Pesticide Illness and Injury Surveillance in Michigan

2008

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Division of Environmental Health
Michigan Department of Community Health

Jennifer M. Granholm, Governor
Janet Olszewski, Director

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Summary

The Michigan Department of Community Health (MDCH) has been conducting surveillance for acute work-related pesticide illnesses and injuries since 2001, and 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), for chemical poisoning (R325.71-R325.75), and for laboratory cholinesterase test results (R325.61 and R325.68). This is the sixth annual report on work-related pesticide illnesses and injuries in Michigan. It includes data on laboratory reporting of cholinesterase blood results and non-occupational surveillance.

From 2001 through 2008, 862 reports of occupational exposures and pesticide illness or injury were received and 615 (71.3%) were confirmed as cases according to the surveillance case definition. In 2008, there were 165 reported occupational cases; 125 (75.8%) were confirmed.

Michigan's Poison Control Centers (PCC) remain the main data source, reporting 114 (69.1%) occupationally exposed individuals. Antimicrobials continue to be a major type of exposure. In 2008, antimicrobials accounted for over two-thirds of the confirmed occupational cases.

The most common contributing factors involved in confirmed occupational cases were spills or splashes of liquid or dust (29 or 25.0%) and mixing incompatible products (27 or 23.3%).

Fourteen (16.1%) of the confirmed cases in 2008, where occupation was known, involved cleaners or housekeepers. Ten (11.5%) were in sales. Eight each (9.2%) were farm workers or inspectors, food service workers, and applicators or landscapers. Where activity of the exposed person was known, 31 (28.4%) were exposed to pesticides inadvertently while doing their regular work that did not involve applying pesticides.

Three cases in 2008 were referred to the Michigan Department of Agriculture (MDA) for investigation of possible pesticide use violations. Five events met the criteria for priority reporting to the National Institute for Occupational Safety and Health (NIOSH). Two events were referred for inclusion in the MDCH Hazardous Substance Emergency Event Surveillance (HSEES) program. These events are described on pages 22 and 23.

Three hundred seventy-six non-occupationally exposed pesticide cases were reported, of which 131 (34.8%) met the definition of a confirmed case. The most common contributing factors for confirmed non-occupational cases were excessive applications and other non-specified label violations (18 or 16.5% each), followed by mixing incompatible products (11 or 10.1%).

Section I: Occupational Pesticide Illness and Injury Surveillance

Background

Acting on concerns about acute occupational pesticide-related illness, NIOSH began collecting standardized information about acute occupational pesticide exposure from selected states in 1998[1] 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).

Pesticide use is widespread in Michigan. In 2007, there were 15,501 different pesticides registered for sale and use in Michigan. There are approximately 16,000 different pesticide products currently used in the United States, and each of them contains one or more of approximately 600 approved pesticide active ingredients. According to the U.S. Environmental Protection Agency (EPA), 1.23 billion pounds of pesticides (excluding antimicrobials and wood preservatives) are used annually[2] in the United States.

Businesses are required to obtain a license from the MDA if they hold themselves out to the public as being in the business of applying pesticides for hire. There are 1,923 businesses licensed to apply pesticides in Michigan. Pesticide applicators are certified by the MDA as either private or commercial. Private certification includes applicators involved in the production of an agricultural commodity (farmers). Agriculture is the second largest income-producing industry in Michigan. All other certified applicators are considered commercial. These include such categories as forestry, wood preservation, ornamental and turf pest control, seed treatment, aquatic, swimming pool, right-of-way, structural pest control, general pest management, mosquito control, aerial, fumigation and several others. In 2007, there were a total of 22,245 certified pesticide applicators and 1,923 licensed businesses. Table 1 shows the number of licensed businesses and certified applicators since 2001.

Table 1

Pesticide Licensing and Certification, 2001-2007							
Type	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Private Certification	10,596	10,075	9,576	9,200	8,793	8,352	8,122
Commercial Certification	13,045	13,089	13,387	13,588	13,485	13,743	14,123
Total Certifications	23,641	23,164	22,963	22,788	22,278	22,095	22,245
Licensed Businesses *	NA	NA	1,755	NA	1,900	1,962	1,923

* The number of licensed businesses in 2001, 2002, and 2004 is not available.

MDA is the agency that regulates pesticide use, and misuse. The Pesticide and Plant Pest Management Division of MDA investigates all allegations of pesticide misuse. They also perform random inspections of licensed businesses. Table 2 shows MDA's staff levels and some of the oversight activities of those staff. Due to budgetary constraints, the number of staff has decreased over time.

[1] http://www.cdc.gov/niosh/topics/pesticides/
[2] http://www.epa.gov/oppbead1/pestsales/01pestsales/usage2001.htm

Table 2

Pesticide Inspections and Investigations, 2001-2007							
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Misuse Investigations	194	165	132	153	182	231	178
Random Inspections	1,126	1,077	1,261	1,266	1,175	797	655
# of Field Staff	20	20	20	18	18	15	15

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

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

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

Methods

Occupational pesticide poisoning is reportable under the Public Health Code (Part 56 of Act 368 of 1978, as amended). This law requires health care providers (including Michigan's two Poison Control Centers), health care facilities, and employers to report information about individuals (including names) with suspected or confirmed work-related diseases to the state. In October 2005, laboratories started reporting acetylcholinesterase and pseudocholinesterase test results in accordance with R 325.61 and R 325.68 additions to the Michigan Public Health Code. These tests are sometimes ordered for patients exposed to organophosphate and carbamate insecticides. Regulations to require the reporting of all pesticide injuries and illnesses went into effect September 18, 2007 (R 325.71-5).

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

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

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

Reported 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.

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 are considered confirmed cases.

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

Confirmed cases are evaluated regarding the severity of the health effect: low, moderate, high and death. The severity index is based on the signs and symptoms experienced, whether medical care was sought, if a hospital stay was involved, and whether work time was lost.[6]

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

In addition, NIOSH is provided information about high priority events. The criteria for defining high priority events are:

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

With prompt reporting of these events by states involved in pesticide illness and injury surveillance, NIOSH can refer cases to the EPA as needed, identify clusters across states, and identify the need for national level interventions.

Finally, if appropriate, MDCH surveillance staff provide educational consultations to reported individuals and their employers about reducing hazards related to pesticide exposures.

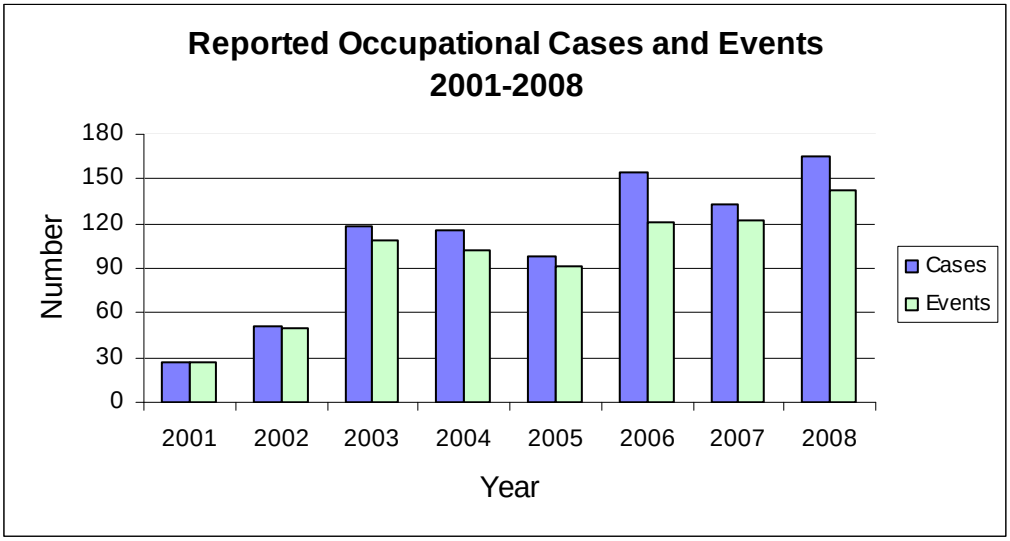
[6] http://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sevindexv6.pdf

Results

Reports

There were 862 reports of acute occupational pesticide poisonings from 2001 – 2008. These represent 766 separate events, 143 of which were reported in 2008. Figure 1 shows the number of reported occupational cases and events by year.

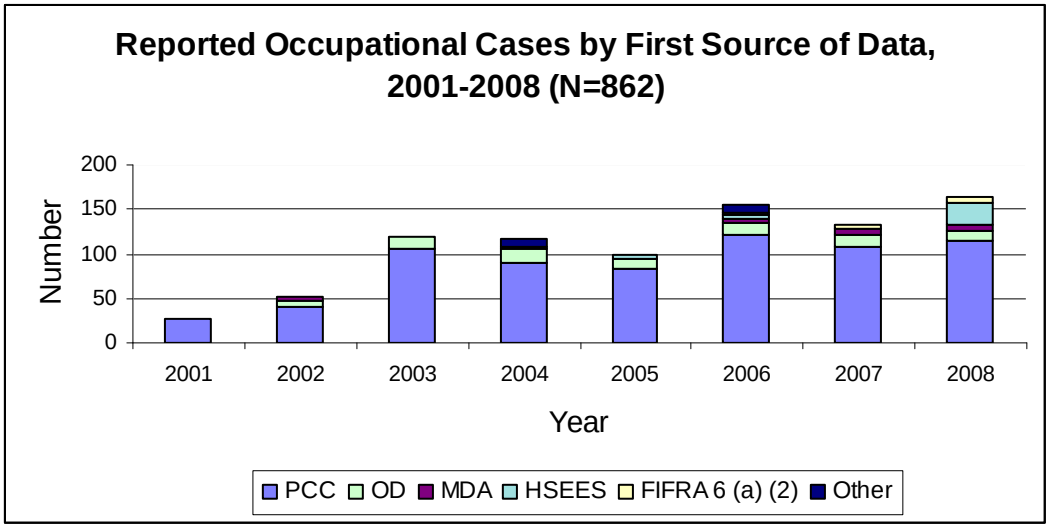
Figure 1



Data Source

The distribution of the sources of the case reports is shown in Figure 2. The Poison Control Centers (PCC) remain the major source of reports. In 2008, 114 (69.1%) of the 165 reported cases were reported by the PCCs. Twenty-six (15.8%) were reported by HSEES. Figure 2 indicates by year the initial source of the cases received. Some cases were reported by multiple sources.

Figure 2



The average time between the event and the report to the State varied by reporting source. Table 3 shows the average number of days between the occurrence of the event and its report to the surveillance system, the median number of days, the number of incidents reported on the day of occurrence, and the percent reported the same day for each data source.

Table 3

Lag Time by Data Source, 2008 Reported Occupational Cases (N=165)				
Source	**Average # of Days**	**Median # of Days**	**# Cases Reported Same Day**	**% Cases Reported Same Day**
PCC	17	2	33	28.9%
OD	305	301	0	0.0%
MDA	187	213	0	0.0%
FIFRA 6 (a) (2)	455	456	0	0.0%
HSEES	20	5	1	3.8

Classification

Of the 862 occupational cases reported from 2001 through 2008, 615 (71.3%) met the criteria to be considered confirmed cases. In 2008, 125 (75.8%) cases were considered confirmed cases. See Table 4.

Table 4

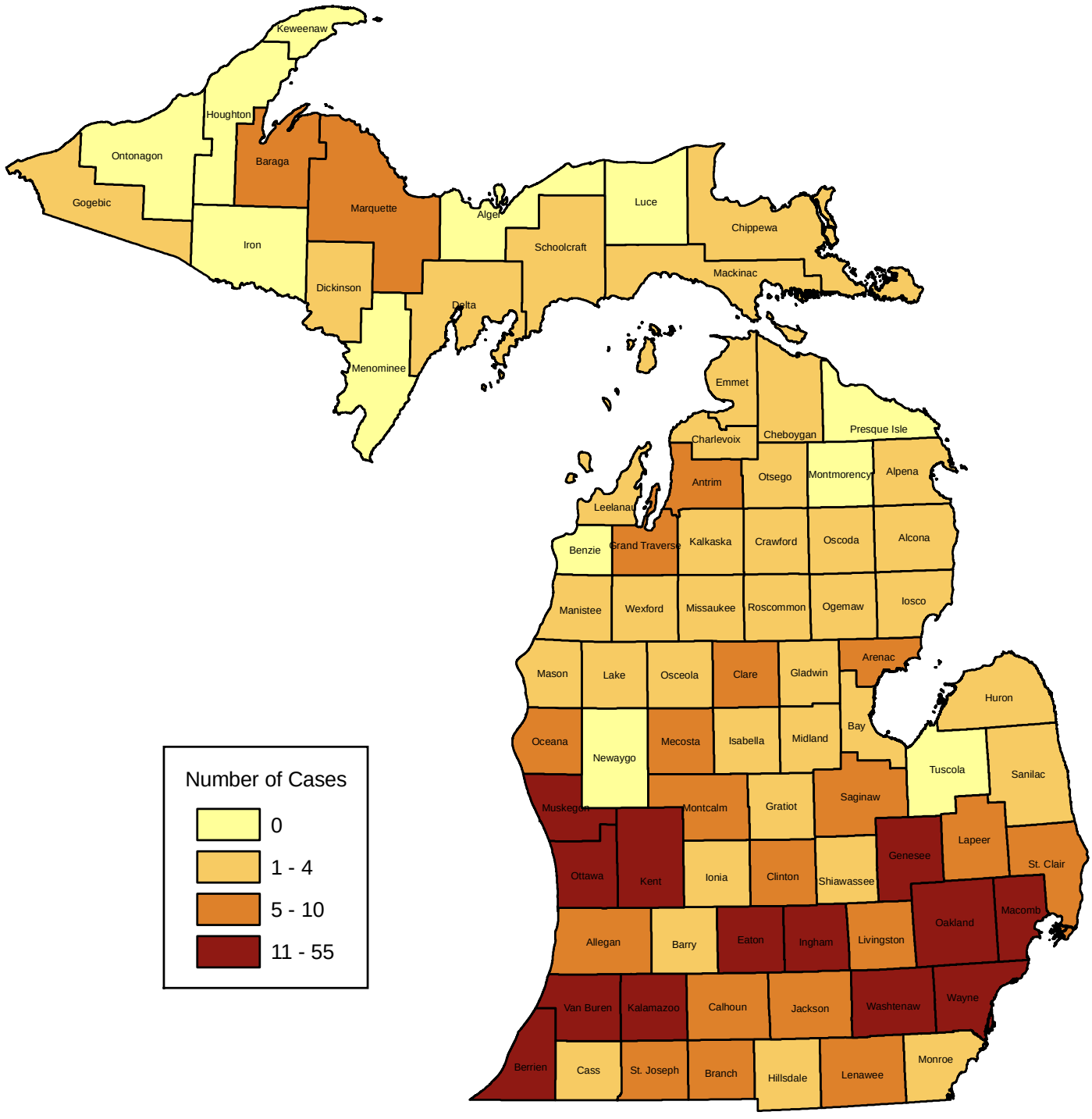
Reported Occupational Cases by Classification, 2008 and 2001-2008				
	2008		**2001-2008**	
Classification	**Number**	**Percent**	**Number**	**Percent**
Confirmed cases				
Definite	9	5.5	83	9.6
Probable	20	12.1	128	14.8
Possible	88	53.3	365	42.3
Suspicious	8	4.8	39	4.5
Total confirmed	*125*	*75.8*	*615*	*71.3*
Not confirmed				
Unlikely	0	0.0	2	0.2
Insufficient Information	36	21.8	209	24.2
Exposed, Asymptomatic	1	0.6	26	3.0
Unrelated	3	1.8	10	1.2
Total not confirmed	*40*	*24.2*	*247*	*28.7*
Total	165	100.0	862	100.0

Location in State

In 2008, there were no known confirmed occupational cases in 45.8% of Michigan's counties (38 of 83 counties). For 16 (12.8%) confirmed cases in 2008, county of exposure was unknown. Arenac County had 10 confirmed cases, and Kent and Macomb Counties had 8 confirmed cases each in 2008. Since the numbers per county are low, Figure 3 shows the distribution of all confirmed occupational cases for the years 2001-2008 to preserve anonymity. During that time period, the county of exposure was unknown for 96 (15.6%) confirmed cases.

