Pesticide Illness and Injury Surveillance in Michigan

2009

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Division of Environmental Health
Michigan Department of Community Health

Jennifer M. Granholm, Governor
Janet Olszewski, Director

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State of Michigan
Governor – Jennifer M. Granholm

Michigan Department of Community Health
Director – Janet Olszewski
Public Health Administration – Jean Chabut, RN, MPH
Bureau of Epidemiology – Corinne Miller, DDS, PhD
Division of Environmental Health – David R. Wade, PhD

Authors
Abby Schwartz, MPH
Martha Stanbury, MSPH

Contributor
Kenneth Rosenman, MD
Michigan State University

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Michigan Department of Community Health
Thomas Largo, MPH

Michigan Department of Agriculture
Brian Rowe, BS

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

Children's Hospital of Michigan Poison Control Center

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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 seventh 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 2009, 1,011 reports of occupational exposures and pesticide illness or injury were received and 716 (70.8%) were confirmed as cases according to the surveillance case definition. In 2009, there were 132 reported occupational cases; 92 (69.7%) were confirmed.

Michigan's Poison Control Center (PCC) remained the main data source, reporting 64.4% of the occupationally exposed individuals. Antimicrobials continue to be a major type of exposure. In 2009, antimicrobials accounted for over two-thirds of the confirmed occupational cases.

The most common route of exposure for confirmed occupational cases in 2009 was inhalation, involved in over half the cases. The most common biological system affected was the respiratory system, with 148 respiratory symptoms reported. Cases have multiple symptoms.

Where occupation was known, 35.0% of the confirmed cases in 2009 involved Building and Grounds Cleaning and Maintenance. Of those, 71.4% were cleaners, housekeepers or maintenance workers and 17.9% were pest control operators. Where activity of the exposed person was known, 37.7% were exposed to pesticides inadvertently while doing their regular work that did not involve applying pesticides.

Four cases in 2009 were referred to the Michigan Department of Agriculture (MDA) for investigation of possible pesticide use violations. One was referred to the Michigan Occupational Safety and Health Administration (MIOSHA) for investigation. Four events met the criteria for priority reporting to the National Institute for Occupational Safety and Health (NIOSH). These events are described on pages 30 and 31.

Five hundred eight non-occupationally exposed pesticide cases were reported, of which 249 (49.0%) met the definition of a confirmed case. Almost two-thirds of the non-occupational cases involved antimicrobials.

The most common contributing factors involved in confirmed occupational and non-occupational cases were mixing incompatible products followed by spills or splashes of liquid or dust.

Section I: Occupational Pesticide Illness and Injury Surveillance

Background

Pesticide poisoning is a potential public health threat due to widespread pesticide use. According to the U.S. Environmental Protection Agency (EPA), 1.2 billion pounds of pesticides (excluding antimicrobials and wood preservatives) were used in the United States in 2001, the last year they collected this data.[1]

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).

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

Evidence has linked pesticides with a variety of acute health effects such as conjunctivitis, dyspnea, headache, nausea, seizures, skin irritation, and upper respiratory tract irritation.[2] The effects of chronic or long term exposures include cancers, immune function impairments, neurological disorders, reproductive disorders, respiratory disorders, and skin disorders.[3]

Acting on concerns about acute occupational pesticide-related illness, NIOSH began collecting standardized information about acute occupational pesticide exposure from selected states in 1998[4] 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 2009, there were 14,521 different pesticides registered for sale and use in Michigan. 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 2,147 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 2009, there were a total of 21,932 certified pesticide applicators and 2,147 licensed businesses. Table 1 shows the number of licensed businesses and certified applicators since 2001.

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[1] http://www.epa.gov/opp00001/pestsales/01pestsales/market_estimates2001.pdf
[2] Recognition and Management of Pesticide Poisonings, ed. Dr. J. Routt Reigart and Dr. James R. Roberts, 5th edition. 1999. http://www.epa.gov/pesticides/safety/healthcare/handbook/handbook.htm
[3] ibid
[4] http://www.cdc.gov/niosh/topics/pesticides/

Table 1

Pesticide Licensing and Certification, 2001-2009									
Type	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Private Certification	10,596	10,075	9,576	9,200	8,793	8,352	8,122	7,848	7,722
Commercial Certification	13,045	13,089	13,387	13,588	13,485	13,743	14,123	14,118	14,210
Total Applicators	23,641	23,164	22,963	22,788	22,278	22,095	22,245	21,966	21,932
Licensed Businesses	NA	NA	1,755	NA	1,900	1,962	1,923	2,025	2,147

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 and the number of inspections have decreased over time.

Table 2

Pesticide Inspections and Investigations, 2001-2009									
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Misuse Investigations	194	165	132	153	182	231	178	180	108
Random Inspections	1,126	1,077	1,261	1,266	1,175	797	655	303	312
# of Field Staff	20	20	20	18	18	15	15	16	13

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 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 Poison Control Center), health care facilities, and employers to report information about individuals (including names) with suspected or confirmed work-related diseases to the state. In October 2005, laboratories started reporting acetylcholinesterase and pseudocholinesterase test results in accordance with R 325.61 and R 325.68 additions to the Michigan Public Health Code. These tests are sometimes ordered for patients exposed to organophosphate and carbamate insecticides. Regulations to require the reporting of all pesticide injuries and illnesses went into effect September 18, 2007 (R 325.71-5).

In addition to information from reports submitted under the public health code, the surveillance system also collects information on individuals with pesticide exposures who have been reported to the Pesticide and Plant Pest Management Division of 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)[5] 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[6] 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.[7] Cases classified as definite, probable, possible, or suspicious are considered confirmed cases.

Confirmed cases are evaluated regarding the severity of the health effect: low, moderate, high and death. The severity index is based on the signs and symptoms experienced, whether medical care was sought, if a hospital stay was involved, and whether work time was lost.[8]

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[5] http://www.michigan.gov/mdch/0,1607,7-132-2945_5105-110654--,00.html
[6] http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef2003_revAPR2005.pdf page 1
[7] ibid, pages 2-3
[8] http://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sevindexv6.pdf

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.

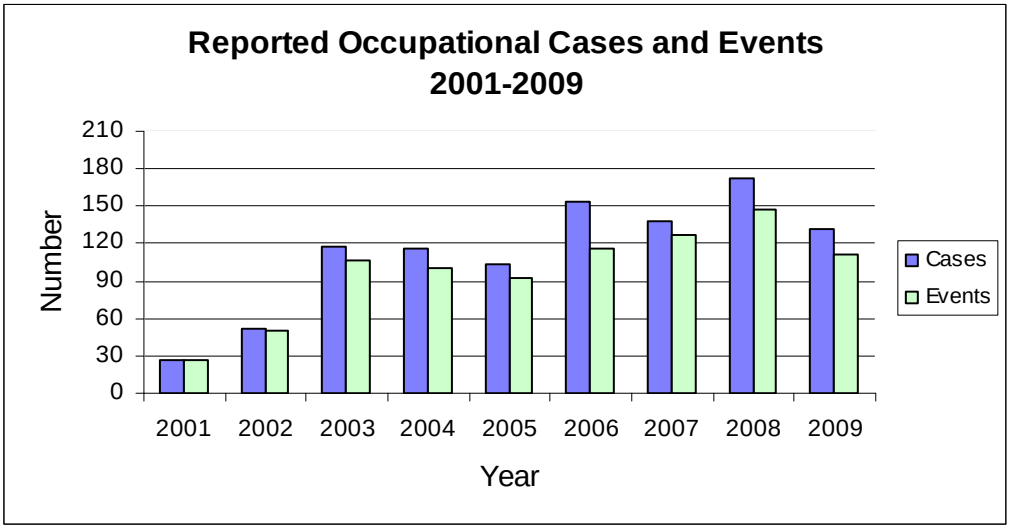
Finally, if appropriate, MDCH surveillance staff provide educational consultations to reported individuals and/or their employers about reducing hazards related to pesticide exposures.

Results

Reports

There were 1,011 reports of acute occupational pesticide poisonings from 2001 – 2009. These represent 879 separate events. In 2009 there were 132 people (cases) (111 events) reported. Figure 1 shows the number of reported occupational cases and events by year.

Figure 1



Report Source

The distribution of the sources of the case reports is shown in Table 3. The Poison Control Center (PCC) remains the major source of reports. In 2009, 85 (64.4%) of the 132 reported cases were reported by PCC. Twenty-six (19.7%) were reported by the Hazardous Substance Emergency Event Surveillance program (HSEES). As of September 30, 2009 the HSEES is no longer funded in Michigan. Some exposures were reported by multiple sources; the table shows the first source.

Table 3

Reported Occupational Cases by First Source of Data 2009 and 2001-2009

	2009		2001-2009	
Data Source	**Number**	**Percent**	**Number**	**Percent**
Poison Control	85	64.4	790	78.1
Hospital	14	10.6	93	9.2
HSEES	26	19.7	60	5.9
MDA	1	0.8	24	2.4
FIFRA	0	0.0	12	1.2
Physician	0	0.0	7	0.7
Co-worker	2	1.5	6	0.6
Relative	0	0.0	5	0.5
Employer	0	0.0	5	0.5
Other	4	3.0	9	0.9
Total	132	100	1011	100

The average time between the event and the report to the State varied by reporting source. Table 4 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 of the main report sources.

