2007. *Clinical Toxicology* 2010; 48:737–744

Mehler L, Beckman J, Badakhsh R, MPH, Diebolt-Brown B, Schwartz A, Higgins S, Gergely R, Calvert GM, Hudson N. Acute Illness and Injury from Swimming Pool Disinfectants and Other Chemicals --- United States, 2002—2008 *MMWR* 2011*;* 60(39); 1343-1347

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2013. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2012. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2011. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2010. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2009. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2008. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2007. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Pesticide Illness and Injury Surveillance in Michigan: 2006. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Occupational Pesticide Illness and Injury Surveillance in Michigan: 2005. www.michigan.gov/mdch-toxics

Michigan Department of Community Health, Division of Environmental Health. Occupational Pesticide Illness and Injury Surveillance in Michigan: 2004. www.michigan.gov/mdch-toxics

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

Quinn MM, Henneberger PK, Braun B, Delclos GL, Fagan K, Huang V, Knaack JL, Kusek L, Lee SJ, Le Moual N, Maher KA, McCrone SH, Hogan Mitchell A, Pechter E, Rosenman KD, Sehulster L, Stephens AC, Wilburn S, Zock JP. Cleaning and disinfecting environmental surfaces in health care: Toward an integrated framework for infection and occupational illness prevention. *Am J Infection Control* 2015 43(5):424-434. http://dx.doi.org/10.1016/j.ajic.2015.01.029

Roberts JR, Reigart JR. *Recognition and Management of Pesticide Poisonings. Sixth edition.* EPA,213. Available at http://www2.epa.gov/pesticide-worker-safety/recognition-and-management-pesticide-poisonings

Schenker MB, Offerman, SR, Albertson TE. *Pesticides in Environmental and Occupational Medicine, Fourth Edition.* Rom WN, Markowitz SB (eds). Lippincott Williams & Wilkins 2007. pp 1158-1179.

Schwartz A, Walker R, Sievert J, Calvert GM, Tsai RJ. Occupational Phosphine Gas Poisoning at Veterinary Hospitals from Dogs that Ingested Zinc Phosphide — Michigan, Iowa, and Washington, 2006–2011. *MMWR* 2012*;* 61(16): 286-288.

Tsai R, Sievert J, Prado J, Incident Reporting Program, Buhl K, Stone D, Forrester M, Higgins S, Mitchell Y, Schwartz A, Calvert GM. Acute Illness Associated with Use of Pest Strips — Seven U.S. States and Canada, 2000–2014. *MMWR* / January 17, 2014 / Vol. 63 / No. 2

Washington Department of Health. Improving Data Quality in Pesticide Illness Surveillance – 2004. June 17, 2004. http://www.doh.wa.gov/Portals/1/Documents/Pubs/334-286.pdf

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):
https://www.epa.gov/pesticide-worker-safety

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 1

Case Narratives, 2014 Confirmed Occupational Cases

Below are descriptions of the confirmed occupational cases reported in 2014. 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/insect growth regulators

MI03754 – A telephone service delivery technician in her 20s was getting something out of her van, and inadvertently hit the nozzle of a can of a pyrethroid insecticide (signal word: Caution). She was sprayed in her nose and mouth and developed oral and nasal irritation and swelling and had a bad taste in her mouth. She rinsed immediately. The can did not have a cap and she subsequently replaced the can to prevent this from happening again.

MI03771 – A greenhouse worker in her 30s moved plants that had recently been sprayed with an organophosphorous insecticide (signal word: Caution). She did not wear any personal protective equipment. She developed nausea, diarrhea, vomiting, abdominal pain, dizziness and a headache. She went to an emergency department and lost a week of work.

MI03772 – A pest control operator in his 30s used pyrethroids and other insecticides daily. He did not always wear his PPE. He developed anemia, shortness of breath and fatigue. He went to an emergency department and was admitted to the hospital for 4 days.

MI03773 – A hospital housekeeper inadvertently sprayed ant spray in her mouth. She developed nausea, vomiting, a headache, and tachycardia. She went to the emergency department.

MI03901 – A paramedic in her 20s was exposed to vomit and off-gassing by a woman who had ingested an organophosphorous insecticide (signal word: Warning) while they were transporting her to a hospital. She was decontaminated at the hospital but developed nausea and vomited later that day. She went to an occupational health clinic two days later (Monday).

MI03904 – A certified mosquito technician in his 40s was spraying with a mixture of a pyrethrin and a pyrethroid insecticides (both with signal word: Caution). He lifted his face shield to wipe sweat from his eyes, not realizing the products had misted onto his clothes. He developed burning, itchy, tearing eyes and called poison control.