Figure 3

Confirmed Occupational Pesticide Poisoning Cases by County of Exposure, 2001-2008 (N= 519*)



* County of exposure was unknown for 96 of the 615 confirmed cases.

The summary information that follows compares data from the 125 confirmed occupational cases reported in 2008. These represent 109 separate events. Appendix I contains a brief narrative of each confirmed occupational case reported in 2008. See the previous annual reports for brief narratives of confirmed cases from previous years.

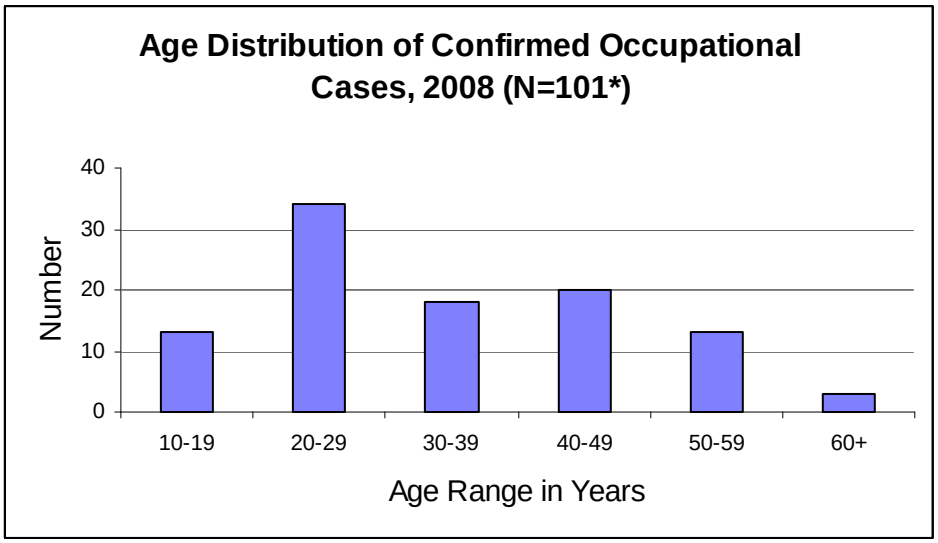
Demographics

Gender
Of the 125 persons with confirmed work-related pesticide illnesses or injuries, 10 (8.0%) were of unknown gender. Where gender was known, 60 (52.2%) were men, and 55 (47.8%) were women.

Race and Ethnicity
For 63 (50.4%) individuals, race was unknown. Where race was known, 55 (88.7%) were white. Ethnicity was unknown for 71 (56.8%) cases. Where it was known, 1 (1.9%) were Hispanic.

Age
The age distribution of the individuals where the age was known is shown in Figure 4. The median age was 32.2, with a range of 16 to 65. Most (71.3%) of the exposed individuals were 20-49 years old.

Figure 4



* Age was unknown for 24 of the 125 confirmed occupational cases.

Industry[7]

Industry of employment was known for 108 (86.4%) of the 125 confirmed cases.
As table 5 shows, the industry categories with the most persons exposed to a pesticide in 2008 were "Accommodation and Food Services" with 17 workers and "Arts, Entertainment, and Recreation" with 14 workers. "Agriculture, Forestry, Fishing, and Hunting" and "Retail Trade" each had 11 exposed workers. Ten of the workers in "Arts, Entertainment, and Recreation" were casino workers who were exposed in the same incident, while washing coins. (See MI1326-MI1335 in Appendix I for more information.) Five of the "Professional, Scientific, and Technical Services" cases worked in veterinary services; four were exposed in the same event due to zinc phosphide poison reacting with a dog's stomach acid to create phosphine gas. (See MI.1433-MI1438 in Appendix I for more information). Five of the "Administrative and Support and Waste Management and Remediation Services" were involved in lawn care or landscaping. Prior to 2007, the 1990 Census Industry Codes were used so those data are not comparable.

Table 5

Industry of Confirmed Cases, 2008 (N=108*)

Type of Industry	Number	Percent
Accommodation and Food Services	17	15.7
Arts, Entertainment, and Recreation	14	13.0
Agriculture, Forestry, Fishing, and Hunting	11	10.2
Retail Trade	11	10.2
Health Care and Social Assistance	10	9.3
Administrative and Support and Waste Management and Remediation Services	10	9.3
Manufacturing	6	5.5
Professional, Scientific, and Technical Services	6	5.5
Other	23	21.3
Total	108	100.0

* Industry was unknown for 17 of the 125 confirmed occupational cases.

Occupation[8]

Occupation was known for 87 (69.6%) of the 125 confirmed cases and is shown in Table 6.

The most common occupation was "Building and Grounds Cleaning and Maintenance". This included 14 cleaners/housekeepers/maintenance personnel. Ten (11.5%) workers were in sales. Eight each (9.2%) were farm workers or inspectors, food service workers, and applicators or landscapers In previous years, the 1990 Census Occupation Codes were used so the data are not comparable.

[7] Categorized based on 2002 North American Industry Classification System (NAICS) codes http://www.census.gov/epcd/naics02/naicod02.htm

[8] Categorized based on 2002 US Bureau of Census Occupation Codes http://www.census.gov/hhes/www/ioindex/ioindex02/view02.html

Table 6

Occupation of 2008 Confirmed Cases (N=87*)		
Occupation	**Number**	**Percent**
Building and Grounds Cleaning and Maintenance	22	25.3
Sales and Related	10	11.5
Food Preparation and Serving Related	8	9.2
Farming, Forestry, and Fishing	8	9.2
Production	6	6.9
Management	6	6.9
Other	27	31.0
Total	87	100.0

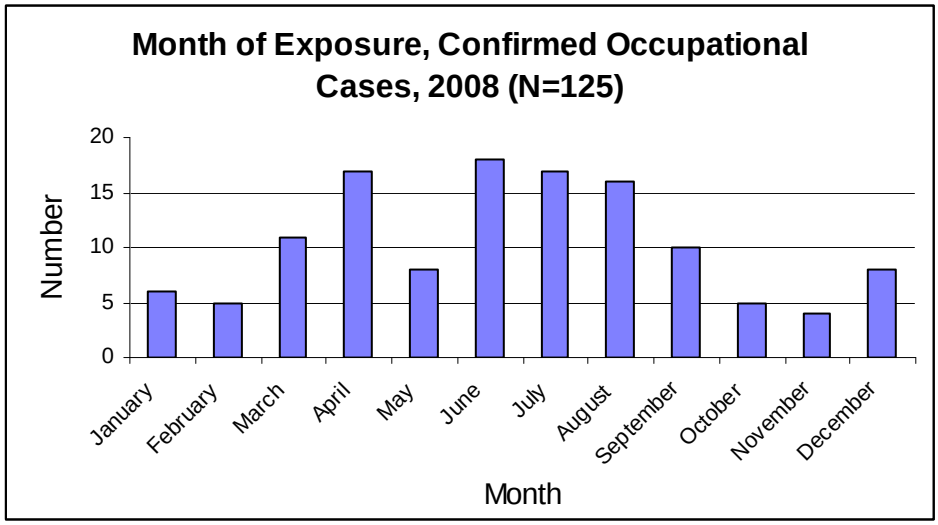
* Occupation was unknown for 38 of the 125 confirmed occupational cases.

Exposures

Month of Exposure

Figure 5 shows that confirmed cases were more likely to be exposed in the spring and summer months.

Figure 5

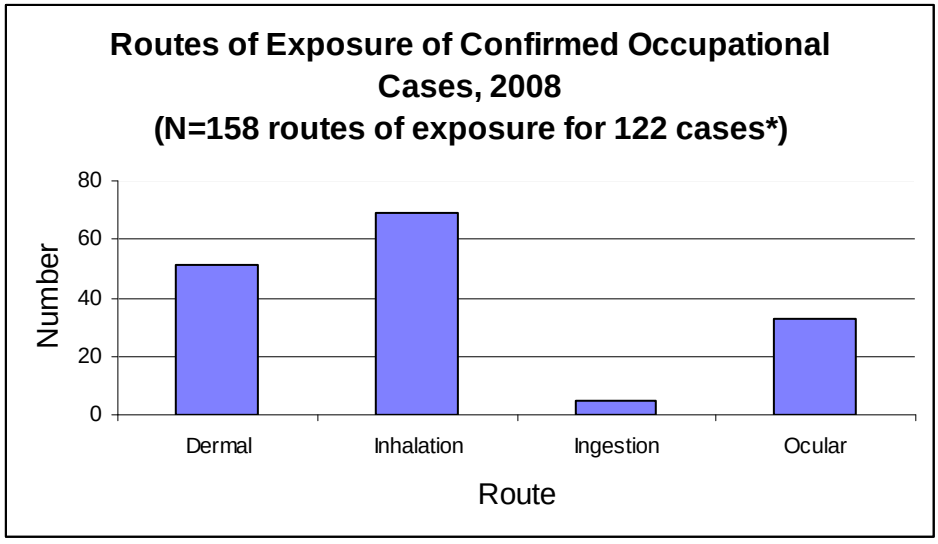


Route of Exposure

Route of exposure indicates how the pesticide entered the body. Figure 6 shows that 122 individuals identified one or more routes of exposure for a total of 158 routes, including 69 inhalation exposures, 51 dermal exposures and 33 ocular exposures. Twenty-eight individuals were exposed through two different routes while four had three routes of exposure.

An inspection division manager for an engineering company that has a specialty in water storage cleaned the inside of a water tank, using a fire hose to remove sediment. The next step was to add powdered chlorine. Another employee spilled some of the chlorine into the tank from a bucket just as the division manager was looking up and some got in the division manager's left eye. He'd removed his safety glasses because they'd fogged up. His eye hurt initially but then felt fine until he removed his contacts seven hours later. His eye was swollen, red, burning and tearing. He went to an emergency department.

Figure 6



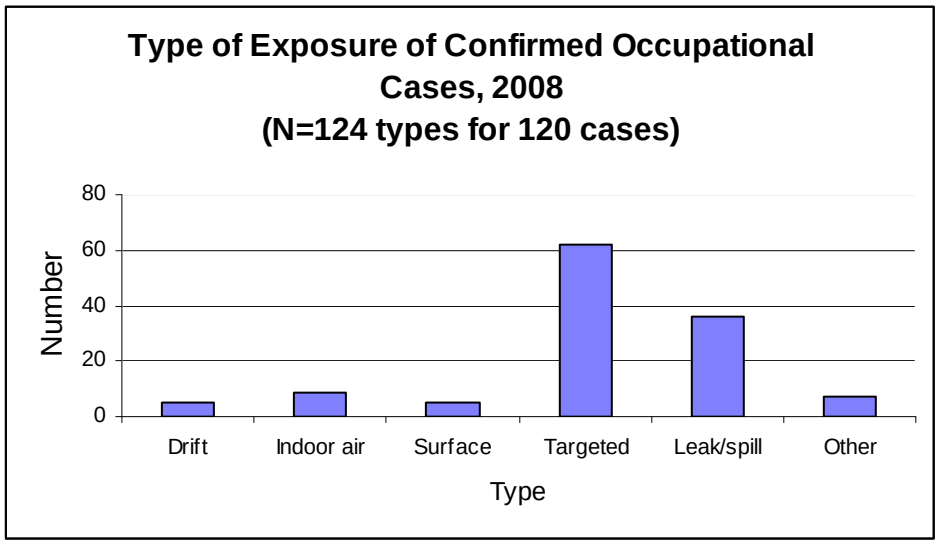
*Route of exposure was unknown for three confirmed cases; 32 had multiple routes of exposure.

Type of Exposure

A 25-year-old nurse sprayed a bed in a prison infirmary with a phenolic disinfectant. She developed difficulty breathing, a sore, swollen throat, anxiety, and rapid heart beat. She was seen on site by a nurse practitioner and taken by ambulance to an emergency department.

Figure 7 shows how workers who became ill were exposed to pesticides. Exposure during a targeted application accounted for 62 exposures. Exposure from an unintentional leak or spill accounted for an additional 36 exposures. For five cases, the type of exposure was unknown. Four workers experienced two types of exposure.

Figure 7



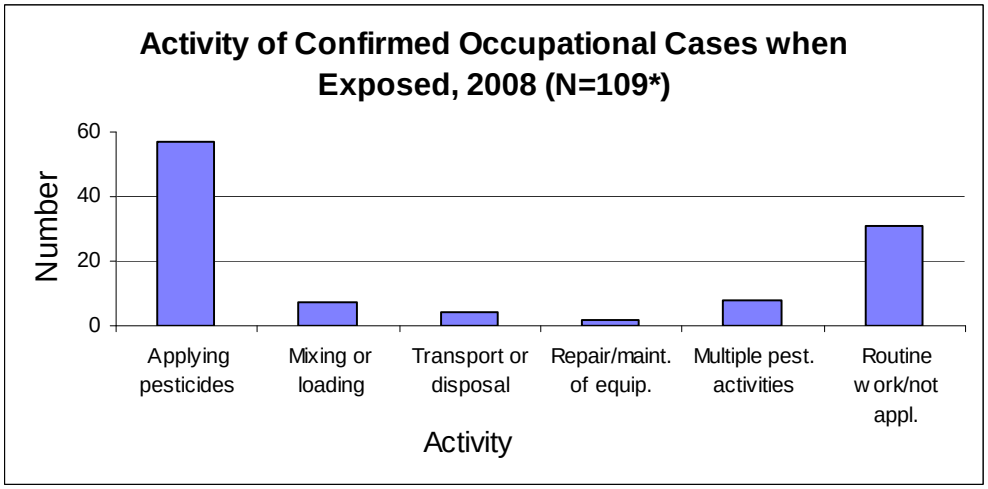
*Type of exposure was unknown for five confirmed cases; four cases had two types of exposure.

Activity at Time of Exposure

Activity at time of exposure was determined for 109 (87.2%) of the confirmed cases. Of those, Figure 8 shows that 31 (28.4%) were doing work activities that did not involve pesticide applications and thus had "bystander" exposure. Fifty-seven (52.3%) individuals who became ill were applying pesticides when they were exposed.