Table 4

Lag Time by Report Source, 2009 Reported Occupational Cases (N=132)				
Source	Average # of Days	Median # of Days	# Cases Reported Same Day	% Cases Reported Same Day
PCC	4	1	7	8.2
Hospital	324	339	0	0.0
HSEES	10	5	0	0.0

Classification

Of the 1,011 occupational cases reported from 2001 through 2009, 717 (70.9%) met the criteria to be considered confirmed cases. In 2009, 92 (69.7%) cases were considered confirmed cases. See Table 5.

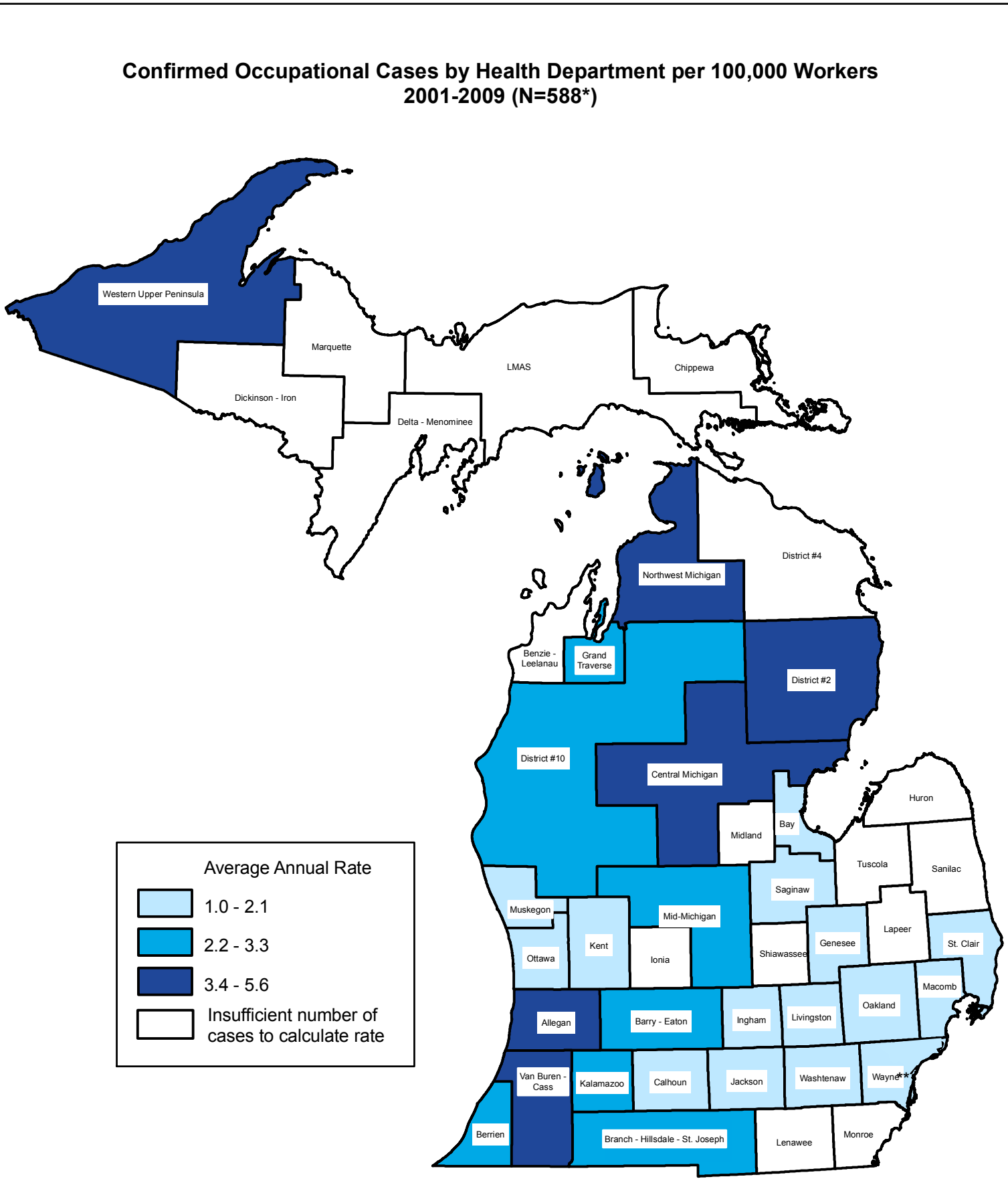
Table 5

Reported Occupational Cases by Classification, 2009 and 2001-2009				
	2009		2001-2009	
Classification	Number	Percent	Number	Percent
Confirmed cases				
Definite	15	11.4	98	9.7
Probable	19	14.4	149	14.7
Possible	57	43.2	426	42.1
Suspicious	1	0.8	43	4.3
Total confirmed	*92*	*69.7*	*716*	*70.8*
Not confirmed				
Unlikely	0	0.0	3	.03
Insufficient Information	38	28.8	253	25.0
Exposed, Asymptomatic	2	1.5	28	2.8
Unrelated	0	0.0	11	1.1
Total not confirmed	*40*	*30.3*	*295*	*29.2*
Total	132	100.0	1011	100.0

Location in State

In 2009, there were no known confirmed occupational cases in 63.9% of Michigan's counties (53 of 83 counties). For 9 (9.8%) confirmed cases in 2009, county of exposure was unknown. Oakland and Wayne Counties had 10 confirmed cases each in 2009. Kalamazoo had eight confirmed cases and Genesee had 7 confirmed cases in 2009. Since the numbers per county are low, Figure 3 shows the distribution of all confirmed occupational cases for the years 2001-2009 to preserve anonymity. During that time period, the county of exposure was unknown for 105 (14.7%) confirmed cases.

Figure 3



* Location of exposure was unknown for 128 of the 716 confirmed cases.

** Wayne County and City of Detroit Health Departments have been combined here.

The summary information that follows presents the data from the 92 confirmed occupational cases reported in 2009. These represent 76 separate events. Appendix I contains a brief narrative of each confirmed occupational case reported in 2009. See the previous annual reports for brief narratives of confirmed cases from previous years.

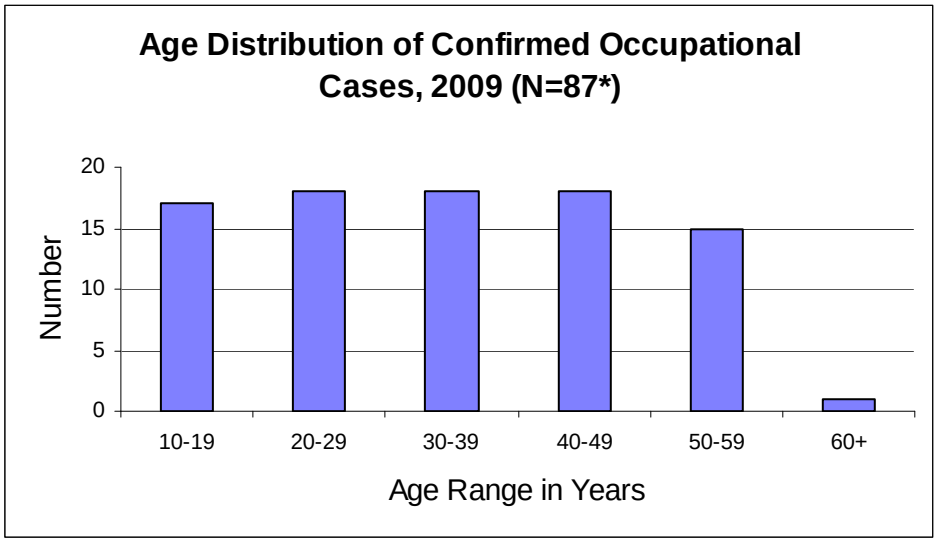
Demographics

Gender
Of the 92 persons with confirmed work-related pesticide illnesses or injuries, 50 (54.3%) were men, and 42 (45.7%) were women.

Race and Ethnicity
Race was known for 56 (60.9%) of the 92 confirmed cases. Where race was known, 46 (82.1%) were white. Hispanic ethnicity was known for 34 (37.0%) of the confirmed cases. Three of these (8.8%) were Hispanic.

Age
The age distribution of the individuals where the age was known is shown in Figure 4. The median age was 34.7, with a range of 17 to 60.

Figure 4



* Age was unknown for 5 of the 92 confirmed occupational cases.

Industry[9]

Industry of employment was known for 81 (88.0%) of the 92 confirmed cases. As table 6 shows, the industry category with the most persons exposed to a pesticide in 2009 was "Health Care and Social Assistance" with 17 workers. There were 11 workers in "Educational Services", 10 in "Accommodation and Food Services" and nine in "Real Estate and Rental and Leasing" which includes structural pesticide operators. Six of the educational services cases were exposed when an herbicide was sprayed outside a school in a light wind. Six students were also reported as having been exposed in this event.

Table 6

Industry of Confirmed Cases, 2009 (N=81*)

Type of Industry	Number	Percent
Health Care and Social Assistance	17	21.0
Educational Services	11	13.6
Accommodation and Food Services	10	12.3
Real Estate and Rental and Leasing	9	11.1
Retail Trade	6	7.4
Manufacturing	6	7.4
Agriculture, Forestry, Fishing, and Hunting	5	6.2
Administrative and Support and Waste Management and Remediation Services	5	6.2
Other	12	14.8
Total	81	100.0

* Industry was unknown for 11 of the 92 confirmed occupational cases.