MI03907 – A greenhouse owner in his 50s sprayed a mixture of two insecticides (signal words: Warning and Caution). His mask became loose so he took it off to refasten it on his face and inhaled the insecticide. He developed shortness of breath and pain with deep breathing and went to an emergency department.

MI03969 – A pest control operator in his 30s got insecticide (signal word: Caution) on his face. It became red and painful and he went to an urgent care center.

MI03979 – A city park manager in her 60s set off an insecticide fogger (signal word: Caution) in a restroom because it was infested with flies. The fogger fell over, so she picked it up. It was facing her, so she inhaled a large amount. She developed a cough that lasted for days, a burning sensation in her throat, chest tightness, difficulty breathing, a headache, and eye irritation. She called poison control. MDHHS sent her safety information and integrated pest management information. In addition MDHHS forwarded product safety ideas she had to NIOSH and the EPA.

MI03980 – A worker in her teens at a vineyard and polo club saw a clear gallon jug and thought it was water. She poured herself a glass and drank some before she realized that it wasn't. It contained diluted insecticide (signal word: Caution). She tried to rinse her mouth out with mouthwash followed by water, but still had a sore throat and stomach pain. She went to an emergency department.

MI03987 – A farm hand in his 60s was spraying an insecticide (signal word: Warning) in a soybean field and had blow-back to his face. His eyes, face, and neck began to burn. His eyes were tearing and his vision was blurry. He went to an urgent care center.

MI04013 – A greenhouse worker in her 50s was exposed to an insect growth regulator (signal word: Caution) working in the greenhouse for about two hours while the plants were being sprayed. That evening she developed a cough and sore throat. She went to an emergency department.

Herbicides

MI03766 – A lawn technician in his 20s sprayed an herbicide (signal word: Danger) under windy conditions. He did not wear PPE because it was too hot, and did not decontaminate at home. He "felt out of it" and was nauseous. He went to an emergency department.

MI03903 - A worker in his 40s had herbicide (signal word: Danger) splash in his face and eye when the container dropped. He flushed his eye immediately at work, and then again at home about an hour later. His eye was red and irritated and the next morning it was draining. He called poison control.

MI03961 – A worker in his 20s was treating ponds with an herbicide using a backpack sprayer that began to leak. His shirt became saturated with the product and he went home and showered. His skin became red and irritated and he went to an emergency department.

MI03975 – A lawn care employee in his 20s was spraying an herbicide (signal word: Caution) and some got in his eyes. He rinsed them promptly but had eye irritation that day and a headache the next day. He called poison control.

MI04032 – A farmer in his 30s was in a tractor spreading fertilizer while a neighbor was spraying crops with several different herbicides and hydrocarbons about ¼ mile away. He thought winds were 15-20 mph. The air conditioning sucked the herbicides into his tractor. The next day his throat was raw and irritated, he was nauseous, and could not keep any food down. He vomited and had diarrhea. He went to his doctor and called poison control.

Disinfectants

MI03746 – A county park maintenance worker in her 40s was cleaning a bathroom with a quaternary ammonium disinfectant (signal word: Danger) when the spray bottle became clogged. She turned it around to see what the problem was. The pressure had built up, and it squirted in her eye, which became irritated and teary. She rinsed it immediately and went to an emergency department. The park system replaced all the spray bottles, and now routinely replaces them every two months. In addition, all maintenance workers received new safety training.

MI03755 – A hairdresser in her 30s at a beauty parlor sprayed some improperly diluted disinfectant to clean a shampoo bowl. She inhaled it and developed a burning nose, difficulty breathing, and a cough. She called poison control. Information about safe disinfectant practices for hair salons was sent to her, to share with her employer.

MI03758 – A new janitor in his 30s cleaned an apartment bathroom with bleach and other chemicals. He developed shortness of breath and a headache and went to an emergency department. He said he still had difficulty breathing when interviewed ten months later.

MI03759 – A man in his 20s had a disinfectant splash in his eye. The product (signal word: Danger) was for institutional and industrial use. He developed eye irritation, blurred vision, and swelling. He called poison control and went to his doctor.

MI03761 – A hospital housekeeper in her 20s had disinfectant (signal word: Danger) spill on her arm. It became red and irritated and she went to an emergency department.

MI03764 – A hospital housekeeper in her 50s got disinfectant (signal word: Danger) in her face and eye, which both became irritated. She went to an occupational health clinic.

MI03769 – A worker in her 40s was cleaning apples with bleach. She developed shortness of breath, a cough, and high blood pressure. She went to an emergency department.

MI03885 – A lifeguard in his teens at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). He developed difficulty breathing, a cough, congestion and a burning sensation in his throat. He was treated on site and taken to an emergency department.