A delivery truck driver had a pallet fall over, causing the powdery residue of a fungicide to rise in a cloud, which he inhaled. He developed trouble breathing, burning in his nose and throat, burning in his chest, chest tightness, hoarseness, runny nose, and tingling in his arms. He was decontaminated by HazMat officials and taken to an emergency department by ambulance. He was told to stay off work for the weekend.

Figure 8



* Activity was unknown for 16 of the 125 confirmed occupational cases.

Medical Care

Table 7 shows where confirmed cases first sought medical care. Fifty-seven (45.6%) of the cases first sought medical advice from poison control. Almost as many (56 or 44.8%) first sought care at an emergency department or urgent care center; of those, 25 (44.6%) involved cases where medical personnel consulted with poison control which then reported the case to MDCH.

Table 7

First Source of Medical Care of Confirmed Occupational Cases, 2008 (N=125)		
First Care	**Number**	**Percent**
Advice from poison control	57	45.6
Emergency room/urgent care	56	44.8
Occupational health clinic	5	4.0
Other, including EMS	4	3.2
Physician office visit	2	1.6
No medical care sought	1	0.8
Total	125	100.0

Product Used

Among confirmed cases, the most common exposure was to antimicrobials (67.2%), followed by insecticides (15.2%). See Table 8

Table 8

Product Type of Confirmed Occupational Cases, 2008 (N=125)		
Product Type	**Number**	**Percent**
Antimicrobial	84	67.2
Insecticide	19	15.2
Herbicide	9	7.2
Rodenticide	4	3.2
Fungicide	2	1.6
Fumigant	1	0.8
Pheromone	1	0.8
Mixture	5	4.0
Total	125	100.0

Severity

Table 9 shows the severity of the case by the type of product used. Most cases (87.2%) were low severity, with no reported deaths in 2008.

A rural letter carrier was sorting letters at the post office when the custodian sprayed some ants with a pyrethroid insecticide near her feet. She had a history of asthma and was exposed for about 10 minutes before she had to leave due to difficulty breathing, cough, wheezing, and trouble swallowing. She went to an emergency department and lost about three weeks of work.

Table 9

Severity by Product Type of Confirmed Occupational Cases, 2008 (N=125)								
Product Type	**Low**		**Moderate**		**High**		**Total**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Antimicrobial	71	65.1	13	92.9	0	0.0	84	67.2
Insecticide	18	16.5	0	0.0	1	50.0	19	15.2
Herbicide	8	7.3	0	0.0	1	50.0	9	7.2
Rodenticide	4	3.7	0	0.0	0	0.0	4	3.7
Fungicide	2	1.8	0	0.0	0	0.0	2	1.6
Fumigant	1	0.9	0	0.0	0	0.0	1	0.8
Pheromone	1	0.9	0	0.0	0	0.0	1	0.8
Mixture	4	3.7	1	7.1	0	0.0	5	4.0
Total	109	100.0	14	100.0	2	100.0	125	100.0

Pesticide products are assigned a signal word[9] based on acute 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). Table 10 shows the severity of the case by signal word, when known. Most cases, no matter the signal word (83.8%) were low severity. The two high severity cases were both considered slightly toxic with a signal word of Caution.

Table 10

Severity by Signal Word of Confirmed Occupational Cases, 2008 (N=74*)								
Signal Word	**Low**		**Moderate**		**High**		**Total**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Caution	35	56.5	1	10.0	2	100.0	38	51.4
Warning	5	8.1	1	10.0	0	0.0	6	8.1
Danger	22	35.5	8	80.0	0	0.0	30	40.5
Total	62	100.0	10	100.0	2	100.0	74	100.0

* For 51 confirmed cases the signal word was unknown or there was a mixture of products with different signal words.

Contributing Factors

Identifying factors contributing to the exposure or illness/injury can improve prevention activities. Table 11 shows the contributing factors, when known, for the confirmed occupational cases in 2008. The most common factors were spills or splashes of liquid or dust and mixing incompatible products. See Appendix II for a description of the contributing factor codes.

[9] http://www.epa.gov/oppfead1/labeling/lrm/chap-07.htm Precautionary Statements

Table 11

Contributing Factors for Confirmed Occupational Cases, 2008 (N=116*)		
Code	Factor	N
01	Notification/posting lacking or ineffective	2
02	People were in the treated area during application	3
03	Inadequate ventilation of treated area before re-entry	1
04	Early re-entry	0
05	Required eye protection not worn or required eye protection inadequate	8
06	Required gloves not worn or required gloves inadequate	3
07	Required respirator not worn or required respirator inadequate	2
08	Other required PPE not worn or inadequate	0
09	Spill/splash of liquid or dust (not involving application equipment failure)	29
10	Application equipment failure	8
11	Pesticide stored within reach of child or other improper storage	1
12	Decontamination not adequate or timely	5
13	Intentional harm	2
14	Excessive application of pesticide	5
15	Label violations NOS (Not otherwise specified, other regulatory issues)	11
16	No label violation identified but person still exposed/ill	4
17	Drift	5
18	Applicator not properly trained or supervised	0
19	Illegal pesticide used/illegal dumping of pesticide	0
20	Mixing of incompatible products	27
97	Other (consider new code)	0
98	Not applicable	0

* Contributing factors were unknown for 26 confirmed cases, while 17 cases had two contributing factors.

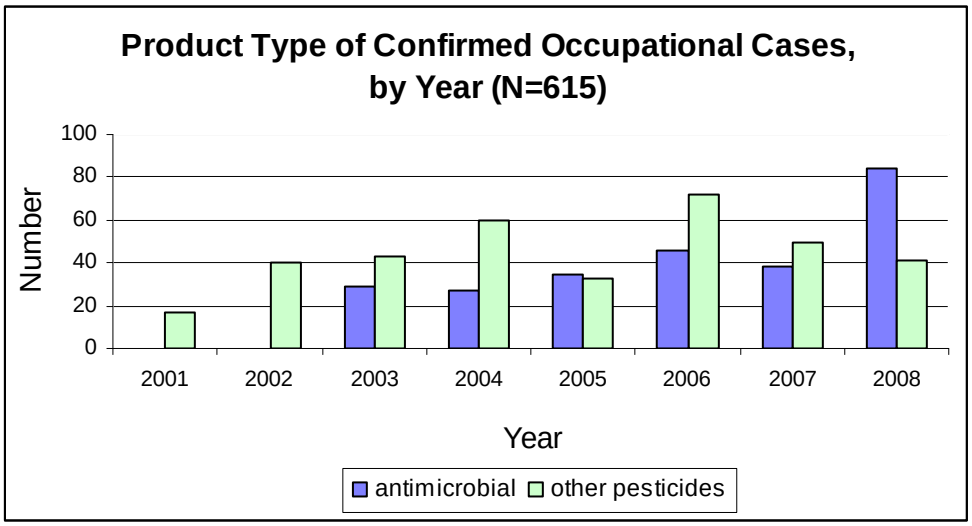
Antimicrobials

Antimicrobial pesticides are substances or mixtures of substances used to destroy or suppress the growth of microorganisms such as bacteria, viruses, or fungi on inanimate objects and surfaces.[10] Antimicrobials are registered by the EPA, just as other pesticides are.

While antimicrobial have always been a substantial portion of confirmed occupational cases, that portion increased in 2008 to over two-thirds of all confirmed occupational cases.

[10] http://www.epa.gov/oppad001/ad_info.htm "What Are Antimicrobial Pesticides?"

Figure 9



Confirmed cases from 2008 with antimicrobial pesticide exposures were compared to cases with exposures to other pesticides:

Gender

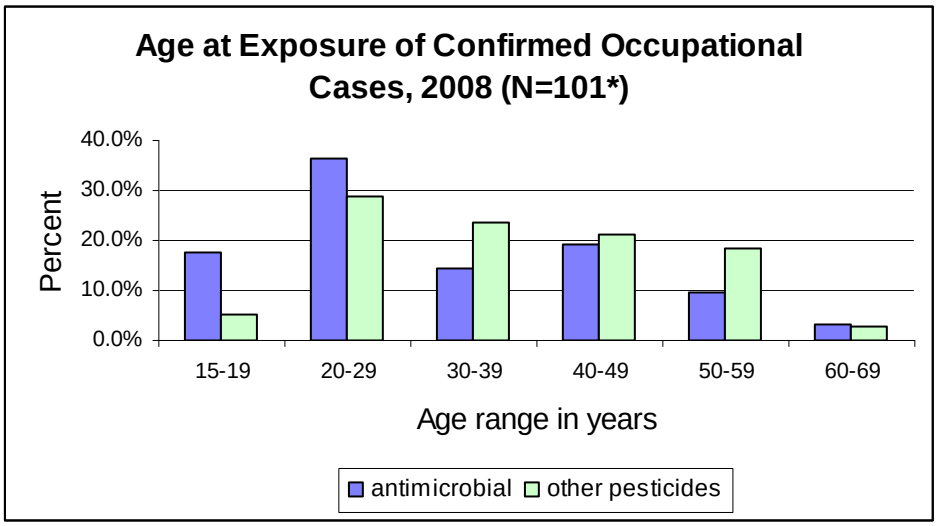
When gender was known, exposure to antimicrobials was similar to exposure to other pesticides, with men accounting for 51.4% of antimicrobial exposures and 53.7% of non-antimicrobial exposures.

Age

Figure 10 shows that workers exposed to antimicrobials tended to be younger (median age 24.7) than those exposed to other pesticides (median age 34.9).

A teenage fast food worker mixed cleaners, including an acid disinfectant (signal word: Danger), a pine oil disinfectant (signal word: Warning), a cleaner containing bleach, and a degreaser, to clean a mop closet. Foam and fumes including chlorine gas were created. She was exposed for about three minutes. She developed a cough, burning throat and her hands turned yellow. She called poison control. The business was evacuated.

Figure 10



* Age was unknown for 24 of the 125 confirmed cases.

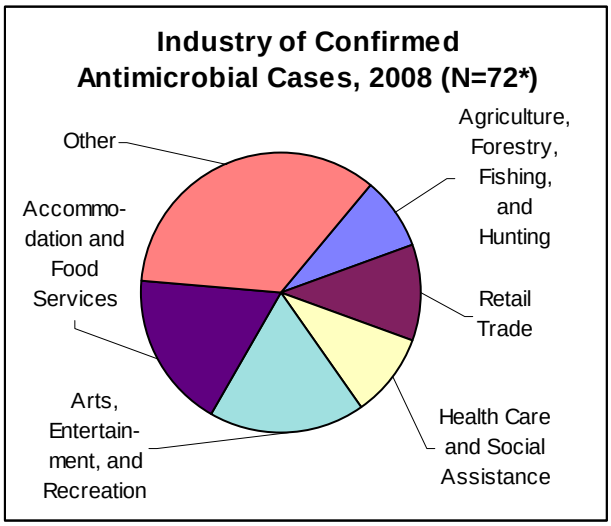
Industry

In almost one-fifth of the antimicrobial cases, the exposed person was working in Accommodation and Food Service. An equal number were working in Arts, Entertainment, and Recreation, ten of whom were exposed while washing coins in a casino. Among other pesticide cases, the largest group was in Administrative and Support and Waste Management and Remediation Services, followed by Agriculture, Forestry, Fishing, and Hunting. See Figures 11 and 12.

A teenage cook was cleaning out a sink with a solution of bleach and water. His boss told him to use gloves, but he didn't, since he'd never had a reaction before. The solution may not have been diluted enough. His hands turned red and hurt very badly, with a burning sensation. His fingers were a little swollen. He called poison control and now wears gloves when cleaning with bleach.

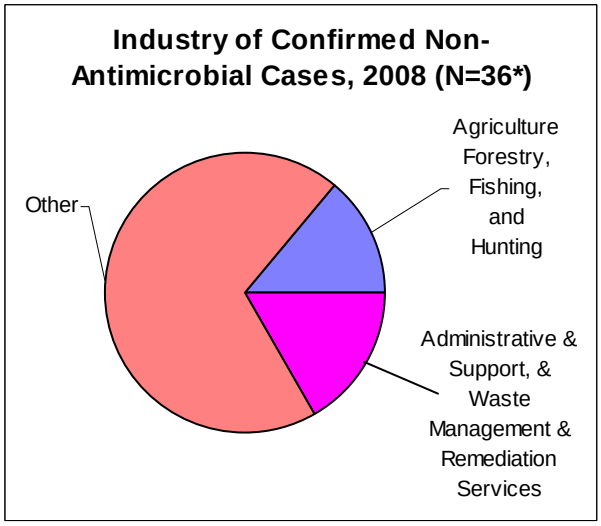
An ultrasound technologist in her 40s used an aldehyde sterilizer (signal word: Danger) for sterilizing ultrasound probes. She dipped a test strip in the solution and ran it around the edge of the container to remove excess liquid. The test paper flew off and flung a drop in her eye. She was not wearing required goggles, or any eye protection. Her eye was burning, tearing and her vision was blurry. The eye was swollen the next day and still painful, but improved. She went to an emergency department, then an employee health clinic and an eye clinic. She now wears goggles when changing the solution.

Figure 11



* Occupation was unknown for 12 antimicrobial cases

Figure 12



* Occupation was unknown for five non-antimicrobial cases

Outreach, Education, and Prevention Activities

Publications and Presentations
Staff members of Occupational Pesticide Illness and Injury Program sought many avenues to provide information about the program and pesticide safety to stakeholders and the general public. In 2008:

- A staff member of the surveillance program represented MDCH on the MDA Pesticide Advisory Committee (PAC) and provided an activity report each quarter. An analysis of quaternary ammonium chloride cases was prepared for a PAC member.

- The 2007 Pesticide annual report was completed, distributed to stakeholders, and made available on the Division of Environmental Health's website.

- Michigan was one of three pilot states to evaluate contributing factor codes, which are now being used by all pesticide surveillance states.

- MDCH staff chaired the pesticide coding committee which worked on data quality assurance, contributing factor codes, lost time from work and activities codes, and PPE codes.

- The MDCH surveillance program contributed to an MMWR article prepared by NIOSH about cases involving total release foggers (bug bombs). (Wheeler 2008.)

- Information about the program, pesticide safety, and occupational disease reporting requirements was provided to migrant health clinics in March 2008.

- Information about MDCH's laboratory cholinesterase surveillance was presented at the Council of State and Territorial Epidemiologists (CSTE) conference.

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

- MDCH surveillance program staff sent information about our program and other resources to the Michigan Migrant Legal Assistance Project.

- The pesticide surveillance program shared information about respiratory symptoms in cases exposed to pyrethrins and pyrethroids with Michigan's asthma surveillance program.

- MDCH staff provided feedback about pesticide exposures to the Office of Public Health Preparedness for a flipchart they developed for health care workers.

- Program materials and pesticide information was made available at tables at the Michigan Safety Conference and the Michigan Growers and Farmworkers conference.

- MDCH surveillance program staff sent information about our program to the Michigan Primary Care Association (MPCA). Staff also attended MPCA meeting of the migrant and seasonal farm worker workgroup.