Occupation[10]

Occupation was known for 80 (87.0%) of the 92 confirmed cases and is shown in Table 7. The most common occupation was "Building and Grounds Cleaning and Maintenance". This included 20 cleaners/housekeepers/maintenance personnel and six pest control operators. Eight (10.0%) workers were in education.

Table 7

Occupation of 2009 Confirmed Cases (N=80*)

Occupation	Number	Percent
Building and Grounds Cleaning and Maintenance	28	35.0
Education, Training, and Library	8	10.0
Food Preparation and Serving Related	6	7.5
Transportation and material Moving	6	7.5
Protective Service	5	6.3
Office and Administrative Support	5	6.3
Production	5	6.3
Other	17	21.3
Total	80	100.0

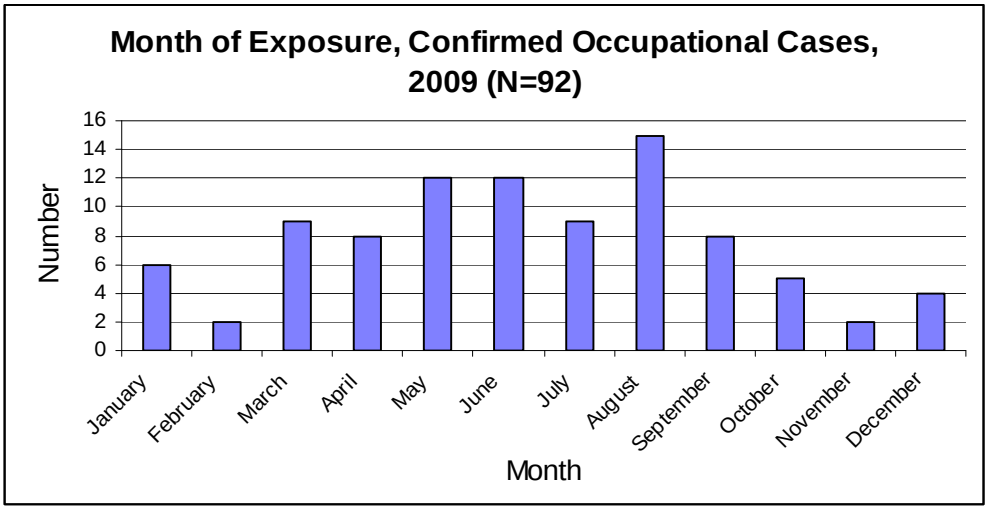
* Occupation was unknown for 12 of the 92 confirmed occupational cases.

[9] Categorized based on 2002 North American Industry Classification System (NAICS) codes http://www.census.gov/epcd/naics02/naicod02.htm
[10] Categorized based on 2002 US Bureau of Census Occupation Codes http://www.census.gov/hhes/www/ioindex/ioindex02/view02.html

Exposures

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

Figure 5



Type of Location
Pesticide exposures take place in a variety of worksite locations. Table 8 shows the location for the 82 cases where location was known. The most common location, Service Establishments, includes hotels, health clubs, and other facilities that usually fall into service industry and are not included in other specific codes for this variable.

Table 8

Location of 2009 Confirmed Occupational Cases (N=82*)

Location Type	Number	Percent
Service Establishment	15	18.3
School	10	12.2
Hospital	10	12.2
Multi-unit Housing	8	9.8
Office	6	7.3
Non-production Agricultural Processing	5	6.1
Retail	5	6.1
Farm	4	4.9
Single Family Home	4	4.9
Greenhouse	2	2.4
Mobile Home/trailer	2	2.4
Day care Facility	2	2.4
Other Institution	2	2.4
Industrial Facility	2	2.4
Other	5	6.1
Total	82	100.0

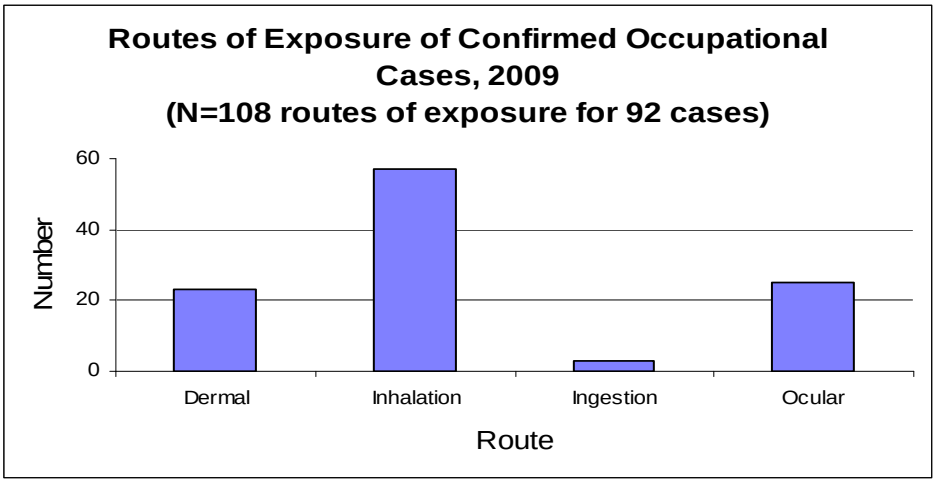
* Location was unknown for 10 of the 92 confirmed occupational cases.

Equipment Used
Type of equipment used was unknown for 40 (43.5%) of cases. The most common type of equipment was a trigger pump, push-pull, or compressed air hand sprayer, involved in 10 exposures. Five involved a total release fogger.

Route of Exposure
Route of exposure indicates how the pesticide entered the body. Figure 6 shows that all 92 individuals identified one or more routes of exposure for a total of 108 routes, including 57 inhalation exposures, 25 ocular exposures and 23 dermal exposures. Ten individuals were exposed through two different routes while three had three routes of exposure.

A farm hand was cleaning a spray nozzle and a bug flew into his eye. He put his hand in his eye to remove it and got insecticide in his eye. His eye was red and burning and he went to an emergency department. He had a chemical conjunctivitis and a corneal abrasion.

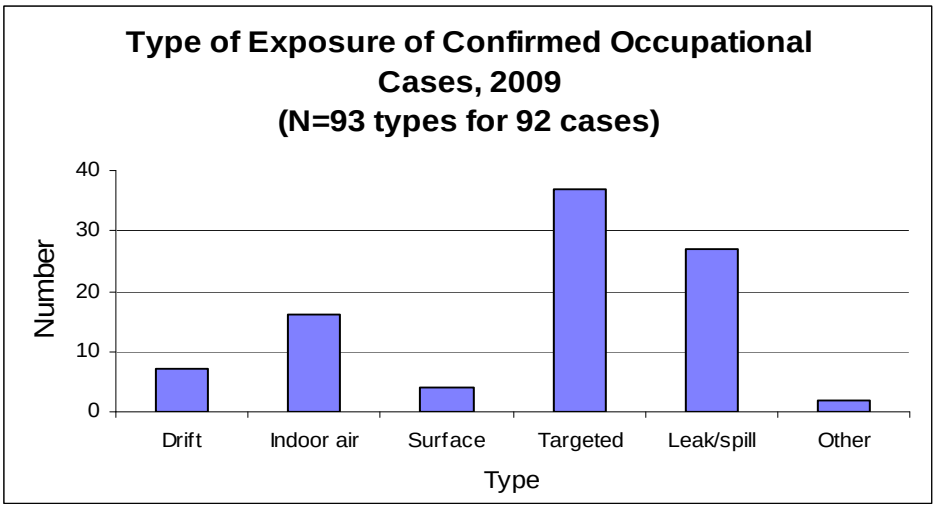
Figure 6



*13 cases had multiple routes of exposure.

Type of Exposure
Figure 7 shows how workers who became ill were exposed to pesticides. Exposure during a targeted application accounted for 37 exposures. Exposure from an unintentional leak or spill accounted for an additional 27 exposures. For two cases, the type of exposure was unknown. Three workers experienced two types of exposure.

Figure 7



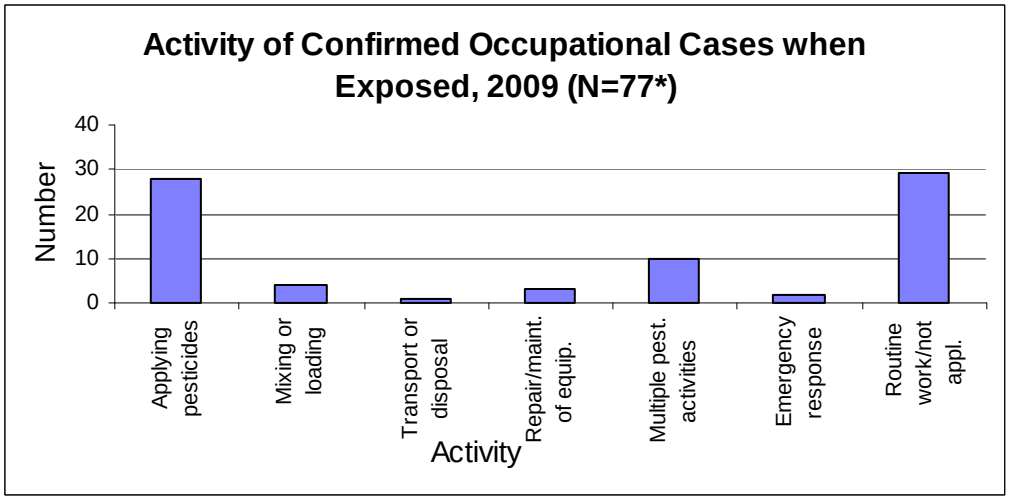
*Type of exposure was unknown for two confirmed cases; three cases had two types of exposure.