MI03886 – A lifeguard in her teens at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). She developed a cough, sore throat, chest

tightness with deep breathing, wheezes, and eye irritation. She was treated on site and taken to an emergency department.

MI03887 – A lifeguard in his teens at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). He developed difficulty breathing, dizziness, and a headache. He was treated on site and taken to an emergency department.

MI03888 – A lifeguard in his teens at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). He developed difficulty breathing and wheezing. He was treated on site and taken to an emergency department.

MI03889 – A lifeguard in her teens at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). She developed nausea, difficulty breathing, chest pain, sore throat, and a headache. She was treated on site and taken to an emergency department.

MI03890 – A lifeguard in his 20s at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). He developed difficulty breathing, a headache, irritated eyes and skin irritation. His skin peeled as if he were sunburned. He was treated on site and taken to an emergency department. He lost four days of work.

MI03891 – A lifeguard in her teens at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). She developed photophobia and a headache. She was treated on site and taken to an emergency department.

MI03892 – A lifeguard in her 20s at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). She developed a cough, difficulty breathing, sore throat, and dizziness. Later her skin was red and painful, as if she had a sunburn. She was treated on site and taken to an emergency department.

MI03893 – A lifeguard in his 20s at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). He developed difficulty breathing and a cough. He was treated on site and taken to an emergency department.

MI03894 – A lifeguard in her 20s at a waterpark was one of many staff and patrons exposed to chlorine gas that was released because a valve was closed while the pump was left on. The county HazMat team responded and twenty-seven people were taken to the hospital with respiratory issues and burning of mucus membranes. (Event MI03478). She developed difficulty breathing, nausea, and vomiting. She was treated on site and taken to an emergency department.

MI03895 – A worker in his 20s at a swimming school was pouring liquid chlorine and inhaled some. He developed shortness of breath, throat irritation, burning and tightness in his chest, a cough, and tachycardia. He went to an urgent care center.

MI03974 – A medical assistant in her 20s at a community health center was exposed to a disinfectant that a coworker was using to clean with. She developed burning, tearing eyes, her throat began to itch and swell, she had difficulty swallowing, and she also developed shortness of breath. She was given Benadryl at the health center and sent to an emergency department.

MI03978 – A cleaner in her 40s at a blueberry factory mixed two disinfectants. She inhaled the fumes and developed a sore throat, cough and wheeze. She went to an emergency department.

MI03985 – A hospital cleaner in her 20s was wringing out a wet cloth to wash a bed rail and was splashed in her right eye with the disinfectant (signal word: Danger). She rinsed it for five minutes before going to the emergency department. It was red and irritated and she had a corneal abrasion.

MI03991 – A pool attendant in her 20s opened pool chlorine tabs (signal word: Danger) s. Some tablets were wet and others dry and when she opened the lid strong fumes were released. She coughed, gagged, fainted and was tired for a couple of days. She went to an emergency department.

MI03992 – A manufacturing worker in his 40s got a disinfectant (signal word: Danger) in his right eye. He rinsed it for 30 minutes in the eyewash at work, but the symptoms continued so he went to an emergency department. He had blurred vision, decreased vision, photophobia, pain, redness, and keratitis.

MI03995 – A hospital custodian in her 20s spilled a container of disinfectant (signal word: Danger) on her hands. They were painful and had a white residue. She went to the emergency department.

MI03996 – A dental aid in her 20s got a disinfectant (signal word: Caution) in her eyes. She rinsed them at an eye wash station. They became red and irritated.

MI03997 – A worker in his 40s at a youth home replaced the lines for a cooling tower. When he came back from lunch he realized one line had popped out and chlorine was going into the tank of sulfuric acid. This created a fog in the room, and the building was evacuated. He developed pain on inspiration, a cough, a sore throat, difficulty breathing, tachycardia and elevated blood pressure. He went to an emergency department.

MI03999 – A hospital housekeeper in her 20s splashed a disinfectant (signal word: Danger) in her eye. It became red and irritated and she went to an emergency department.

MI04003 – A fast food worker in her 20s splashed a disinfectant (signal word: Caution) in her eye. It became painful and was tearing. She went to an emergency department.

MI04005 – A dog kennel worker in her 20s poured too much bleach on the floor to clean with. She developed a cough, sore throat, and irritated eyes. She called poison control.

MI04006 – A hospital janitor in her teens dropped a mop bucket and disinfectant (signal word: Danger) splashed in her eyes. They became red, dry, and itchy and she went to the emergency department.

MI04012 – A day care director in her 30s was helping a teacher clean with a disinfectant (signal word: Danger). Some splashed into her eye which became irritated and she had blurry vision. She called poison control.