MDA Reports
Three cases were reported to MDA in 2008. The first, MI01232, was an applicator for a lawn care company. He said that one day he contacted his manager, who worked in another city, to say it was windy and was told that it was not too windy and he should spray. Several times that day as he was spraying an herbicide he felt spray on his face. That night he began to feel sick, with nausea, vomiting, headache, and lightheadedness. He went to an emergency department. This case was referred to MDA. The MDA investigation did not identify any violations.

Another incident, MI01395, involved a worker who cut down trees for a utility right of way and then applied an herbicide to the stumps. He was soaked with the herbicide when he over-pumped a spray container and pressure caused the product to spill out all over him. He started to develop back pain, diarrhea, bloating, and several days later was hospitalized with acute tubulointerstitial nephritis. He was not a registered or certified applicator, or working under the supervision of one. The case was referred to MDA but they were not able to identify any violations. MDCH sent the individual information about the product and its toxicity.

In the third case, MI01417, a waitress was exposed to a pyrethroid insecticide after it was sprayed in the kitchen and dining room. She developed shortness of breath, tremors, unsteady gait, nausea, eye irritation, and a headache. She called poison control and went to an urgent care center where she was diagnosed with reactive airway disease. She lost 1-2 days of work. The case was referred to MDA but they were not able to identify any violations. MDCH sent the individual information about pesticide safety and how to apply for Michigan's Pesticide Notification Registry.[11] The case was also referred to the Michigan's work-related asthma surveillance program.

NIOSH Reports
Five events were reported to NIOSH as high priority events. All five involved multiple exposed individuals.

Three events were not occupational. One involved someone spraying for roaches at home. Five family members had sore throats and runny noses. Another non-occupational event involved 15 individuals exposed to pool chlorine at a motel. They all began to cough and the pool was shut down. In a second pool-related incident five children at a pool party in a motel developed vomiting, coughing, runny noses, and irritated eyes.

The first occupational event involved 10 employees cleaning coins at a casino. Most developed skin irritation and a rash. Two employees with a history of asthma also had respiratory symptoms.

[11] The Michigan Pesticide Notification Registry allows someone with a physician diagnosed condition to be notified prior to a pesticide application to turf or ornamental plants on property adjacent to the applicant.

The final event reported to NIOSH involved a veterinary clinic where a dog was being treated that had ingested mole bait containing zinc phosphide. The veterinarian induced vomiting, as recommended by animal poison control. She and several other people in the animal hospital became ill from the resulting phosphine gas. She developed a headache, sore throat, felt lightheaded, and generally did not feel well. She completed her shift and went to an emergency department the next day, where tests indicated an elevated white blood cell count. She felt ill for about two and a half weeks. One employee developed dizziness, chest tightness, and a cough. Two were dizzy and had headaches and two had only headaches. The Fire Department was called to test the air.

HSEES Referrals
Two cases, MI01277 and MI01280 were referred to HSEES because they were work-related chemical releases resulting in injury. In MI01277 a relief operator at a baby food manufacturing plant was present when a mixture of antimicrobials was released into the air at a higher concentration than usual due to a faulty flow meter. He developed shortness of breath, wheezing, chest pain, headache, lightheadedness, nausea, and vomiting. He went to an emergency department and was admitted to the hospital overnight.

In MI01280 a fruit processing line worker inhaled a sterilizing compound, possibly mixed with a cleaner, used to sterilize bins. He developed a sore throat, cough, difficulty breathing, and a headache. He went to an emergency department and lost about a week of work. Educational materials were sent to his employer.

Other Prevention
Four cases received educational material – MI01395 and MI01417, mentioned above, and two other cases. One was MI01440, involving a fast food restaurant owner who was working in an office building whose lawn had been sprayed for weeds. The smell came in the front door, and lingered for days. She developed a headache, nausea, throat irritation and eye irritation and called poison control. MDCH sent her information about the Michigan Pesticide Notification Registry.

The other case, MI01443 involved someone swimming near a pool pump, who breathed in a whiff of pool chlorine when the pool pump was turned on. She developed a cough, wheezing, shortness of breath, rhonchi, and chemical pneumonitis and was admitted to a hospital for six days. MDCH sent her information about chlorine.

Discussion

Surveillance Data
There were more reported occupational cases in 2008, compared to 2007 (165 vs. 132), and more confirmed occupational cases (125 vs. 87). That increase was due to an increase in antimicrobial cases, with 100 reported and 84 confirmed antimicrobial cases in 2008 vs. 54 reported and 37 confirmed antimicrobial cases in 2007.

Workers exposed to antimicrobials tended to be younger (median age 24.7) than those exposed to other pesticides (median age 34.9). Antimicrobial exposures remain an area of ongoing concern.

More than a quarter of the confirmed cases in 2008 were engaged in activities not related to pesticide application. Better education of users of pesticides on safe pesticide application is needed to prevent inadvertent workplace exposures.

MDCH began using laboratory cholinesterase test reporting as another data source in late 2005. Section II summarizes the findings from this source. The surveillance system was expanded to include non-occupational pesticide injuries and illnesses in 2006. Section III summarizes data on the 141 confirmed non-occupational cases reported in 2008.

Interventions
MDCH has continued to refer cases to MDA for investigation of possible safety violations. MDCH also worked to improve pesticide education for individuals, health care providers, and other stakeholder groups through the distribution of brochures and presentations listed in the results section. Education must remain a priority for both certified and non-certified pesticide applicators, since both groups may be exposed or expose others.

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

The problem of identifying pesticide-related illness for public health surveillance begins with difficulties in recognition and diagnosis, because the diverse signs and symptoms experienced can resemble an acute upper respiratory illness, acute conjunctivitis, or acute gastrointestinal

illness, among other conditions. In these cases, patients may not seek medical care, or may not be correctly diagnosed if an occupational and environmental history that asks about pesticide exposure is not taken by the health care provider (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. Another problem is that even when diagnosed, pesticide-related illnesses and injuries may not be reported due to the reluctance on the part of workers and their health care providers to involve state agencies because of concerns about job security, lack of knowledge of the public health code reporting requirements, or lack of time to report (Calvert et al, 2001). Additional education to promote recognition of pesticide poisoning and compliance with the reporting requirement is needed.

More outreach is needed to educate health care providers on the importance of recognizing and reporting instances of occupational pesticide illnesses and injuries. While the emergency department was the first source of care for 56 (44.8%) of confirmed occupational cases in 2008, the hospital submitted an occupational disease report for only six (10.7%) of those cases. The remaining cases were brought to the program's attention by the PCC, but if the health care providers in the hospital do not call the PCC for advice or the coding of medical encounter does not include a diagnostic code specific to pesticides, the case is unlikely to be identified by the surveillance system.

Like data from other occupational disease and illness surveillance systems,[12] 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. (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 for OD and MDA reports. This presents difficulties in following up with reported cases because of worker mobility, especially among seasonal farm workers. PCC reports are received promptly, but do not always contain sufficient information to allow contact with the exposed individual. Lack of information from follow-up often results in a case classification of "insufficient information."

Notwithstanding these limitations, the Michigan occupational pesticide surveillance system is receiving and investigating reports of occupational pesticide illness and injury, including follow-up prevention activities. In addition, the surveillance system has expanded to include non-occupational cases and follow-up on laboratory reports of cholinesterase test results, more than doubling the cases evaluated.

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

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Additional Resources

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

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

Pesticide-Related Illness and Injury Surveillance: A How-To Guide for State-Based Programs DHHS (NIOSH) publication number 2006-102. October 2005 http://www.cdc.gov/niosh/docs/2006-102/

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

EPA Pesticide Product Label System: http://oaspub.epa.gov/pestlabl/ppls.home

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

Information on licensing and registration for pesticide application businesses, credentials for certified technicians, and laws and regulations for pesticide application: www.michigan.gov/mda/0,1607,7-125-1569_16988---,00.html

Information on the federal Worker Protection Standard (worker exposure to pesticides in agriculture): www.epa.gov/pesticides/health/worker.htm. In Michigan, call the Pesticide and Plant Pest Management Division, MDA, at (517) 373-1087.

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

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

Section II: Laboratory Cholinesterase Test Surveillance

Background

Cholinesterase is an enzyme necessary for regulation of proper nerve impulse transmission. If the amount of this enzyme is reduced below a critical level, nerve impulses to the muscles can no longer be controlled, resulting in serious consequences and even death. Two classes of insecticides, organophosphates and carbamates, act as cholinesterase inhibitors; that is, they reduce the amount of cholinesterase available for the body's use. Depression of cholinesterase activity can be measured by several related blood tests. There is considerable variation in values between laboratories and among unexposed individuals, thus comparison of results from when a person is not exposed to their own subsequent results within hours of exposure is the best measure of cholinesterase inhibition from insecticide exposure. It should be noted that suspected pesticide exposure is not the only reason cholinesterase tests are ordered. Most notably, these tests may be ordered prior to surgery, where succinylcholine (a paralyzing agent that is eliminated by cholinesterase enzymes) may be used as part of the anesthesia, to indentify persons with a genetic deficiency of these enzymes who should not receive this medication , or to identify the cause of a bad reaction if they have received this medication.

MDCH began using laboratory cholinesterase test reporting as another data source for the work-related pesticide illness and injury surveillance system, beginning in late 2005. This section presents results from the MDCH laboratory surveillance system for cholinesterase-inhibiting pesticide exposure/illness.

Methods

In September 2005, MDCH rules for clinical laboratory reporting of cholinesterase test results went into effect. By 2007, most laboratories were reporting electronically. Laboratory test results are managed in an excel data file that included identifying and demographic information about the tested individual, the test results, and the laboratory reference ranges for those results. It should be noted that each laboratory has its own test procedures and reference ranges. Further, some laboratories run up to six types of cholinesterase test results per specimen (e.g. acetylcholinesterase, pseudocholinesterase). Individuals with single test results below the laboratory reference range, or with tests from specimens taken on two or more occasions where there was a change from baseline of more than 20%, are flagged for follow-up to determine the reason for the test. If the test was for suspected pesticide exposure, the follow-up includes collection of information about the type of pesticide, the source of exposure, the employer, and any associated symptoms or diagnosed illness. Results of laboratory tests in 2008 are presented.

Results

In 2008 laboratories reported 634 test results on 490 individuals. Fifty-six (11.4%) of these individuals met criteria for follow-up, including 49 (87.5%) with a low test result and seven (12.5%) with a 20% change from the first reported test. Table 12 shows the reason for the cholinesterase test. Twenty-five (44.6%) of the 56 individuals were tested because of potential work-related pesticide exposure.

Table 12

Persons with Abnormal Laboratory Cholinesterase Tests, 2008 (N=56)		
Reason for Test	**Number**	**Percent**
Occupational	25	44.6
Non-Occupational		
Surgery	*13*	
Suicide attempt with pesticide	*1*	
Other	*4*	
Total non-occupational	18	32.2
Unknown *(including four non- Michigan residents)*	13	23.2
Total	56	100.0

Follow-up of the work-related cases identified five employers among the 25 work-related cases.

Table 13

Employers Identified, 2008 (N=6)		
Employer	**Number**	**Percent**
Dow Chemical Company	14	56.0
Mead Johnson Nutritionals	1	4.0
Saginaw Co Mosquito Abatement Commission	6	24.0
US Fish & Wildlife	2	8.0
West Michigan Tree Service	2	8.0
Total	25	100.0

Nineteen of the 25 individuals were identified by a low test result; in sixteen of these the test was a baseline test upon employment, before any possible exposure. Four had a test result with a 20% increase from the first test reported, and two had a test result with a greater than 20% decrease from the first test. One individual was interviewed; he had no memory of any specific exposure or symptoms. All were part of employer routine monitoring programs.

Discussion

The cholinesterase test results led to the identification of employers who are testing employees because of the use of cholinesterase-inhibiting pesticides at work. The Michigan Department of Agriculture has agreed to consider employer follow-up based on data from this system. We will continue to track reports and collect medical and exposure information from individuals who meet criteria for follow-up. In the future we will routinely interview individuals with low test results or those who have a 20% change in their results. Symptomatic individuals will be included in the pesticide illness/injury surveillance system.

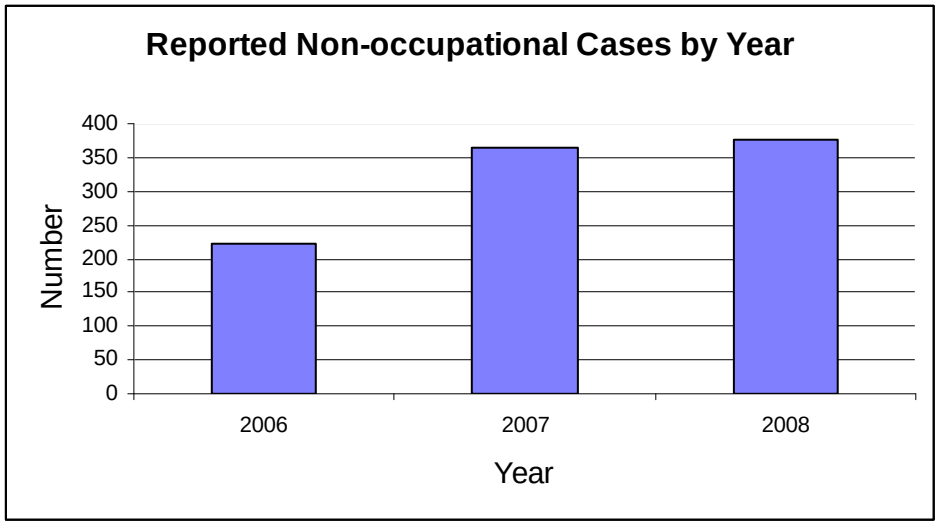
While the cholinesterase laboratory reporting system presents a number of challenges to data management and interpretation, we believe that it provides a useful addition to our pesticide illness and injury surveillance system. In addition it has the potential to identify exposures at an early stage prior to symptoms to review work practices and thus prevent exposure, symptoms, and disease.

Section III: Non-occupational Exposures

To better characterize the impact of pesticide use in Michigan, the MDCH pesticide surveillance program began collecting information about non-occupational exposures in 2006. Suicide attempts are excluded. The occupational case definition and data sources were used for these cases as well.