Activity at Time of Exposure

Activity at time of exposure was determined for 77 (83.7%) of the confirmed cases. Of those, Figure 8 shows that 29 (37.7%) were doing work activities that did not involve pesticide applications and thus had "bystander" exposure. Twenty-eight (36.4%) individuals who became ill were applying pesticides when they were exposed.

A pesticide applicator was spraying for mosquitoes, using a pyrethroid insecticide. It was not overly windy, but when he walked into an open area some sprayed back on his cheeks. He was wearing safety glasses and a mask (not required), but his cheeks were still exposed. He did not notice that the pesticide got on his skin until about an hour later, when his skin began to feel hot, burning and tingling. He washed then, but thinks he may have spread the chemical when washing. He called poison control and lost one day of work.

Figure 8



* Activity was unknown for 15 of the 92 confirmed occupational cases.

Product Used

Among confirmed cases, the most common exposure was to antimicrobials (70.7%), followed by insecticides (14.1%) and herbicides (13.0%). See Table 9.

Table 9

Product Type of Confirmed Occupational Cases, 2009 (N=92)		
Product Type	**Number**	**Percent**
Antimicrobial	65	70.7
Insecticide	13	14.1
Herbicide	12	13.0
Animal repellent	1	1.1
Mixture	1	1.1
Total	92	100.0

A fire fighter in his 40s was mopping a floor and some quaternary ammonium disinfectant splashed in his eye. He did not rinse it out for about an hour. His eye was irritated and he went to an occupational health clinic and then an emergency department. He was diagnosed with chemical keratitis and was referred to an eye specialist.

Severity

Table 10 shows the severity of the case by the type of product used. Most cases (71.7%) were low severity, with no reported deaths in 2009.

Table 10

Severity by Product Type of Confirmed Occupational Cases, 2009 (N=92)						
Product Type	**Low**		**Moderate**		**Total**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Antimicrobial	45	68.2	20	76.9	65	70.7
Insecticide	12	18.2	1	3.8	13	14.1
Herbicide	7	10.6	5	19.2	12	13.0
Animal Repellent	1	1.5	0	0.0	1	1.1
Mixture	1	1.5	0	0.0	1	1.1
Total	66	100.0	26	100.0	92	100.0

Pesticide products are assigned a signal word[11] 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 11 shows the severity of the case by signal word, when known.

Table 11

Severity by Signal Word of Confirmed Occupational Cases, 2009 (N=38*)						
	Low		**Moderate**		**Total**	
Signal Word	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Caution	15	53.6	5	50.0	20	52.6
Warning	1	3.6	1	10.0	2	5.3
Danger	12	42.9	4	40.0	16	42.1
Total	28	100.0	10	100.0	38	100.0

* For 42 confirmed cases the signal word was unknown; 12 involved a mixture of products with different signal words.

[11] http://www.epa.gov/oppfead1/labeling/lrm/chap-07.pdf

Symptoms

Table 12 shows the type of symptoms reported by confirmed occupational cases in 2009. Cases could have multiple symptoms in one biological system as well as symptoms in more than one system. The most commonly reported symptoms were respiratory symptoms, including shortness of breath, cough, sore throat, and chest tightness.

Table 12

Reported Symptoms of Confirmed Occupational Cases, 2009

System	Number	Percent
Respiratory	148	40.0%
Eye	71	19.2%
Neurologic	58	15.7%
Dermal	51	13.8%
Gastrointestinal	33	8.9%
Cardiovascular	7	1.9%
General	2	0.5%
Total	370	100.0%

A maintenance worker for a property management company went into a house that had recently been treated with a pyrethrin based total release fogger. After a few minutes in the house he had to leave. He felt nauseous and he vomited. He also developed a cough, sore throat, and headache. He couldn't take a deep breath and his sinuses flared up. He did not seek medical care.

Medical Care

Table 13 shows where confirmed cases first sought medical care. More than half of the cases first sought medical advice from poison control. Almost a third first sought care at an emergency department or urgent care center. Twenty-one (48.8%) involved cases where medical personnel consulted with poison control.

Table 13

First Source of Medical Care of Confirmed Occupational Cases, 2009 (N=92)

First Care	Number	Percent
Advice from poison control	48	52.2
Emergency room/urgent care	32	34.8
Other, including EMS	6	6.5
Occupational health clinic	3	3.3
Physician office visit	2	2.2
No medical care sought	1	1.1
Total	92	100.0

Contributing Factors

Identifying factors contributing to the exposure or illness/injury can improve prevention activities. Table 14 shows the contributing factors for the confirmed occupational cases in 2009. The most common factors were mixing incompatible products and spills or splashes of liquid or dust. For 13 cases (10.4%) no label violations were identified but the person was still exposed and became ill.

Table 14

Contributing Factors for Confirmed Occupational Cases, 2009 (N=125*)

Factor	N	Percent
Mixing of incompatible products	25	20.0%
Spill/splash of liquid or dust (not involving application equipment failure)	22	17.6%
No label violation identified but person still exposed/ill	13	10.4%
Decontamination not adequate or timely	10	8.0%
Required eye protection not worn or required eye protection inadequate	7	5.6%
Drift	7	5.6%
Notification/posting lacking or ineffective	6	4.8%
Pesticide stored within reach of child or other improper storage	6	4.8%
Other	29	23.2%
Total	125	100.0%

* Contributing factors were unknown for seven confirmed cases, while 34 cases had two or more contributing factors.

A hospital cleaner was cleaning a hospital tray. Her rag was wet, and when it hit the lip of the tray some of the disinfectant splashed in her eye. Eye protection was not required. Her eye became red, irritated, and dry. She went to the emergency department and was diagnosed with a corneal abrasion. She thinks if they were allotted more time to clean they could be more thorough and careful.

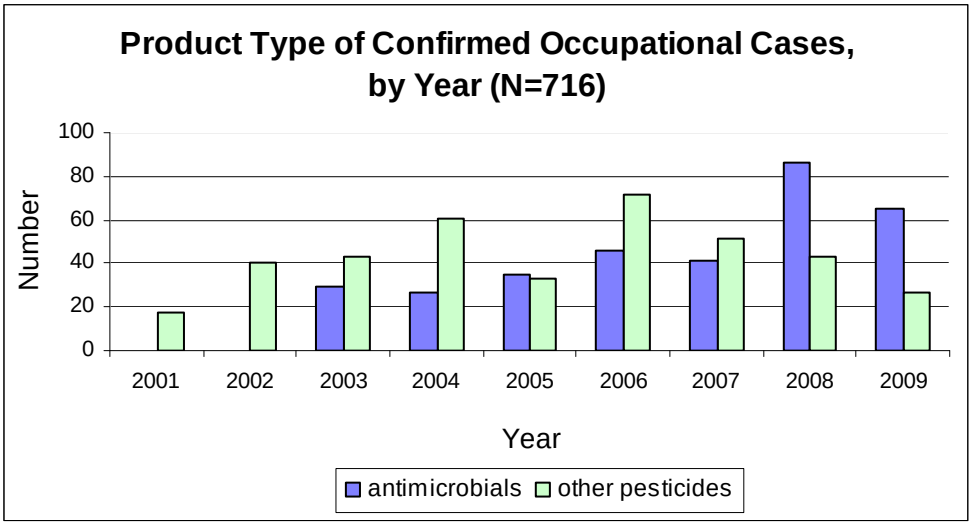
An apartment maintenance man spent the afternoon laying carpet in an apartment where an insecticide fogger had been set off earlier that day. The apartment was not posted to indicate that a pesticide had been used, and the applicator did not communicate to the maintenance man that the application had been postponed to that morning. The maintenance man developed a headache, nausea, diarrhea, vomiting, cough, shortness of breath and a sore throat. He called poison control and lost two days of work.

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.[12] Antimicrobials are registered by the EPA, just as other pesticides are.

While antimicrobials have always been a substantial portion of confirmed occupational cases, that portion increased to 67.2% of all confirmed occupational cases in 2008 and was 70.7% in 2009.

Figure 9



Confirmed cases from 2009 with antimicrobial pesticide exposures were compared to cases with exposures to other pesticides:

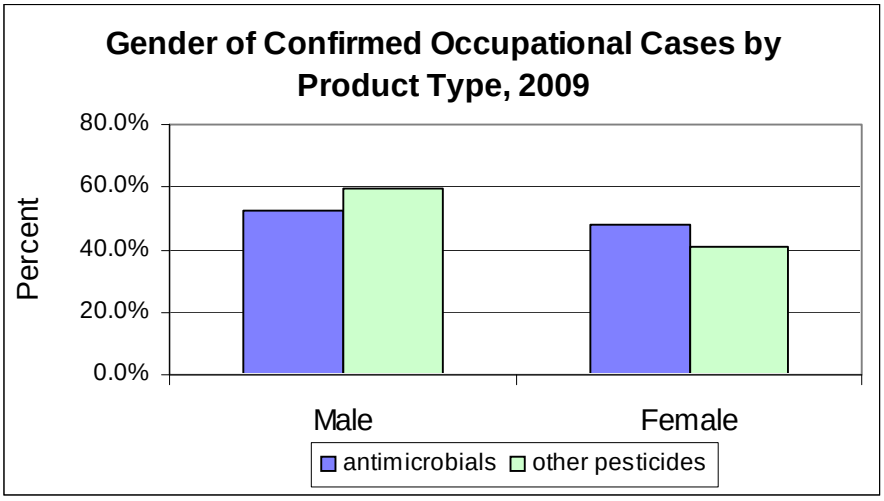
Two fire-fighters responded to an explosion when a new formulation of Trichloro-S-Triazinetrione (a chlorine based disinfectant, algicide and bactericide) was mixed with calcium hypochlorite at a mobile home swimming pool. They were wearing fire-fighter turn out gear but both developed skin and eye irritation. They went to a hospital emergency department. Eight other people were injured and the area was evacuated.