MI04014 – A social service agency employee in her 50s poured a bottle of Pine sol into a toilet bowl. She inhaled fumes and developed nasal and throat irritation. A coworker called poison control.

MI04085 – A hospital housekeeper in her 30s was using a disinfectant wipe (signal word: Caution) and some disinfectant splashed into her eye. Her eye was irritated and she had altered visual acuity. She flushed it at work and went to an occupational health clinic where it was irrigated again.

MI04097 – A casino cleaner in her 60s was splashed in the eye with a disinfectant (signal word: Danger). She developed a red, irritated eye, and keratitis. She went to an emergency department.

MI04104 – A worker in his 20s cleaned with bleach and pine sol and inhaled fumes. He became dizzy, was nauseous, had difficulty breathing, had a headache, and his skin was tingling. He went to an emergency department.

MI04110 – A worker at a fitness center mixed bleach with another disinfectant and inhaled fumes. She developed chest tightness, a cough, nausea, and vomiting. She went to an urgent care center.

Fungicides

MI03757 – A farmer in his 50s was spraying rinse water from a pesticide tank that had contained a mixture of fungicides at about 3 AM when he felt as though some spray got in his mouth. He spit it out and then rinsed his mouth at home. The next afternoon he felt nauseous and had a stomach ache and his blood pressure was elevated. He went to an emergency department.

MI03902 – A greenhouse worker in his 20s set off a fungicide (signal word: Caution). He left, but returned to get his wallet He developed shortness of breath and throat irritation. He called poison control.

Algaecides

MI03994 – A pest control applicator in his 20s for an aquatic pest control company was clearing a pump on a boat. The pump was being used to apply algicide (signal word: Danger) on a lake. He was tightening clamps and a drop flew in his eye. He had taken his safety glasses off so he could see better. He developed a red, burning, tearing eye and went to an urgent care center.

MI01077 – A manager in his 20s at a lake and beach treatment company spilled an algicide (signal word: Caution) on his scrotum. He removed his clothing and washed the area immediately, but the next day it began to burn. On the day after that blisters formed. He went to an urgent care center five days after the exposure with open, weeping blisters. He lost two days of work.

Mixture

MI03910 – A farm manager in his 20s was detaching a line from a tractor with a boom containing a mixture of a fungicide (signal word: Caution and an insecticide (signal word: Danger). He yanked it and some of the diluted products splashed on his face. He got a taste in his mouth and a splash in his eye. He was not wearing the required eye protection. He rinsed immediately with water from a water bottle. He developed a numb tongue, eye irritation, became anxious and went to an emergency department.

Appendix 2

Safety and Effectiveness of Consumer Antiseptics; Topical Antimicrobial Drug Products for Over-the-Counter Human Use[8]

Excerpts

This final rule covers only over-the-counter consumer antiseptic washes that are intended for use as either a hand wash or a body wash, and does not cover health care antiseptics, consumer antiseptic rubs, antiseptics identified as "first aid antiseptics", or antiseptics used by the food industry.
The FDA considered 22 active ingredients. They deferred rulemaking on three active ingredients to allow for the development and submission of new safety and effectiveness data to the record for these ingredients. The deferred active ingredients are benzalkonium chloride, benzethonium chloride, and chloroxylenol.

For the remaining 19 ingredients, the FDA determined that "The data and information submitted for these active ingredients are insufficient to demonstrate that there is any additional benefit from the use of these active ingredients in consumer antiseptic wash products compared to nonantibacterial soap and water." And "The available information and published data for the 19 active ingredients considered in this final rule are insufficient to establish the safety of long-term, daily repeated exposure to these active ingredients used in consumer wash products."

The nineteen active ingredients that may no longer be added to hand soaps and body washes:

- Cloflucarban
- Fluorosalan
- Hexachlorophene
- Hexylresorcinol
- Iodophors (Iodine-containing ingredients)
  - Iodine complex (ammonium ether sulfate and polyoxyethylene sorbitan monolaurate)
  - Iodine complex (phosphate ester of alkylaryloxy polyethylene glycol)
  - Nonylphenoxypoly (ethyleneoxy) ethanoliodine
  - Poloxamer—iodine complex
  - Povidone-iodine 5 to 10 percent
  - Undecoylium chloride iodine complex
- Methylbenzethonium chloride
- Phenol (greater than 1.5 percent)
- Phenol (less than 1.5 percent)
- Secondary amyltricresols
- Sodium oxychlorosene
- Tribromsalan
- Triclocarban
- Triclosan
- Triple dye

[8] https://www.federalregister.gov/articles/2016/09/06/2016-21337/safety-and-effectiveness-of-consumer-antiseptics-topical-antimicrobial-drug-products-for