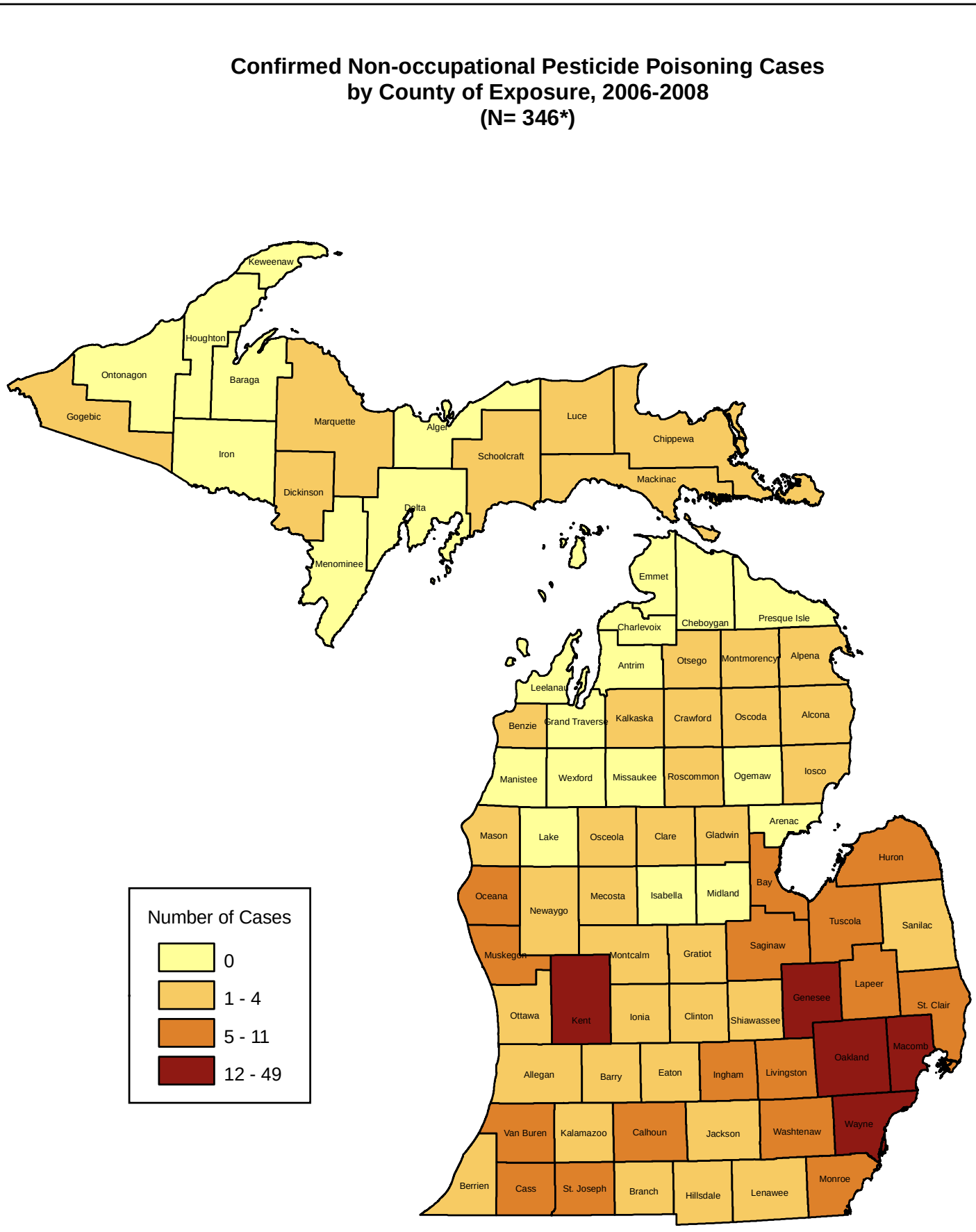
Reports
In 2008, there were 376 reported non-occupational cases. See Figure 13.

Figure 13



Location in State
In 2008, there were no confirmed non-occupational cases in 46 of Michigan's 83 counties (55.4%). For 14 (10.7%) confirmed cases, county of exposure was unknown. There were 14 confirmed cases exposed in Van Buren County, 11 in Wayne County, 9 in Kent, and 8 in Oakland in 2008. Figure 14 shows the distribution of confirmed non-occupational cases from 2006 through 2008.

Figure 14



* County of exposure was unknown for 30 of the 376 confirmed cases.

Classification
One hundred thirty-one (34.8%) of these reported cases met the NIOSH criteria (other than work-relatedness) to be considered confirmed cases, compared to 75.8% of occupational cases. Due to limited resources, no case follow-up was done, resulting in a lower percentage of confirmed cases than for occupational cases. In addition, 84 (22.3%) were children who had possibly ingested a rodenticide, but had no signs or symptoms and 10 (2.7%) were children with a possible moth ball ingestion, again with no signs or symptoms. (Table 14.)

Table 14

Reported Cases by Classification, Occupational vs. Non-occupational, 2008

	Occupational		Non-occupational	
Classification	**Number**	**Percent**	**Number**	**Percent**
Confirmed cases				
Definite	9	5.5	1	.03
Probable	20	12.1	12	3.2
Possible	88	53.3	96	25.5
Suspicious	8	4.8	22	5.9
Total confirmed	*125*	*75.8*	*131*	*34.8*
Not confirmed				
Unlikely	0	0.0	1	0.3
Insufficient Information	36	21.8	145	38.6
Exposed, Asymptomatic	1	0.6	94	25.0
Unrelated	3	1.8	5	1.3
Total not confirmed	*40*	*24.2*	*245*	*65.2*
Total	165	100.0	376	100.0

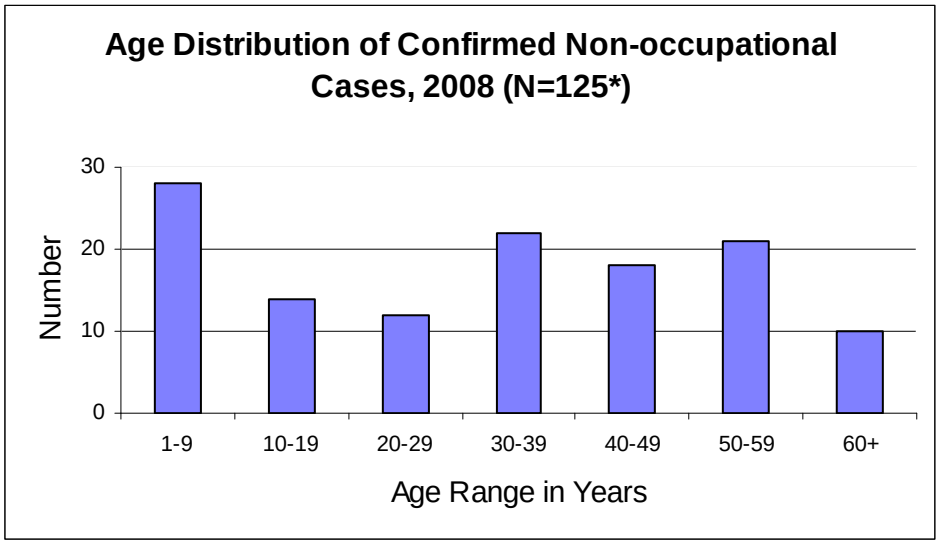
Demographics

Gender
Of the 131 persons with confirmed illnesses or injuries, 52 (39.7%) were men and 79 (60.3%) were women.

Age
The age distribution of individuals where the age was known is shown in figure 15. The median age was 33.2, with a range of 1 to 85.

A baby girl was found playing with an arsenic-containing ant trap in the family's kitchen. She vomited a total of seven times, was pale, and had decreased alertness and activity. Her parents called poison control and took her to a medical center. Her urine arsenic level was elevated and she was transferred to another hospital for treatment with the chelating agent dimercaprol.

Figure 15



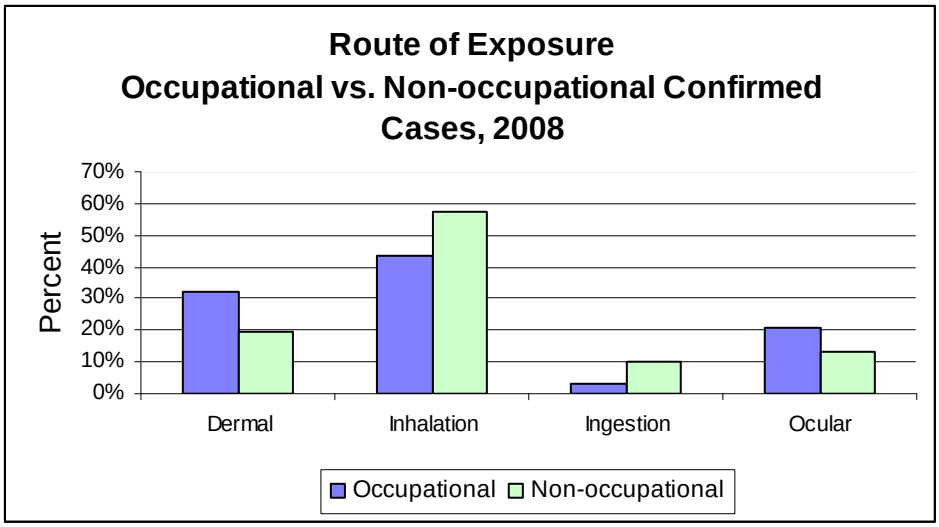
* Age was unknown for 6 of the 131 confirmed non-occupational cases.

Exposures

Route of Exposure

Route of exposure was identified for 126 of the 131 confirmed non-occupational cases. There were 170 identified routes of exposure. There were 18 cases with two routes of exposure, four cases with three routes, and six cases with four routes. The most common route was inhalation (98). See Figure 16 for a comparison of routes of exposure for occupational and non-occupational cases.

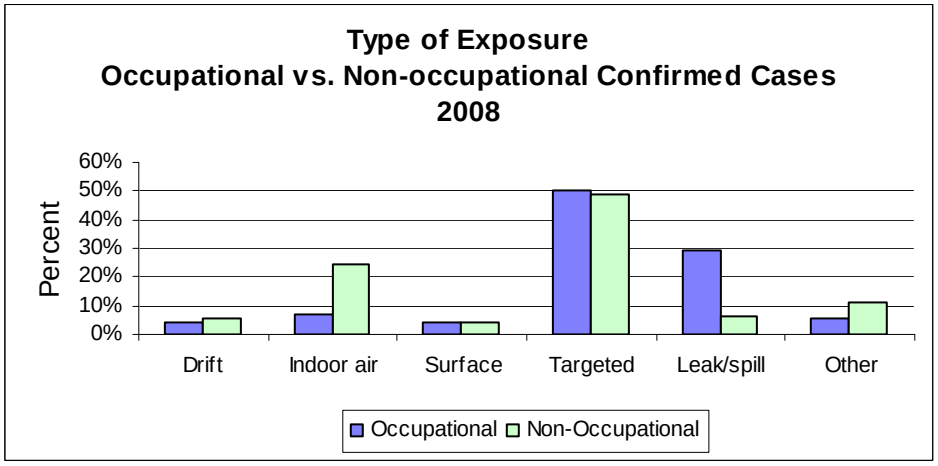
Figure 16



Type of Exposure

Type of exposure was also identified for 119 of the confirmed non-occupational cases. There were 112 cases with one type of exposure, six with two types, and one with three types. For non-occupational cases, the most common type of exposure was from a targeted application (62). See Figure 17 for a comparison of type of exposure for occupational and non-occupational cases.

Figure 17



Product Used

Table 15 compares the products to which confirmed occupational cases and confirmed non-occupational cases were exposed. While antimicrobials were the most common exposure for occupational cases, non-occupational exposures were most likely to be due to insecticides.

Table 15

Product Type of Confirmed Cases, 2008						
	Occupational		Non-Occupational		Total	
Product Type	Number	Percent	Number	Percent	Number	Percent
Antimicrobial	84	67.2	48	36.6	132	51.6
Insecticide	19	15.2	58	44.3	77	30.1
Herbicide	9	7.2	2	1.5	11	4.3
Insect repellent	0	0.0	12	9.2	12	4.7
Rodenticide	4	3.2	4	3.1	8	3.1
Fungicide	2	1.6	3	2.3	5	2.0
Fumigant	1	0.8	0	0.0	1	0.8
Pheromone	1	0.8	0	0.0	1	0.8
Mixture	5	4.0	4	3.1	9	3.5
Total	125	100.0	131	100.0	256	100.0

Severity
Table 16 compares the severity of confirmed occupational cases with confirmed non-occupational cases.

Table 16

Severity of Confirmed Cases, 2008				
	Occupational		Non-occupational	
Severity	Number	Percent	Number	Percent
Low	109	87.2	119	90.8
Moderate	14	11.2	9	6.9
High	2	1.6	3	2.3
Total	125	100.0	131	100.0

Activity at Time of Exposure
Activity at time of exposure was unknown for 15 non-occupational confirmed cases in 2008. When known, more than half of all non-occupational cases (69 or 59.5%) were not involved with the pesticide application when they were exposed. Most of these bystander cases (50 or 72.5%) were exposed indoors.

A woman in her 50s was in a swimming pool when the pump was turned on. She was standing near the pump outlet and breathed in a whiff of chlorine. She began coughing and then later vomited and had trouble breathing. She called poison control and went to an emergency department. She was admitted to the hospital for six days with chemical pneumonitis.

Contributing Factors
Identifying factors contributing to the exposure or illness/injury can improve prevention activities. Table 17 shows the contributing factors, when known, for the confirmed non-occupational cases in 2008. The most common factors were excessive applications and other non-specified label violations, followed by mixing incompatible products. See Appendix II for a description of the contributing factor codes.

A man in his 20s used a pyrethroid flea fogger in his house. The directions said to leave for two hours. He returned after three hours and was in the house for about 20 minutes. It is unknown if he opened windows. He developed shortness of breath, dizziness, nausea, shakiness, sweating, and a fast heart beat. He went to an emergency department.

Table 17

Contributing Factors for Confirmed Non-occupational Cases, 2008 (N=109*)		
Code	Factor	N
01	Notification/posting lacking or ineffective	0
02	People were in the treated area during application	9
03	Inadequate ventilation of treated area before re-entry	5
04	Early re-entry	4
05	Required eye protection not worn or required eye protection inadequate	0
06	Required gloves not worn or required gloves inadequate	0
07	Required respirator not worn or required respirator inadequate	0
08	Other required PPE not worn or inadequate	0
09	Spill/splash of liquid or dust (not involving application equipment failure)	9
10	Application equipment failure	2
11	Pesticide stored within reach of child or other improper storage	8
12	Decontamination not adequate or timely	3
13	Intentional harm	1
14	Excessive application of pesticide	18
15	Label violations NOS (Not otherwise specified, other regulatory issues)	18
16	No label violation identified but person still exposed/ill	9
17	Drift	8
18	Applicator not properly trained or supervised	0
19	Illegal pesticide used/illegal dumping of pesticide	0
20	Mixing of incompatible products	11
97	Other (consider new code)	4
98	Not applicable	0

* Contributing factors were unknown for 30 confirmed cases, while 8 cases had two contributing factors.

Comparison of Occupational and Non-occupational Exposures

There were a number of similarities between occupational and non-occupational cases in Michigan. Most cases, both occupational (87.2%) and non-occupational (90.8%), were classified as low severity. About half of all exposures for both occupational and non-occupational cases were considered targeted (50.0% and 48.8% respectively). This means the individual was exposed to an application of a pesticide material released at the target site, and not carried from the target site by air. Inhalation was the most common route of exposure (43.7% of occupational cases and 57.6% of non-occupational cases).

There were also some differences between the two populations. Exposed individuals in non-occupational exposures were more frequently bystanders rather than involved in the pesticide application (28.4 % of occupational cases and 59.5% of non-occupational cases). The type of product the individual was exposed to also differed, with 67.2% of occupational cases being exposed to antimicrobials vs. 36.6% of non-occupational cases, while 53.4% of non-occupational cases were exposed to insecticides or insect repellents (vs. 15.2% of occupational cases).

Because of inadequate resources, insufficient information is collected on many of the non-occupational cases to either confirm these cases or better characterize the exposure to be able to institute preventive action.