Gender

Thirty-four men and 31 women were reported as having been exposed to antimicrobial pesticides at work. In 2009 men represented 52.3% of the antimicrobial exposures and 59.3% of the exposures to other types of pesticides.

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

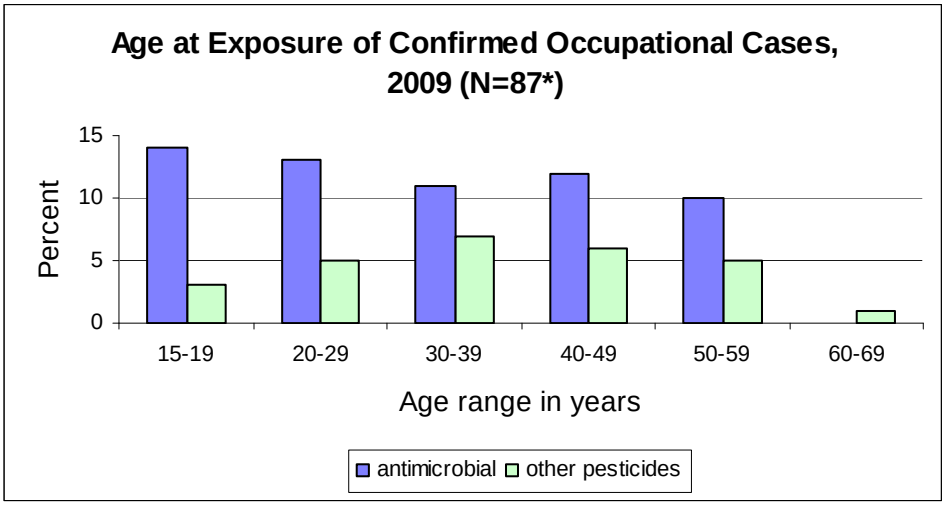
Figure 10



Age

Figure 11 shows that workers exposed to antimicrobials tended to be younger (median age 31.7) than those exposed to other pesticides (median age 38.4).

Figure 11



* Age was unknown for 5 of the 92 confirmed cases.

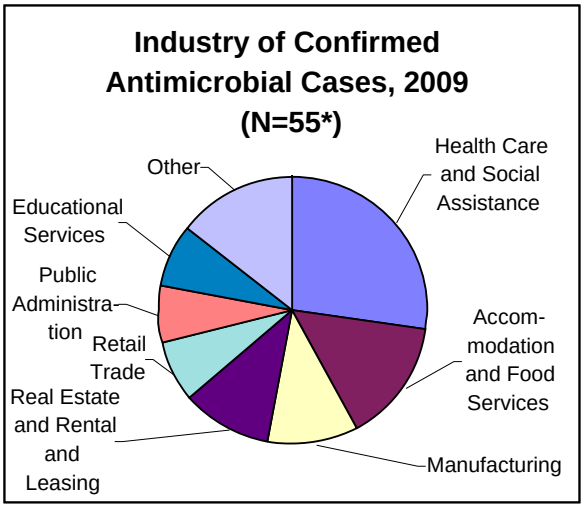
A teenaged dishwasher was changing the sodium hypochlorite solution, taking a line from the dishwasher out of an old bucket and putting into a fresh bucket. Some splashed in his eye. His eye became red and was burning and tearing. He rinsed his eye at work and went to an emergency department where it was rinsed again. He was diagnosed with a corneal burn.

A sales person for a tanning salon in her teens was wiping down the tanning beds between customers with a quaternary ammonium disinfectant. Respiratory protection was not required. She developed a sore throat, cough, and nausea. She called poison control and went to an occupational health clinic.

Industry

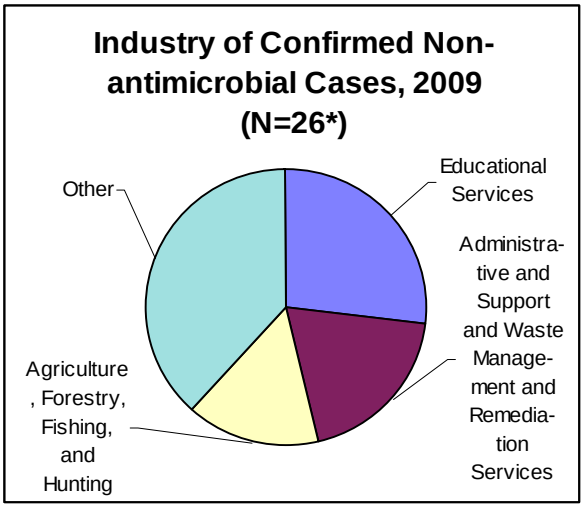
The most common industry of workers exposed to antimicrobials was "Health Care and Social Assistance" followed by "Accommodation and Food Services". See Figures 12 and 13.

Figure 12



* Occupation was unknown for 10 antimicrobial cases

Figure 13



* Occupation was unknown for one non-antimicrobial case

A hospital worker cleaned a patient's room with a sodium hypochlorite disinfectant. The door was closed and she was exposed for two to three minutes. She developed a red face, a burning sensation in her eyes, throat and tongue, and a hoarse voice. She went to the emergency department.

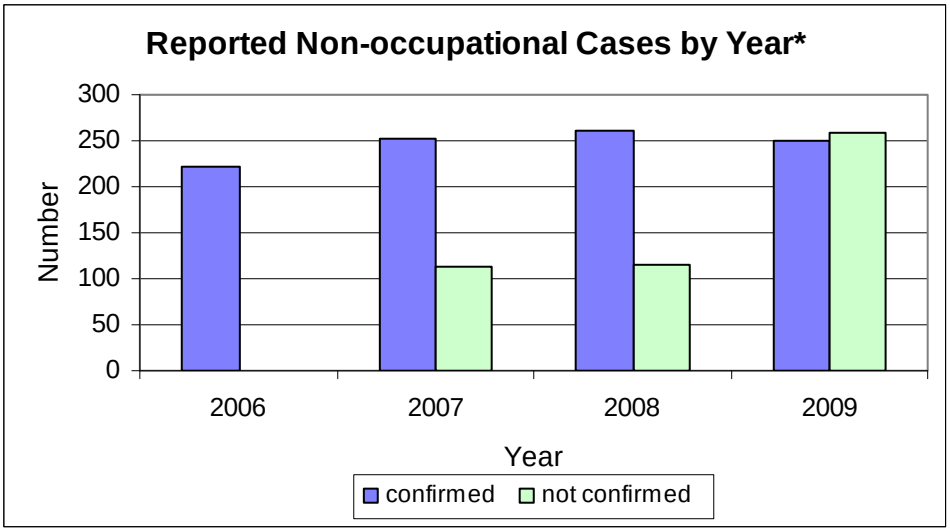
An apartment cleaner washed a shower with a sodium hypochlorite disinfectant. She rinsed it and thought the drain was clear. She then used an acid disinfectant to clean rust spots. The products mixed in the drain to form chlorine gas. She inhaled the fumes and developed shortness of breath, cough, wheezing, decreased air movement, sinus drainage, headache, and a red throat. She went to an emergency department.

Section II: Non-occupational Exposures

To provide a more complete characterization of the impact of pesticide use in Michigan, the MDCH pesticide surveillance program began collecting information about non-occupational exposures in 2006. Suicide attempts using pesticides are excluded. The occupational case definition and report sources were used for these cases as well.

Reports
In 2009, there were 508 reported non-occupational cases. See Figure 14.

Figure 14



* Only confirmed non-occupational cases were captured in 2006.

A woman in her 30s opened a container of pool chemicals and inhaled some of the chlorine dust. She developed shortness of breath, stridor and retractions, wheezing, burns in her throat, and bradycardia. She was hospitalized for a week.

Classification
Two hundred forty-nine (49.0%) of these reported cases met the NIOSH criteria (except for the work-related criterion) to be considered confirmed cases, compared to 69.7% of occupational cases. One hundred seventeen (23.0%) of the 259 unconfirmed cases were children who had possibly ingested a rodenticide, but were asymptomatic.

Table 16

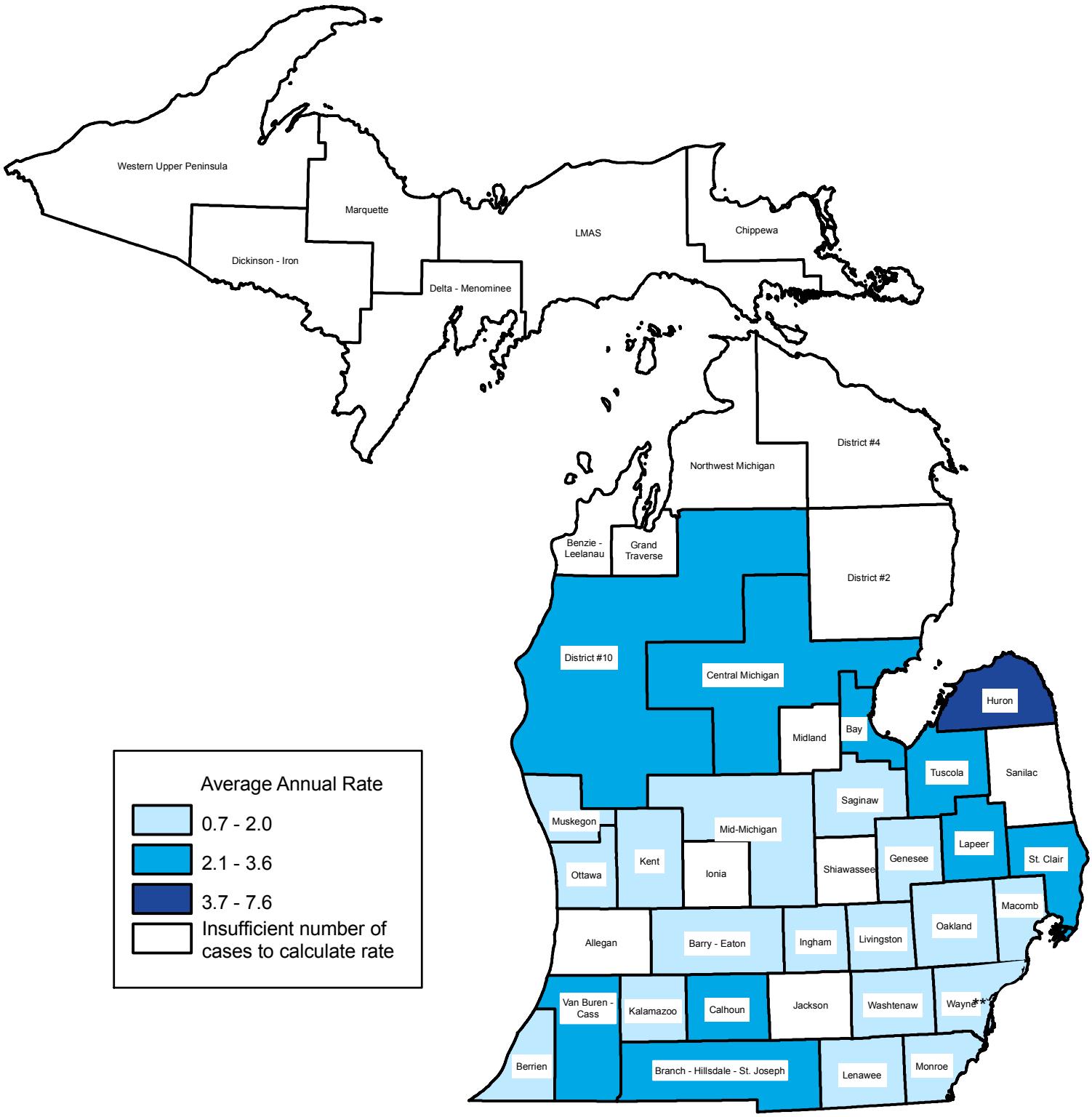
Reported Cases by Classification, Occupational vs. Non-occupational, 2009				
	Occupational		Non-occupational	
Classification	Number	Percent	Number	Percent
Confirmed cases				
Definite	15	11.4	0	0.0
Probable	19	14.4	39	14.7
Possible	57	43.2	193	38.0
Suspicious	1	0.8	17	3.3
Total confirmed	*92*	*69.7*	*249*	*49.0*
Not confirmed				
Unlikely	0	0.0	0	0.0
Insufficient Information	38	28.8	64	12.6
Exposed, Asymptomatic	2	1.5	195	38.4
Unrelated	0	0.0	0	0.0
Total not confirmed	*40*	*30.3*	*259*	*51.0*
Total	132	100.0	508	100.0

Location in State

In 2009, there were no confirmed non-occupational cases in 31 of Michigan's 83 counties (55.4%). For 13 (5.2%) confirmed cases, county of exposure was unknown. There were 36 confirmed cases exposed in Wayne County, 23 in Oakland County, 18 in Kent, and 17 in Macomb in 2009. Figure 15 shows the distribution of confirmed non-occupational cases from 2006 through 2009.

Figure 15

Confirmed Non-occupational Cases by Health Department per 100,000 Persons 2006-2009 (N=579*)



* Location of exposure was unknown for 41 of the 620 confirmed cases.

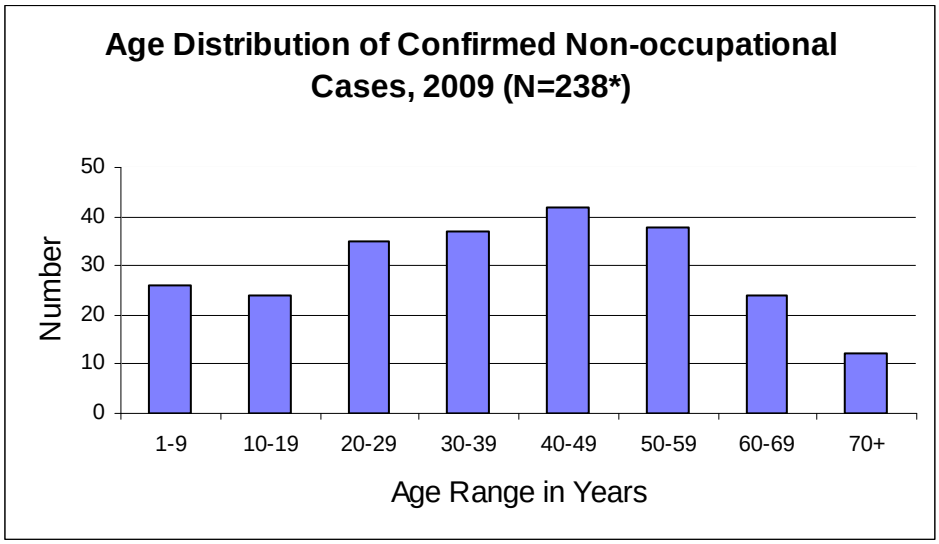
** Wayne County and City of Detroit Health Departments have been combined here.

Demographics

Gender
Of the 249 confirmed cases, 91 (36.7%) were men and 157 (63.3%) were women.

Age
The age distribution of individuals where the age was known is shown in figure 16. The median age was 38.3, with a range of 7 weeks to 90.

Figure 16



* Age was unknown for 11 of the 249 confirmed non-occupational cases.

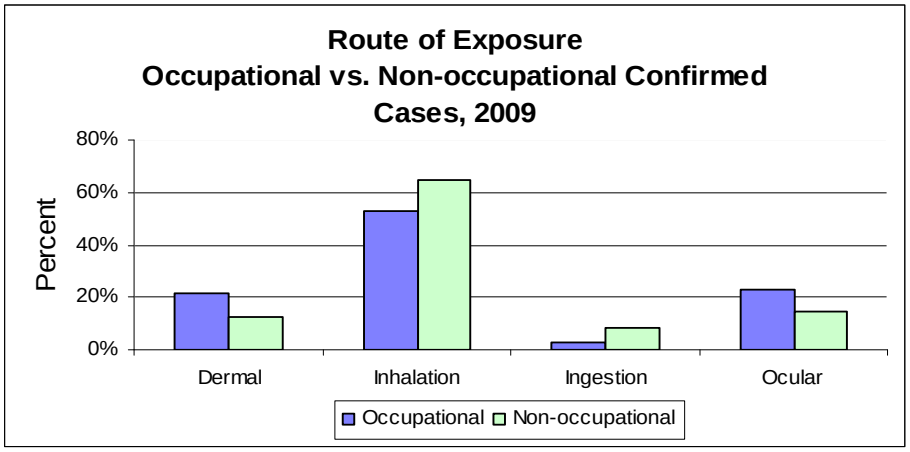
A 13-month-old ingested an unknown amount of Lysol. He vomited four times, was drooling, had hypertension, and developed a small ulcer in his mouth. He was taken to an emergency department.

Exposures

Equipment Used
Type of equipment used was unknown for 137 (55.0%) of the 249 confirmed non-occupational cases. The most commonly reported types were aerosol can (19), total release fogger (17), manual placement (14), and trigger pump, push-pull, or compressed air hand sprayer (11).

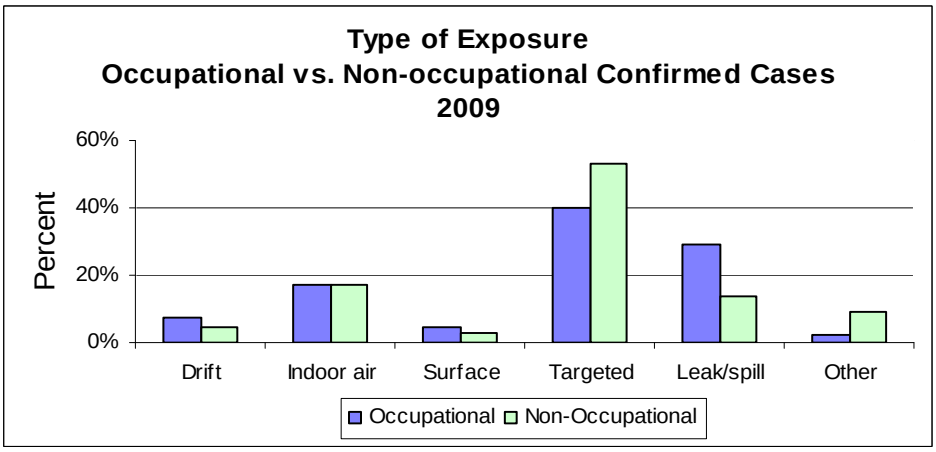
Route of Exposure
Route of exposure was identified for 245 of the cases. There were 278 identified routes of exposure. There were 18 cases with two routes of exposure, six cases with three routes, and one case with four routes. The most common route was inhalation (179). See Figure 16 for a comparison of routes of exposure for occupational and non-occupational cases.