Appendix I

Case Narratives, 2008 Confirmed Occupational Cases

Below are descriptions of the confirmed occupational cases reported in 2008. The narratives are organized by product type and include a description of the signs and symptoms that resulted from the exposure and medical care received. Where known, age, gender, industry, and occupation are included. In addition, more specific information about the product such as chemical class or the signal word for acute toxicity assigned by the EPA, is provided when known. The signal word is assigned based on the highest hazard of all possible routes of exposure. Caution means the product is slightly toxic if eaten, absorbed through the skin, or can cause slight eye or skin irritation. Warning means the product is moderately toxic if eaten, absorbed through the skin, or can cause moderate eye or skin irritation. Danger means the product is highly toxic, is corrosive, or causes severe burning to the eye or skin that can result in irreversible damage.

Insecticides

MI01233 – A department store employee in her 50s was stocking shelves when an insect fogger fell and started to release the insecticide. She stayed for several minutes to dispose of the fogger. About fifteen minutes later, she became short of breath and an hour or so after that developed numbness and tingling in her hand. She went to an occupational medical clinic and then an emergency department.

MI01239 – An office worker in her 40s was at work when a coworker in a neighboring cube sprayed a plant with a pyrethrin insecticide (signal word: Caution). Some of the spray got on her face, causing an itchy, burning sensation and her skin became red and swollen. She reported the incident to MDA and an investigation found that a pesticide application was made in violation of the facility's IPM program and that the application manner allowed off-target discharge. A warning letter was issued.

MI01289 – A pesticide applicator in his 20s was wearing a mask while spraying an insecticide (signal word: Caution) in an attic. After 30 minutes, his boss called and told him to wear a respirator when using that product. He developed difficulty breathing and wheezing that night. The next day he developed diarrhea, nausea, vomiting, and body aches. He went to an urgent care clinic.

MI01348 – A landscaping employee in his 20s went into an empty tank that had contained a pyrethroid insecticide (signal word: Caution). The vapors caused his face to become red, and he his skin felt tender, with a burning sensation. He went to an emergency department where he was diagnosed with allergic dermatitis.

MI01353 – A restaurant employee in her 20s was cleaning a bathroom. She sprayed a wall with a pyrethrin insecticide to get rid of fruit flies. She began to cough and went outside for fresh air. After about 10 minutes she went back to finish cleaning the bathroom and remained there, cleaning it, for about a half hour. Her cough got worse, and she began to feel dizzy, and

developed a sore throat, chest tightness and pain with every breath. She vomited 4-5 times and went to an urgent care clinic.

MI01386 – A structural pesticide applicator in his 40s had some pyrethrin insecticide (signal word: Caution) drip onto his shirt from a leaky connection between an aerosol can and a hose. He developed a red, itchy rash. He called poison control and went to his doctor.

MI01388 – A cherry farmer in his 30s sprayed his trees with an organophosphate insecticide (signal word: Danger) for several hours. That night he developed diarrhea, sweating, a fast heart beat, and a fever. His wife called poison control.

MI01402 – A pesticide applicator for a lawn care company in his 30s, was applying an insecticide/fertilizer mix (signal word: Caution) and a chlorophenoxy herbicide (signal word: Danger) on a windy day. He inhaled some and may have gotten some on his hands. He was wearing cloth and leather gloves. He started to develop shortness of breath. After doing a couple of lawns, he started shaking and couldn't catch his breath. He went into fresh air and washed and started to feel better. He called poison control and went to his doctor the next day.

MI01414 – A hair salon employee in her 50s was at the front of the salon when a coworker sprayed her chair for lice with a pyrethroid insecticide (signal word: Caution). She returned, and not realizing the chair had been sprayed, touched it and then her face. She had a bad taste in her mouth that did not go away when she washed. Her mouth felt numb and tingly and her lips were swollen. She also developed a blister on her lip. She called poison control.

MI01417 – A waitress in her 30s was exposed to a pyrethroid insecticide (signal word: Caution) after it was sprayed in the kitchen and dining room. She developed shortness of breath, tremors, unsteadiness, nausea, eye irritation, and a headache. She called poison control and went to an urgent care center where she was diagnosed with reactive airway disease. She lost 1-2 days of work. The case was referred to MDA, and MDCH sent information about the Michigan Pesticide Notification Registry.

MI01420 – A sign installer in his 20s was taking apart a sign that had a wasps' nest inside it. He went to the truck and got the aerosol can of pyrethroid insecticide (signal word: Caution) that is kept on hand there. The wasps were swarming him,, so he did not see clearly which way to aim the can. He sprayed himself directly in the face. His skin was red and swollen; his eyes burned, and were blurry and itchy. He had trouble breathing initially, and had a headache and nausea. His eyes and throat were dry and itchy for about a week. His employer called poison control and he went to an occupational health clinic. He lost one day of work. He thinks the nozzle of the can should be redesigned with a different shape or off center, so it is easy to see which way it will spray.

MI01432 – A rural letter carrier in her 50s was sorting letters at the post office when the custodian sprayed some ants with a pyrethroid insecticide (signal word: Caution) near her feet. She had a history of asthma and was exposed for about 10 minutes before she had to leave due to difficulty breathing, cough, wheezing, and trouble swallowing. She went to an emergency department and lost about three weeks of work.

MI01472 – A cabin cleaner in her 20s sprayed a hornets' nest with a pyrethroid insecticide (signal word: Caution). The wind picked up as she was spraying and blew some into her face and right eye. Her eye was burning, tearing and red. She called poison control.

MI01499 – A telephone technician in his 50s needed to work on an above-ground box with access to buried telephone wires. He thought there might be wasps, so he got out an aerosol can of pyrethroid insecticide (signal word: Caution). He took off the cover and set it down nearby. In taking off the cover to the box accessing the wires, he hit and punctured the can. His pant leg was sprayed. He continued to work the rest of the day, about 7 ½ hours, but his thigh began to burn. The area was warm and red, and he also had a bad taste in his mouth. He called poison control and went to an emergency department.

MI01510 – An adult woman sprayed a pyrethroid insecticide (signal word: Caution) at work. Her face was exposed to some of the mist. The next day she developed a small rash on her chin and slight swelling on her face. The rash then spread all over her body and the facial swelling became more pronounced. She went to an emergency department and called the manufacturer for information.

MI01519 – A service technician for a phone company sprayed a wasp's nest while up a pole. He was very close and some sprayed back on his hands and clothes. Also, some got on his hands from the wet wires. He used a pyrethroid insecticide (signal word: Caution). His hands started to burn. He wiped them with alcohol wipes in his truck and drove to a restaurant to wash them. His hands were red and burning for a few days, and numb and tingly for about a week.

MI01533 – A woman in her 30s sprayed herself in the eye with a pyrethrin plus pyrethroid insecticide (signal word: Caution) at work. It was painful and itchy and she had blurry vision. Her coworker called poison control and she went to an emergency department.

MI01536 – A tree sprayer in his 20s used a pyrethroid insecticide for a couple of months. He wore safety glasses but no respiratory protection. He developed anxiety, a flushed feeling, headaches and shortness of breath and went to his physician.

MI01576 – A teenaged farmhand applied a permethrin insecticide to animals, rubbing it into their skin with his bare hands. He developed abdominal pain and nausea. He went to an emergency department.

MI01628 – A lawn technician in his 30s was spraying soffit and fascia with a pyrethroid insecticide (signal word: Caution). Mist droplets bounced back into both eyes. He developed red, painful eyes, a headache, and nausea and went to an emergency department. Eye protection was not required according to the pesticide label.

Herbicides

MI01232 – An applicator for a lawn care company in his 20s contacted his manager in another city to say it was windy. He was told that it was not windy and he should spray. Several times that day as he was spraying an herbicide (signal word: Danger) he felt spray on his face. That

night he began to feel sick, with nausea, vomiting, headache, and lightheadedness. He went to an emergency department. This case was referred to MDA; no violations were found.

MI01313 – A senior sales associate at a clothing store in her 50s inhaled an herbicide (signal word: Warning) that had been sprayed outside and brought in through the ventilation system. She became itchy all over, and had throat and eye irritation. She went to an emergency department. See case MI01314.

MI01314 – A senior assistant manager at a clothing store in her 50s inhaled an herbicide (signal word: Warning) that had been sprayed outside and brought in through the ventilation system. Her lips and tongue felt numb, and she developed nausea, lightheadedness, chest tightness, and a headache. She went to an emergency department. See case MI01313.

MI01376 – A farmer in his 20s was spraying his soybean field with a glyphosate herbicide (signal word: Caution) using a boom tractor. The wind blew up and the herbicide blew into his eyes. His eyes burned, and were red and teary. When he could open them, his vision was blurry. He went to an urgent care center.

MI01395 – A worker in his 30s who cut down trees for a utility right of way and then applied an herbicide (signal word: Caution) to the stumps, was soaked with the herbicide when he over-pumped a spray container. He developed back pain and several days later was hospitalized with acute tubulointerstitial nephritis. He was not a registered or certified applicator, or working under the supervision of one. The case was referred to MDA.

MI01419 – A pregnant hospital worker in her 20s was exposed to a chlorophenoxy herbicide (signal word: Caution) that was brought in through the air vent. She developed dizziness, a headache, nausea, and vomiting. She went to the emergency department.

MI01422 – A farmer in his 40s applied two herbicides to his fields He came home, showered and changed his clothes and then developed stomach pain, diarrhea, and dizziness. He called poison control.

MI01440 – A fast food restaurant owner in her 50s was working in an office building whose lawn had been sprayed for weeds. The smell came in the front door, and lingered for days. She developed a headache, nausea, throat irritation and eye irritation and called poison control. MDCH sent her information about the Michigan pesticide notification registry.

MI01479 – A landscaper in his 20s developed weakness, nausea, vomiting, headaches and blurred vision. He had dermal exposure to a glyphosate herbicide (signal word: Caution) as well as possible dehydration. He went to an emergency department.

MI01515 – An adult male sprayed a field with an herbicide (signal word: Caution). The next day he walked in the field. Two days after that he went to an emergency department with nausea, vomiting, sweating, fever and confusion.

Antimicrobials

MI01210 – A hospital nurse in her 40s was spraying a shelf overhead with a disinfectant containing alcohol and quaternary ammonia (signal word: Caution) and some mist got in her eyes. Her eyes were burning and tearing. She went to the emergency department and called poison control.

MI01224 – A school custodian in her 60s was spraying a quaternary ammonia disinfectant (signal word: Danger) when the hose came off the bottle and she was sprayed on her face, in her eyes, and on her clothes. She rinsed her face and felt fine. A day and a half later, she woke up with red, swollen, teary, painful eyes and blurry vision. She went to an urgent care clinic and then later to the school's occupational clinic.

MI01234 – A worker on a dairy farm in his 30s had some sodium hydroxide splash out of a pipe onto his legs and in one eye. He went to an emergency department.

MI01245 – A leasing consultant for a property management firm in her 20s was working directly over the storage area for pool chemicals where brominating tablets (signal word: Danger) were stored and used. The brominator had a leaky pipe that was not repaired and was located near the furnace, so fumes were transferred to the office through the vents. She and her supervisor became sick. She was exposed from the time of her employment in July until she and her supervisor were evacuated and moved to another office in December. She developed acne, was very sleepy, lost her appetite, had migraine headaches, had low blood pressure, fainted, and her eyes were irritated. She went to an occupational heath clinic, her own physician, a dermatologist, and called poison control.

MI0249 – A systems analyst in her 30s cleaned off her desk and telephone with a quaternary ammonia chloride disinfecting wipe (signal word: Caution). She used the telephone before it dried off, and inhaled the disinfectant. She became dizzy, had a headache, and was nauseous. She called poison control and went to the company nurse.

MI01251 – A worker in his 20s splashed his eye with a disinfectant (signal word: Danger) when cleaning something. His face and eyes were red and his eyes burned and were tearing. His vision was blurry. He went to an emergency department and was diagnosed with chemical conjunctivitis.

MI01256 – A cook in his 20s dumped bleach down a drain that had shrimp in it, to clean the drain. There may also have been ammonia down the drain. A chemical reaction occurred, and when he leaned over the drain he inhaled chloramine gas that made him lightheaded and nauseous, with pain on deep breathing. He went outside for fresh air, which helped. Other symptoms included dry mouth, increased phlegm, wheezing and a cough. It took about 3 days for all symptoms to resolve, except the cough, which lingered a little longer. He called poison control the day after his exposure.

MI01257 – A pet groomer in her 20s was trying to open a new box of quaternary ammonium chloride disinfectant (signal word: Caution). As she pulled on the plastic pull-ring some splashed

out into her left eye. She had a red, irritated eye and went to an emergency department, with a follow-up appointment with an ophthalmologist. She was diagnosed with a chemical burn.

MI01264 – A clothing store worker in her 20s was cleaning a dressing room door using a quaternary ammonium chloride disinfectant wipe. It was very wet, and some liquid splashed in her eye, which became red and irritated. She rinsed her eye in a sink and called poison control.

MI01265 – A dairy farm employee in his teens mixed bleach with an acid cleaner and developed shortness of breath, a cough, respiratory depression, and a sore throat. He went to an emergency department and was diagnosed with chemical pneumonitis.

MI01267 – A worker in a day care center got a quaternary ammonium chloride based disinfectant (signal word: Caution) on her hands. They became swollen and painful. She went to an emergency department where she was diagnosed with first-degree burns and told to stay off work for two days.

MI01276 – A restaurant manager in his 20s was cleaning equipment with an alkaline cleaner and forgot to put on gloves. His hands began to feel 'slimey' and he rinsed them off. They became red, a little swollen, and he had a burning sensation. They cracked and the skin peeled. He went to an urgent care clinic and was diagnosed with 1st degree burns. He thinks employees should be coached to be aware of what others are doing, so if someone does not wear gloves, other employees can remind them.

MI01277 – A relief operator in his 40s at a baby food manufacturing plant was present when a mixture of antimicrobials was released to the air at a higher concentration than usual due to a faulty flow meter. He developed shortness of breath, wheezing, chest pain, headache, lightheadedness, nausea, and vomiting. He went to an emergency department and was admitted to the hospital overnight.

MI01280 – A fruit processing line worker in his 20s inhaled a sterilizing chemical (signal word: Danger), possibly mixed with a cleaner, used to sterilize bins. He developed a sore throat, cough, difficulty breathing, and a headache. He went to an emergency department and lost about a week of work. Educational materials were sent to his employer.

MI01284 – A store manager in her 40s mixed bleach and ammonia in a bucket and cleaned with it. She developed chest discomfort and throat irritation. Her husband called poison control and she went to an emergency department.

MI01286 – A housekeeper in her 30s at a retirement home mixed bleach and laundry detergent in a bucket and used the mixture to wipe down the washers and driers. She did not wear gloves, and her hands turned a purplish-black color. She had a burning sensation and her hands were a little swollen and her skin dried out. She called poison control and went to an emergency room.

MI01309 – A teacher's aide in his 20s was lifting a container of quaternary ammonium chloride based disinfectant (signal word: Danger) to put it on a shelf, out of reach of the children. He looked up just as a drop from the container fell down and it splashed in his eye. His eye was red,

burning, and tearing. He washed it immediately for about 20 minutes and went to an urgent care and then an eye specialist. He lost about 1½ days of work.