Figure 16



Type of Exposure
Type of exposure was identified for 240 of the 249 confirmed non-occupational cases. There were 227 cases with one type of exposure and 13 with two types. For non-occupational cases, the most common type of exposure was from a targeted application (134). See Figure 17 for a comparison of type of exposure for occupational and non-occupational cases.

Figure 17



Product Used

Table 17 compares the products to which confirmed occupational cases and confirmed non-occupational cases were exposed. Antimicrobials were the most common exposure for both occupational and non-occupational cases, followed in both categories by insecticides.

Table 17

Product Type of Confirmed Cases, 2009						
	Occupational		Non-Occupational		Total	
Product Type	Number	Percent	Number	Percent	Number	Percent
Antimicrobial	65	70.7	161	64.7	226	66.3
Insecticide	13	14.1	53	21.3	66	19.4
Herbicide	12	13.0	12	4.8	24	7.0
Insect repellent	0	0.0	15	6.0	15	4.4
Fungicide	0	0.0	3	1.2	3	0.9
Animal Repellent	1	1.1	1	.04	2	0.6
Rodenticide	0	0.0	2	0.8	2	.06
Mixture	1	1.1	2	0.8	3	0.9
Total	92	100.0	249	100.0	341	100.0

A landlord put moth balls in a crawl space. The tenant developed a stomachache, headache, throat tightness, wheezing, and coughing. He went to an emergency department.

Severity

Table 18 compares the severity of confirmed occupational cases with confirmed non-occupational cases. Twelve confirmed non-occupational cases were admitted to a hospital for treatment; six of these were high severity cases.

Table 18

Severity of Confirmed Cases, 2009				
	Occupational		Non-occupational	
Severity	Number	Percent	Number	Percent
Low	66	71.7	217	87.1
Moderate	26	28.3	26	10.4
High	0	0.0	6	2.4
Total	92	100.0	249	100.0

Activity at Time of Exposure

Activity at time of exposure was unknown for 24 non-occupational confirmed cases in 2009. When known, the most common activity was routine living (85 or 37.8%).

Contributing Factors

Identifying factors contributing to the exposure or illness/injury can improve prevention activities. Table 19 shows the contributing factors, when known, for the confirmed non-occupational cases in 2009. The most common factors were mixing incompatible products followed by spills and splashes. See Appendix II for a description of the contributing factor codes.

Table 19

Contributing Factors for Confirmed Non-occupational Cases, 2009 (N=257*)

Factor	N	Percent
Mixing of incompatible products	74	28.8%
Spill/splash of liquid or dust (not involving application equipment failure)	34	13.2%
Excessive application of pesticide	26	10.1%
No label violation identified but person still exposed/ill	26	10.1%
Label violations NOS (Not otherwise specified, other regulatory issues)	23	8.9%
Pesticide stored within reach of child or other improper storage	21	8.2%
Drift	16	6.2%
Inadequate ventilation of treated area before re-entry	9	3.5%
Other	28	10.9%
Total	125	100.0%

* Contributing factors were unknown for 32 confirmed cases, while 40 cases had two or more contributing factors.

A woman was trying to bleach a swim suit with a mixture of bleach and ammonia, which would produce chloamine gas. She inhaled the fumes, and then continued to be exposed to fumes as she held the bucket, trying to get it out of house. Then she threw the contents in the sink, causing more fumes to form. She developed chest tightness, shortness of breath, and a headache. She called 911. The ambulance took her to a hospital where she was admitted for 3 days. Clinical findings included hypoxia, burns on the inside of her nose, a mild face burn, urinary incontinence, crackles, wheeze, atelectasis, and pneumonitis.

A couple was mixing an herbicide with water in their basement. It spilled, and they spent about an hour cleaning it up. The wife developed a stomach ache, nausea, and a headache. She went to an emergency department. The husband had a headache but was not a confirmed case.

A man sprayed 1/2 gallon of insecticide under his mobile home for ants. The odor seeped into the trailer and his wife's lips became numb and she felt nauseous.

Comparison of Occupational and Non-occupational Exposures
There were a number of similarities between occupational and non-occupational cases. Most cases, both occupational (71.7%) and non-occupational (87.1%), were classified as low severity. The most common type of exposure for both occupational and non-occupational cases was targeted (39.8% and 53.0% respectively) exposures. 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 (52.8% of occupational cases and 64.4% of non-occupational cases). Antimicrobials were the most common type of pesticide used when cases were exposed (70.7% of occupational cases and 64.7% of non-occupational cases). When activity at time of exposure was known, exposed individuals were bystanders rather than involved in the pesticide application at a similar rate (37.7 % of occupational cases and 37.8% of non-occupational cases). The most common contributing factor was mixing incompatible products (20.0% occupational and 28.8% non-occupational) followed by a spill or splash (17.6% occupational and 13.2% non-occupational).

Non-occupational cases were more commonly reported than occupational cases. (132 reported and 92 confirmed occupational cases vs. 508 reported and 249 confirmed non-occupational cases.) In addition, there were also some differences between the two populations. For confirmed occupational cases, 54.3% were male, while for confirmed non-occupational cases 36.7% were male. When known, the median age for occupational workers was 34.7 and the range was 17-60. For non-occupational exposures although the median age was similar at 38.4 there was a wider range of ages, 2 months to 90 years. 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 better characterize the exposure and institute preventive action.

Outreach, Education, and Prevention Activities

Publications, Presentations, and Other Outreach Activities
Staff members of Occupational Pesticide Illness and Injury Program used many avenues to provide information about the program and pesticide safety to stakeholders and the general public. In 2009:

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

- The 2008 Pesticide annual report was completed, distributed to stakeholders, and made available on the Division of Environmental Health's website.

- The MDCH Pesticide webpage provided links to over 100 other sites with information about pesticides and their safe use. These links were checked and updated to ensure the usefulness of the page. This site received 392 hits in 2009. In addition, MDCH's educational booklet, "What You Need to Know about Pesticides and Your Health" received 1,078 hits. Previous annual reports received a total of 852 hits.

- MDCH staff worked with the Michigan Primary Care Association, Migrant Health Promotion, Farmworker Legal Services, and InterCare Community Health Network to address the lack of information among farmworkers and health professionals about pesticide safety, rights, and reporting requirements. Together we hosted two statewide pesticide education events in May 2009: (1) An interactive, day-long training for outreach workers and others who have direct contact with farmworker families; and (2) an hour-long webinar for health professionals. The principal investigator of the surveillance program, Dr. Kenneth Rosenman, was one of the two speakers for the webinar.

- MDCH staff chaired the pesticide coding committee of the SENSOR-Pesticides states, which worked on data quality assurance, equipment codes, lost time from work and activities codes, PPE codes and refining some signs and symptoms codes. MDCH staff presented coding changes at the 2009 annual CSTE (Council of State and Territorial Epidemiologists).

- MDCH surveillance program staff participated in Michigan's Bed Bug Working group, drafted one section of the manual, and provided feedback on materials developed by the group.

- Information about drift cases was provided to NIOSH for possible publication.

- Safety materials were sent to workers and employers as appropriate.

- Data on cases related to waterborne illnesses were shared with the CDC.

- 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.

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

MDA Referrals
Four events were reported to MDA in 2009. The first one was not a confirmed case because we were unable to find out what specific pesticide was used. A loan officer in her 50s was at work when the air conditioning unit pulled in an herbicide that was sprayed on a golf course next door. It smelled bad and she had a funny taste in her mouth. Her tongue became numb and her throat irritated. This case was referred to MDA because of possible drift. Safety information was also sent to her employer. MDCH is awaiting information about the results of any investigation.

The second case referred was a teenaged pesticide applicator for a lawn care company. He was driving when he noticed through the side mirror that the tank containing a mixture of herbicides was leaking due to a broken valve. He pulled over and tried to contain the spill and it got all over his legs. (See MI01892.) The case was referred to MDA because of the human exposure and lack of decontamination supplies on the truck. MDCH is awaiting information about the results of any investigation.

In another instance, a hospital histology technician was working in an unventilated area when a coworker, with the approval of the supervisor, sprinkled some pellets on the floor to repel mice. She developed a number of symptoms and went to the emergency department. (See MI01966.) The case was referred to MDA to ensure the hospital had an IPM program in place.

The final event involved two carpet cleaners (MI02050 and MI02051) who cleaned a carpet that had been treated with a pyrethroid insecticide for bed bugs. They both became ill. This was referred to MDA because of the lack of notification. MDA has not completed its investigation of this event.

MIOSHA Referral
One case reported in 2009 was referred to the Michigan Occupational Safety and Health Administration for investigation. A high school pool technician was exposed to pool chlorine for 10 – 15 minutes due to problems with the air exchange or pool chemical equipment. He developed shortness of breath, chest pain, throat and eye irritation, shallow breathing, and tachypnia. He went to an occupational health clinic and was taken by ambulance from there to a hospital emergency department. MDCH referred this case to MIOSHA which inspected the worksite and cited two violations. One, failure to establish and implement a written respiratory protection plan and provide effective information and annual training on hazardous chemicals, was considered serious. The other citation was for failing to verify in writing that the required

workplace hazard assessment was performed and that each affected employee had received and understood the required training. MIOSHA proposed $3,250 in fines.