MI01317 – A self-employed maintenance man in his 60s cleaned out a drain in a bowling alley, using an acid drain opener. He then planned on mopping the floor with bleach (sodium hypochlorite) diluted in water. He dropped the bleach container and about two gallons of bleach went down the drain, reacting with the acid to produce chlorine gas. He developed a cough, sore throat, and irritated eyes. He ventilated the bowling alley immediately. There were no customers present. He called poison control.

MI01319 – An apartment complex employee in his 40s inhaled chlorine meant to be put in pool. He was coughing and short of breath. A coworker called poison control.

MI01324 – A cashier in her30s used a disinfectant (signal word: Danger) to clean out a cooler. She did not wear the required PPE and thought it was incorrectly diluted. Some got on her arm, and she developed a red, itchy, burning rash. She went to an urgent care center. Her employer stopped using that product.

MI01325 – A teenaged bagger/courtesy clerk at a grocery store was cleaning tiles in the cart area with a quaternary ammonium chloride based disinfectant (signal word: Danger) for a few hours. She became lightheaded; had difficulty breathing, a cough, and a headache; and felt weak and nauseous. EMS was called and then she went to an outpatient clinic. She lost 1-2 days of work.

MI01326-1335 – Ten employees were exposed to a quaternary ammonium chloride based disinfectant (signal word: Caution) while cleaning coins in a casino. They went to an emergency department complaining of rashes on their hands, arms, and legs. Two of them had a history of asthma and developed respiratory symptoms.

MI01336 – A male teenager was near a coworker who mixed an acid cleaner with bleach, releasing chlorine gas. He developed a cough, burning nose, swollen throat, and difficulty breathing. H went to an emergency department.

MI01355 – A veterinary technician in her 20s squirted some concentrated quaternary ammonium chloride based disinfectant (signal word: Danger) into a mop bucket filled with water. She was not wearing required eye protection and some splashed back into her eye. She had a red, irritated eye, blurry vision and tearing. She went to an emergency department.

MI01366 – A self-employed cleaner in her 40s was cleaning an office building. She mixed bleach with another sodium-hypochlorite disinfectant (signal word: Warning) to clean walls in an unventilated area. She developed a persistent, hard cough and difficulty breathing. The symptoms lasted about 3 days, and she called poison control the second day.

MI01368 – A construction worker in his 20s filled his water cup from a jug that is rinsed each evening with bleach. He noticed a bleach taste and that night he was nauseous and had throat irritation that lasted at least two days. He then called poison control and went to see a doctor.

MI01375 – An employee of a heating and cooling company spilled a cleaner containing sodium hydroxide on his hands. They became red and burned. His wife called poison control.

MI01380 – A hotel cleaner in her 20s used bleach for about 10 hours and became dizzy, vomited, and had eye irritation with tearing and a swollen eyelid. She called poison control.

MI01390 – A cleaner in a fruit packing plant in his 20s knocked a bucket with quaternary ammonia disinfectant (signal word: Danger) and some splashed in his eyes. He was wearing prescription glasses, but not the required eye protection (goggles, face shield, or safety glasses). His eyes were red and irritated. He rinsed them for 30 minutes each and went to an emergency department.

MI01391 – A worker in her 20s had diluted bleach splash in her eyes when a bottle that was loose from its nozzle dropped to the floor. She rinsed her eyes which burned and were puffy. A coworker called poison control.

MI01406 – An engineer in his 30s was blasting a wall with a mixture of bleach and dry ice. His respirator malfunctioned, and he was hit in the face with the mixture under pressure. He developed difficulty breathing and was coughing up blood. He called poison control and went to an emergency department. He spent one and a half days in the hospital.

MI01412 – A pizzeria employee in his 20s got some sanitizer (signal word: Warning) on his skin. He did not wash his hands and later ate a piece of pizza. He developed hot flashes and dizziness.

MI01427 – A teenager was working getting pools ready using a chlorine product. He came home one day with red, tearing eyes. His mother called poison control.

MI01456 – A nurse got some sodium hypochlorite disinfectant (signal word: Caution) in her eye. It was red and irritation. She called poison control and went to the emergency department.

MI01465 – A teenage prep chef mixed an acid cleaner with bleach in a bucket to clean floors. He was briefly exposed to the resultant chlorine gas before he left the area. He developed a cough, some difficulty breathing and a burning sensation in his lungs, throat, and eyes. He went to an emergency department, where he was diagnosed with mild chemical pneumonitis. When interviewed, five months after exposure, he said he still felt pain when around bleach.

MI01466 – A gallon jug of pool chlorine fell and splashed a teenager in his eyes. They became red, irritated, and watery. He went to an emergency department where his eyes were irrigated.

MI01468 – A health club employee in her 20s broke out into open sores when she used the pool. Her mother called poison control, and they thought it was likely due to poor chemical management in the pool.

MI01470 – A shift leader in her 50s at a coffee shop was putting away dishes from the dish drainer, and knocked a tube containing a quaternary ammonia sanitizer (signal word: Danger). It

swung out, and a big splash went under her glasses into her right eye. She felt severe pain and had blurry vision for the rest of the day. She washed with an eye wash and called poison control.

MI01509 – A hospital housekeeper in her 20s was cleaning a stretcher with a quaternary ammonia disinfectant (signal word: Danger). Her cloth was too wet, and some splashed in her eye. She immediately rinsed it out, but it continued to burn. Her eyelid swelled up, her eye was tearing, and she had blurry vision. She went to an emergency department the next day and was diagnosed with corneal abrasion and chemical conjunctivitis.

MI01527 – An adult male put a quaternary ammonia sanitizer (signal word: Warning) in his mouth, thinking it was a Tums. His mouth began to burn, and he developed blisters. The manufacturer was called, as well as the nurse-line of the local hospital.

MI01545 – A teenage farm worker was washing blueberries with chlorine dioxide. She developed shortness of breath, cough, wheezing, rapid breathing, and a fast heart rate and went to an emergency department.

MI01546 – A plumber in his 30s was working on a house. He did not know that another company had chlorinated the well. He drank some water and his throat became irritated, his lips and mouth felt like they were melting, and his stomach was upset. He called poison control.

MI01547 – A house cleaner in her 40s used an acid cleaner to clean a toilet bowl. When she flushed the toilet, it overflowed and the cleaner came into contact with the bleach based toilet cleaner in the tank (both signal word: Danger). This created chlorine fumes that she breathed in for about 30 minutes. She coughed until she vomited. At home she showered. She woke up the next morning with chest congestion and called her doctor, who referred her to poison control.

MI01551 – An ice cream parlor manager in her 20s was washing dishes. She pushed a button to release a sodium hypochlorite sanitizer into the sink, but the machine was empty. The air pressure caused sanitizer in the line to splash into her eye. Her eye was red and painful and she could not see for a couple of days. She called poison control and went to an urgent care clinic.

MI01569 – An employee at a golf and country club in his 20s was in the pool room when the pump broke and leaked fumes from chlorine tabs (signal word: Danger). He had trouble breathing; a burning sensation to his nose, throat, and chest; wheezing, cough; and pain on deep breathing; and diminished breath sounds. He went to an emergency department and was transferred to a regional hospital.

MI01574 – A teenage cook was cleaning out a sink with a solution of bleach and water. His boss told him to use gloves, but he didn’t, since he’d never had a reaction before. This solution may not have been diluted enough. His hands turned red and hurt very badly, with a burning sensation. His fingers were a little swollen. He called poison control and now wears gloves when cleaning with bleach.

MI01577 – A laborer in a nursery in his 40s was splashed in his eye with a quaternary ammonia-containing disinfectant/algicide (signal word: Danger). It was burning and he had blurred vision. He called poison control.

MI01588 – A pool worker at a fitness center in his 20s spilled pool chlorine on his arms. His arms became red, irritated, and itchy. His workplace called poison control.

MI01590 – An adult worker at a fast food restaurant mixed a quaternary ammonia disinfectant (signal word: Danger) with bleach. She inhaled some fumes and developed mouth and throat irritation. She called poison control.

MI01592 – A quality control supervisor for a plastics manufacturing company in her 40s was cleaning her office cubicle floor. She mopped with ammonia and water, but it didn't get as clean as she wanted. She waited until she thought the ammonia was dry, and then used a degreaser, scrubbing on her hands and knees. She wore gloves and safety glasses, but no respiratory protection. Later that afternoon she became dizzy and lightheaded, and went to sleep. The next morning she woke up and felt like her lungs were burning, she had shortness of breath, her face was red, and her scalp tingled. She called poison control and went to an urgent care center.

MI01599 – A worker in her 20s jumped on a counter and landed on her knees. The counter had some concentrated acid-based disinfectant (signal word: Danger) on it. She reported redness, swelling, blisters, and irritation on her knees. She called poison control and went to a physician who diagnosed her as having a chemical burn.

MI01607 – A custodian at a senior center in her 40s was emptying a mop bucket containing bleach water into a sink in a closet. She accidentally bumped a shelving unit and a bottle of toilet bowl cleaner containing ammonia fell off, into the sink. It broke and when the cleaner mixed with the bleach water chloramine fumes were released. She began coughing and choking immediately. She also developed nausea, headache, dizziness, trouble breathing, sore throat and eye irritation. She went to an emergency department. When interviewed nine months later, she said she still had trouble breathing when she exercised, although she hadn’t before the exposure.

MI01617 – An ultrasound technologist in her 40s used an aldehyde sterilizer (signal word: Danger) for sterilizing ultrasound probes. She dipped a test strip in the solution and ran it around the edge of the container to remove excess liquid. The test paper flew off and flung a drop in her eye. She was not wearing required goggles, or any eye protection. Her eye was burning, tearing and her vision was blurry. The eye was swollen the next day and still painful, but improved. She went to an emergency department, then an employee health clinic and an eye clinic. She now wears goggles, at least when changing the solution, and uses a paper towel to absorb excess solution.

MI01620 – A self-employed pool builder and maintainer in his 40s was closing down a pool. He picked up a gallon container of a sodium hypochlorite containing disinfectant (signal word: Danger) out of his truck by the cap, which was loose. The container fell, and chlorine splashed up into his eye. His eye became red and irritated. He called poison control and went to an emergency department.

MI01621 – An adult worker opened a dishwasher containing a sodium hypochlorite containing disinfectant (signal word: Danger) and suds splashed into his eye. His eye was painful and red. He flushed it and went to an emergency department where he was diagnosed with a corneal burn.

MI01622 – A worker in her 20s was being trained to clean hotel rooms. The trainer used a quaternary ammonia disinfectant (signal word: Danger) on the toilet. She also used window cleaner on the bathroom sink. The trainee became unresponsive, was sweating, had dilated pupils, and white chalky lips. When she recovered she said that while ill she could hear the trainer, but could not see or talk. She was taken to an emergency department.

MI01623 – A restaurant worker mixed an acid disinfectant (signal word: Danger) with bleach. About a half hour later he had a cough and shortness of breath. He went to an emergency department.

MI01624 – A teenage hotel employee got quaternary ammonium chloride disinfectant (signal word: Danger) in her eye. She had eye irritation and an ocular burn. She went to an emergency department.

MI01627 – A school custodian in his 30s mixed bleach with another product. When he sprayed it, he began to cough and had trouble breathing. He called his wife, who called poison control.

MI01632 – A gas station cashier in her teens cleaned the bathroom, and went to hang a squirt bottle with bleach water over the sink. The bottle broke, fell, and solution splashed up into her eye. She had eye pain for two to three days. She called poison control and went to an urgent care clinic.

MI01635 – A woman in her 50s who cleans newly constructed houses was cleaning a bathroom. She and her partner mixed ammonia with water. The water was from a new well that had been treated with chlorine, and the pipes had not been flushed out so there was excessive chlorine in the water. She breathed in the fumes all day and started coughing early on. She also developed eye pain that made sleeping difficult, sneezing, congestion, and itchy, irritated hands. She called poison control.

MI01636 – A woman in her 50s who cleans newly constructed houses was cleaning a bathroom. See MI01635. She and her partner mixed ammonia with water. The water was from a new well that had been treated with chlorine, and the pipes had not been flushed out so there was excessive chlorine in the water. She breathed in the fumes all day and developed a cough, sneezing, eye irritation and her lungs hurt.

MI01638 – A maintenance man in his 20s was maintaining a slide and splash pool at a motel. He added muriatic acid to balance the pH, and then used the same container to add hypochlorite. He forgot to rinse out the container first. A cloud of chlorine gas instantly developed. He developed chest tightness, a cough, difficulty breathing, was sweating, and pale. He went to an emergency department. When interviewed eight months later he said he still coughs a little more than he used to.

MI01647 – A man in his 30s was helping out on his parents' dairy farm. An automatic dispenser for the alkaline disinfectant (signal word: Danger) used to wash the dairy equipment was plugged up. It was off, but when he loosened the plug, pressure caused the product to squirt out into his eye. He was not wearing required eye protection and his eye became red, irritated, and teary. He rinsed it immediately and went to an urgent care center.

MI01655 – A machine operator for an automotive supplier in her 30s sprayed a phenol disinfectant (signal word: Caution) at work and some sprayed on her legs. She developed a red, itchy rash and went to an urgent care and was given steroids. Several hours later her symptoms became worse, including swelling and itching, and she went to an emergency department.

MI01659 – A teenage fast food worker mixed cleaners, including an acid disinfectant (signal word: Danger), a pine oil disinfectant (signal word: Warning), a cleaner containing bleach, and a degreaser, to clean a mop closet. Foam and chlorine fumes were created, and she was exposed for about three minutes. She developed a cough, burning throat and her hands turned yellow. She called poison control. The business was evacuated.

MI01660 – As a result of mixing bleach with a 'descaler', fumes were formed at a civic association. A female employee developed a cough, shortness of breath and chest pain. Poison control was called and she was referred to an emergency department. She was treated with oxygen and cough medicine and told to stay off work for two days. (See MI01659.)

MI01661 – As a result of mixing bleach with a 'descaler', fumes were formed at a civic association. A male employee had a slight cough initially and then developed a headache. Poison control referred him to a physician or an occupational health clinic, but he did not feel he needed to be seen. (See MI01660.)

MI01162 – A male worker at a convenience store dumped a bucket with nitric and phosphoric acid cleaning solution down a sink. Someone had previously poured bleach into the sink. A cloud of chlorine gas immediately formed and he started coughing and wheezing. He went to an occupational health clinic.

MI01663 – An inspection division manager (in his 30s) for an engineering company that has a specialty in water storage was cleaning the inside of a water tank, using a fire hose to remove sediment. The next step was to add powdered chlorine. Another employee spilled some of the chlorine into the tank from a bucket just as the division manager was looking up and some got in the division manager's left eye. He'd removed his safety glasses because they'd fogged up. His eye hurt initially but then felt fine until he removed his contacts seven hours later. His eye was swollen, red, burning and tearing. He went to an emergency department.

MI01664 – A teenage worker in a coffee shop got some quaternary ammonia disinfectant (signal word: Danger) on her hands. She rinsed them for 10 minutes but still felt a burning sensation and warmth. Gloves are required for this product. Her manager called poison control.

MI01665 – A worker for a house cleaning company in his 40s got bleach on his face, shirt and in his eyes. He was nauseous and his eyes hurt. He went to an occupational health clinic.

MI01666 – A teenage worker in a deer meat processing factory was exposed to fumes from bleach used to wash the floors. His eyes became red and irritated, and he called poison control.

MI01667 - An operating room nursing assistant in her 50s was pouring a quaternary ammonia disinfectant (signal word: Danger) from a jug into a mop bucket. Some spilled and soaked through her pants to her leg. She changed her pants but did not rinse her leg at that time. About 1-1/2 hours later her leg began to itch. It became red, painful and had small bumps. She went to the emergency department.

MI01668 – A nurse in her 20s was spraying a bed in a prison infirmary with a phenolic disinfectant (signal word: Danger). She developed difficulty breathing, a sore, swollen throat, anxiety, and a fast heart beat. She was seen on site by a nurse practitioner and taken by ambulance to an emergency department.

MI01669 – A cleaner in her 40s in an assisted living apartment complex mixed a sodium hypochlorite disinfectant (signal word: Danger) with an acid disinfectant (signal word: Caution) to clean a toilet. She was exposed to chlorine gas fumes and vomited. After fresh air she still felt anxious. Poison control was called.

MI01675 – A plumber in his 50s got bleach in his eyes from vat at a water treatment plant. His eyes were burning and red, and he had photophobia and blurred vision. He went to an emergency room.

MI01676 – An adult dishwasher in a bar put too much sanitizer in the sink for the sanitizing rinse. She was washing and sanitizing the dishes by hand, without gloves. Her hands became red, cracked, itchy, and they hurt when she put them in water. She called poison control. She did not want to consult a physician because she did not have insurance.

MI01677 – A prison worker in her 20s was splashed in the eye when an inmate dropped bleach mixed in water. Her eye was burning and she went to an emergency department. She had chemical conjunctivitis and a corneal abrasion.

Fumigants

MI01625 – A worker in a grain elevator in his 40s was exposed to a fumigant (signal word: Danger). He developed nausea, vomiting, diarrhea and a headache. He went to an emergency department.

MI01637 – A worker in a grain storage area in his 60s was exposed to fumes from the fungicide (signal word Danger) used to treat the wheat. He became dizzy and pale with an unsteady gait and blurry vision. He went to an emergency department.

Fungicides
MI01310 – A truck driver in his 40s had a pallet fall over, causing powdery residue of a fungicide to rise in a cloud, which he and two others inhaled. He developed trouble breathing; burning in his nose and throat; burning in his chest; chest tightness; hoarseness, and tingling in his arms. He was decontaminated by HazMat officials and taken to an emergency department by ambulance. He was told to stay off work for several days.

MI01471 – An assistant superintendent at a golf course in his 40s mixed a fungicide (signal word: Danger) and some powder got on his face. He was wearing safety glasses, as required, but as he sprayed perspiration containing the fungicide ran into his eye and it began to burn and was red and tearing. He washed it on site and went to an emergency department where he was diagnosed with a corneal injury.

Rodenticides
MI01433 – A veterinarian in her 40s induced vomiting in a dog that had eaten a mole bait containing zinc phosphide (signal word: Caution), as recommended by animal poison control. She and three other people in the animal hospital became ill from the exposure to phosphine gas resulting from the zinc phosphide mixing with stomach acids. She developed a headache, sore throat, felt lightheaded, and generally did not feel well. She completed her shift and went to an emergency department the next day, where tests indicated an elevated white blood cell count. She felt ill for about two and a half weeks. The Fire Department came out to test the air. They declared it safe. Poison control was called. See MI01436-38.

MI01436 – A woman in her 30s working at an animal hospital was one of several people exposed to phosphine gas from the vomit of dog that had eaten a mole bait containing zinc phosphide (signal word: Caution). She felt lightheaded and developed a headache. Poison control was called. See MI01433.

MI01437 – A woman in her 30s working at an animal hospital was one of several people exposed to phosphine gas from the vomit of dog that had eaten a mole bait containing zinc phosphide (signal word: Caution). She felt lightheaded and developed a headache. Poison control was called. See MI01433.

MI01438 – A veterinary technician in her 30s working at an animal hospital held down a dog that had eaten a mole bait containing zinc phosphide (signal word: Caution) while vomiting was induced. She was one of several people exposed to the resulting phosphine gas, and the first to feel ill. She developed dizziness, chest tightness, and a cough. She had a history of asthma and used her inhaler. Poison control was called. See MI01433.

Mixtures
MI01253 – A teenager working on a farm was burning containers that had previously held a pyrethroid insecticide (signal word: Warning) and a glyphosate herbicide (Signal word: Caution). He started coughing and then became nauseous and vomited multiple times. He went to an emergency department.

MI01431 – An agricultural inspector in her 40s was checking plum trees for plum pox virus. A homeowner told her and her partner that there were some plum trees in his apple orchard and gave them permission to check them. While they were in the orchard, the owner started spraying it with a mix of two insecticides and a fungicide (signal word for all three: Caution). Some got on her skin and clothes and she inhaled some as well. Her throat hurt and her eyes burned. She went to an emergency department. Her supervisor reported the event to MDA, which reported it to MDCH.

Other

MI01272 – An in-home service worker in her 60s was exposed to fumes from pheromone traps for mealy moths in a client's apartment. She developed a stuffy nose and difficulty breathing and called poison control. The client had difficulty breathing and called 911. The client's cat also appeared to be ill until after the apartment was ventilated.

Appendix II

Contributing Factor Codes

Codes	Code description	Instructions for coding and comment field	Examples of text for comment field
01	Notification/posting lacking or ineffective	Use comment field to indicate if posting or notification was required. Note if it was WPS/state/local/label requirement. Describe any posting or notification that did occur, and how it failed to meet requirements. Note if there was a citation issued.	"Workers not told field had been sprayed, saw no signs." "Resident set off foggers without telling roommates." "Landscape application not posted as required by state law. Citation given."
02	People were in the treated area during application	If known, use comment field to state why people were present. Indicate whether or not the applicator knew others were present.	"Worker sprayed in the office without clearing the area; unaware that spraying could cause health problems." "Applicator unaware that irrigation worker was in orchard during ground spraying due to lack of communication on the farm." "Employee accompanied pesticide applicator to unlock doors."
03	Inadequate ventilation of treated area before re-entry	Code if you suspect that ventilation of treated area was a problem. Specify in the comment field if label requirements for ventilating building/greenhouse were not followed.	"Homeowner waited specified time before returning, but did not open windows to ventilate." "Shipping container had strong smell when opened." "Person reported strong odor in office upon re-entry."
04	Early re-entry	If known, include the REI or the re-entry statement on label. Indicate how early people entered the area. This applies to WPS/state/local/label requirements. This code also applies to home products.	"REI was 4 hrs, workers report that they followed the spray rig along the row." "Homeowner ran back in house to cover fish tank after activating foggers." "Label states 'keep unprotected persons out of area until sprays are dry' but vegetation still wet when worker began pulling out the sprayed plants."
05	Required eye protection not worn or required eye protection inadequate	State the required eye protection (safety glasses, goggles, face shield). Did they wear it? In the comments, include the following information if known: 1) the employer did not provide the equipment; 2) the employee removed it (and why); 3) the wrong type was worn; or 4) the eye protection was not fitted properly.	"Goggles fogging up, took them off." "Employer didn't provide; employee unaware they were required." "Label requires goggles, applicator wore safety glasses" "Wearing sunglasses, thought this counted as eye PPE." "Goggles not tight fitting, seal breaks when he turns head at end of row."

06	Required gloves not worn or required gloves inadequate	State the required hand protection. Did they wear it? In the comments, include the following information if known: 1) the employer did not provide the gloves; 2) the employee removed the gloves (and why); or 3) the wrong type was worn.	"Wrong gloves worn. Wore what was provided." "Removed gloves to blow his nose."
07	Required respirator not worn or required respirator inadequate	State the respiratory protection required. Did they wear it? In the comments, include the following information if known: 1) respirator not provided by the employer; 2) person removed the respirator (and why); 3) wrong type worn; 4) respirator not fit-tested or improperly adjusted; or 5) Used the wrong type of cartridges.	"Wore respirator during application, but not when he made early re-entry to check soil. Didn't think it was needed for short exposure." "Respirator cartridges not changed regularly enough." "Respirator had wrong type of cartridge. Also, employer cited for improper fit test."
08	Other required PPE not worn or inadequate	State what PPE was missing or inadequate, and why.	"Wore leather boots/shoes instead of rubber boots." "No coveralls, gloves, head gear, or apron. All required for mixer/loaders. He only wore PPE required for applying."
09	Spill/splash of liquid or dust (not involving application equipment failure)	Code for releases due to leaking storage containers, packaging failure or poor package design. This code includes the following: 1) splashes, spills, or powder releases during product opening/mixing/use; 2) exposures occurring during the transportation or storage of pesticides; 3) exposure due to inadvertent spray in the wrong direction; and 4) secondary exposures to spills (e.g. EMS, ER, Med, Vet). If the wind blows pesticide spray back into an applicator's face, it should be coded under 05-08, 15, or 16 depending on the underlying causal factor. Exposures due to application equipment failure are coded under 10.	"Exposed to leaking bottle in retail store" "Dropped bag of granules. Breathed dust." "Aerosol can facing wrong way, discharged into face" "Small splash from tank when adding water." "Opening chlorine pool tabs & puff of dust blew into face." "Backpack sprayer not secured on truck during transport. Tipped over." "Aerosol can malfunctioned."
10	Application equipment failure	Improper preparation, assembly, or maintenance of application equipment. This code includes nozzles plugging, valves not tightened properly, spray lines splitting, o-ring failure, or leaking backpack sprayers. If known, provide specific information about what failed and why. Product container/package malfunction (e.g., fogger sprayed out to the side when activated) should be coded under 09.	"Spray hose ruptured on power sprayer. Suspected hose was old." "Leaking clamp on backpack sprayer." "Power duster malfunctioned, poor equipment maintenance." "Valve on shipping container failed." "Fixing clogged nozzle when it discharged into his face."

11	Within reach of child or other improper storage	Indicate if stored within reach of children, transferred to or stored in an inappropriate container such as a food or beverage container, or if left out after use. When this code is selected, use discretion when coding any other codes. Label violations (4-8, 15) and intent to harm (13) usually do not apply to children, unless the child was mature enough to understand the requirements and implications of pesticide use.	"Lice shampoo left out on counter. Toddler drank it." "Cat knocked insecticide off garage shelf." "6 y/o sprayed brother in face in retail store aisle. He got the can off a low shelf" "Someone brought in Pine Sol in a pop bottle. He thought it was his pop and took a swallow." "Brought insecticide into work to share; transferred to plastic containers that melted."
12	Decontamination not adequate or timely	Code if decontamination of person, equipment, or spill did not occur, or was not done in a timely manner. When known, explain why. Indicate if decontamination supplies were not available or inadequate. Include inability to change clothes and/or wash after spill/splash.	"Spilled pesticide on skin, kept working. No decontamination supplies on the truck." "Worker did not have eye wash handy; washed out eye with iced tea drink." "Spill not cleaned up for three days, strong odor in indoor air." " Worker spilled pesticide on skin. He washed up & put on clean cloth coveralls, but did not change out of contaminated jeans."
13	Intentional harm	Cases involving intentional harm to self, others, pets or wildlife. These could be referred to law enforcement. If person is attempting to use it for intended purpose but just doesn't follow label, code the specific label violation or use code 15 for other label violations.	"Spouse suspected of intentional harm with mothball application." "Baited hotdogs with OP to poison neighbor's annoying dog." "Ate rat poison in suicide attempt."
14	Excessive application	Indicate if a pesticide was applied above the label rate or if an excessive number of products were used.	"Product applied at too high a rate." "Swam in over-chlorinated pool." "Sprayed house not realizing housemate had already sprayed earlier." "Inspector noticed visual signs of over-application."
15	Label violations NOS (NOS – Not otherwise specified, other regulatory issues)	Code other label violations, not listed under another code. This includes spraying when windy, and failure to clean up or an off-label application (site or pest).	"Spraying in windy conditions." "Didn't read label, used outdoor insecticide indoors" "Disinfectant used to kill ants. Not labeled use."
16	No label violation identified but person still exposed/ill	Code for situations where the label may be inadequate. This includes: 1) the label required PPE, REI, or notification was followed, but did not prevent exposure/illness; 2) PPE, REI, or notification not required, but might have prevented exposure/illness; and 3) information on individual sensitivity (e.g. MCS, ACI, preexisting asthma dx)	"Wore all required PPE, still exposed during application." "Entered field 6 hrs after REI expired and became ill." "Allergic reaction despite all PPE worn, person may have been sensitive." "Label states 'wear eye protection', but a splash reached around sides of safety glasses." "Eye PPE not required, but eye exposure resulted in severe reaction." "No label requirement for clearing area or ventilating before reoccupying."

17	Drift	Include cases: 1) confirmed by laboratory analysis of samples, or 2) a witness saw, smelled or felt the spray off-site regardless of sample results. In the comments, note the following: 1) the distance of the exposed person from the site of application; 2) any underlying conditions (wind, temperature inversion, improper seal of soil, other poor practices by applicator, etc.); or 3) if a citation for drift was issued.	"Patient felt spray on arm 80 ft from the application." "Warm weather caused product to volatilize and move into adjacent building." "School bus driver alleged that air blast sprayer did not turn off nozzles at end of row, spray hit bus windshield. No samples to confirm or cite for drift."
18	Applicator not properly trained or supervised	Code this when the worker reports an obvious lapse in supervision or safety training. Include cases where federal, state, or label requirements are for a licensed/certified/registered applicator, but the applicator did not meet requirements.	"Unlicensed person applying Restricted Use Pesticide without direct supervision." "Employer didn't provide PPE or safety instruction." "Not his usual job, unaware of the chemical hazards." "Not supervised appropriately" "Patient unable to read label in English, no one read or explained to him."
19	Illegal pesticide used/Illegal dumping	Product makes pesticide claims, but is not registered by EPA and/or state. This does not include use of an old cancelled product unless it was specifically banned from use. Explain in comment field if exposure was a result of illegal dumping or disposal.	"Methyl parathion applied illegally to homes." "Tres Pasitos, an illegal pesticide, was used in the home." "Illegal dumping of pesticide containers."
20	Mixing incompatible products	Mixing incompatible products (e.g., bleach & ammonia)	"Mixed bleach and acid cleaner in mop bucket." "Washed walls with ammonia and then floor with bleach."
97	Other (consider new code)	Code contributing factors that don't fit elsewhere. Explain in the comment field.	"Pesticide fire created hazardous fumes. Building evacuated."
98	Not applicable	Not applicable	
99	Unknown (Default value/Uncoded)	When you don't know whether label was followed and have no idea how or why the worker was exposed, code "Unknown." Use if follow-up is not complete or not done, or if based on available information you are still unable to determine the cause.	"No interview with patient; unsure how exposed" "Spray records not provided; don't know if REI observed."

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