NIOSH Reports
Four events were reported to NIOSH as high priority events, two because they involved four or more ill individuals and two because they resulted in hospitalization.

The first involved nine staff members and 19 students at a school where an herbicide was sprayed outside. (See MI01690-94, MI01696, MI02024-5, and MI02040.) They developed a variety of symptoms. The school was evacuated and paramedics were called to the scene. The school contacted the fire department, which cleaned up the hazardous material, and MDA, which inspected the clean up and provided information about required integrated pest management (IPM). The school implemented new spray policies, including parental notification in advance of any spraying, posting signs, not spraying within 150 feet of the building except on weekends, and not spraying during school hours.

Five workers at a fruit processing plant were exposed to chlorine fumes. Chlorine was added to the wash water to kill bacteria and citric acid was added to keep the pH low. The pH was not tested and chlorine fumes were created. Four teenagers and one adult developed symptoms and went to an emergency department (MI01722-26). The employer hired an air quality person and also had the fire department check the plant out. They aired out the plant and stopped adding citric acid. The employer replaced the system that added citric acid with a new system.

The next event involved a non-occupational exposure. A man was cutting trees in the woods with friends. They sprayed each other with “a lot” of OFF! and the man inhaled some. He started coughing up blood, and was admitted to a hospital.

Another non-occupational exposure involved a woman who opened a container of pool chemicals and inhaled chlorine. She developed shortness of breath, stridor and retractions, wheezing, burns in throat, and bradycardia. She was hospitalized for a week.

Other Interventions
A cardiology technologist at a hospital was exposed to an herbicide sprayed near an air intake. She developed a headache, twitching, pressure behind her eyes, eye irritation, nausea, dizziness, inability to concentrate, inability to put thoughts together, and memory problems. She went to the emergency department and a neurologist. Integrated Pest Management (IPM) information was sent to the hospital. (See MI01685.)

A lifeguard at a fitness club poured some acid into a measuring cup to adjust the pH of a spa. She accidentally knocked into something and spilled the acid into a bucket that contained pool chlorine that was going to be used to mop floors. The resultant chlorine gas caused a cough, shortness of breath, sore throat, nasal irritation, headache, dizziness, and tearing. MDCH sent safety information to her and her employer. (See MI01736.)

A fogger containing dichlorvos was set off in a greenhouse at a university. A graduate student went in to work in an attached lab and was exposed (case not reported until 2010). She

developed a headache, dizziness and shortness of breath. Public safety and firefighters responded to a report of smoke coming out of the greenhouse. The greenhouse was posted, indicating a pesticide application was in progress, but the firefighters went in anyway. The fire chief came out and invited two public safety officers in, so they could see what was causing the problem. They were not wearing any PPE. One left immediately and developed a cough (MI01836, not a confirmed case since he only had one symptom). The other safety officer was inside longer. He developed nose, eye, and throat irritation, a cough, tearing, and nausea (see MI01746). Safety information was sent to the university.

A fast food manager (MI01930) was spraying sidewalk cracks with an herbicide on a windy day. When he came in, he washed his hands, but not his arm as he did not realize that he'd been exposed. The next day he had a red, itchy rash with blisters on his arm. He did not have any pesticide training but declined a referral to MDA. He was sent the MDCH booklet “What You Need to Know about Pesticides and Your Health”.

An office manager’s boss brought his dog into the office and there were fleas. He sprayed in the room with the coffee maker and cups, without telling the office manager until after she drank out of a coffee cup. She did not have any symptoms and did not want the event reported to MDA. MDCH sent information about IPM and fleas for her to share with her employer.

An apartment maintenance man spent the afternoon laying carpet in an apartment where an insecticide fogger had been set off earlier that day. He developed a number of symptoms and lost two days of work. (See MI02072.) He declined a referral to MDA, but was interested in information about certification. In addition to sending information about Certification requirements, MDCH also sent him pesticide safety and IPM information.

Discussion

Surveillance Data
There were fewer reported and confirmed occupational cases in 2009, compared to 2008 (132 vs. 172 and 92 vs. 125, respectively). However, the 132 reports received in 2009 were similar to 133, the average number of occupational reports from 2001 through 2009. The number of reported events (111) was also similar to the average (115).

There were more reported non-occupational cases in 2009 (508 vs. 376, although fewer were confirmed (249 vs. 260).

The number of antimicrobial cases remained high, comprising 70.7% of confirmed occupational cases and 66.3% of confirmed non-occupational cases. Workers exposed to antimicrobials tended to be younger (median age 31.7) than those exposed to other pesticides (median age 38.4). Antimicrobial exposures remain an area of ongoing concern.

When looking at factors contributing to the pesticide exposure, mixing incompatible products was the most common factor for both occupational and non-occupational cases. Better education and more prominent labeling might help to reduce the number of exposures.

Most confirmed occupational cases (71.7%) were considered low severity. Half of all the confirmed cases were from exposure to pesticides that had the signal word Caution, indicating that the product was only slightly toxic. This included individuals who were classified as moderately severity cases

The most common route of exposure was inhalation, followed by ocular exposures. These exposuers could be prevented by requiring personal protective equipment.

More than a third of the confirmed occupational cases in 2009 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.

Interventions
MDCH has continued to refer cases to MDA for investigation of possible safety violations and has begun making referrals to MIOSHA. MDCH also worked to improve pesticide education for individuals, health care providers, and other stakeholder groups through the distribution of brochures and presentations listed in the results section. In particular MDCH contributed to a day-long training for migrant outreach workers and others who have direct contact with farmworker families and an hour-long webinar for health professionals. 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 "inert" ingredients that have no effect on the target pest but may have adverse human health effects. Depending on the chemicals involved, pesticides can have short- and long-term adverse health effects on different organ systems, including the skin, gastrointestinal, respiratory, nervous, and reproductive systems.

The problem of identifying pesticide-related illness for public health surveillance begins with difficulties in recognition and diagnosis, because the diverse signs and symptoms experienced can resemble 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 32 (34.8%) confirmed occupational cases in 2009, the hospital submitted an occupational disease report for only nine (28.1%) of those cases. The remaining cases were brought to the program's attention by poison control and HSEES, but if the health care providers in the hospital do not call the poison center 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,[13] 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.)

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

This surveillance system continues to face challenges due to the time lag between the occurrence and the reporting of the incident for hospital 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.

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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/

Appendix I

Case Narratives, 2009 Confirmed Occupational Cases

Below are descriptions of the confirmed occupational cases reported in 2009. 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 range, gender, industry, and occupation are included. In addition, more specific information about the product such as chemical class or the signal word for acute toxicity assigned by the EPA, is provided when known. The signal word is assigned based on the highest hazard of all possible routes of exposure. Caution means the product is slightly toxic if eaten, absorbed through the skin, or can cause slight eye or skin irritation. Warning means the product is moderately toxic if eaten, absorbed through the skin, or can cause moderate eye or skin irritation. Danger means the product is highly toxic, is corrosive, or causes severe burning to the eye or skin that can result in irreversible damage.

Insecticides

MI01683 – A farm hand in his 40s was cleaning a spray nozzle and a bug flew in his eye. He put his hand in his eye to remove it and got a pyrethroid insecticide (signal word: Caution) in his eye. His eye was red and burning and he went to an emergency department. He was diagnosed with a chemical conjunctivitis and a corneal abrasion.

MI01688 – A maintenance worker for a property management company in his 30s went into a house that had recently been treated with a pyrethrin based total release fogger. After a few minutes in the house he began to cough. He also developed trouble breathing, a sore throat and a runny nose. He went to an emergency department. See coworker MI01733.

MI01733– A maintenance worker for a property management company in his 50s went into a house that had recently been treated with a pyrethrin based total release fogger. After a few minutes in the house he had to leave. He felt nauseous and he vomited. He also developed a cough, sore throat, and headache. He couldn't take a deep breath and his sinuses flared up. He did not seek medical care. See coworker MI01688.

MI01746 – Smoke was coming out of the greenhouse and a deputy chief of public safety at a university in his 50s was one of a number of responders to a possible. The greenhouse was posted, indicating a pesticide application was in progress, but firefighters went in, with PPE. The fire chief came out and invited the deputy chief to go in, so he could see what was causing the problem - a fogger containing an organophosphorous insecticide (signal word: Danger) was going off. The deputy chief went in without PPE and was exposed for about 25 minutes. He developed nose, eye, and throat irritation a cough which lasted about a day, tearing, and nausea. He called poison control and went to an emergency department.

MI01891 – A teenaged pizza delivery person was spraying a pyrethroid insecticide (signal word: Caution) up at cracks in the front door of the pizzeria. Some fell on his face and shoulders. He

developed difficulty breathing, cough, diarrhea, nausea, vomiting, stomach ache, skin irritation, and blacked out. He called poison control.

MI01907 – A pesticide applicator in his 20s was spraying outside a condo complex for mosquitoes, using a pyrethroid insecticide (signal word: Caution). It was not overly windy, but when he walked into an open area some sprayed back on his cheeks. He was wearing safety glasses and a mask, even though they were not required, but his cheeks were still exposed. He did not notice that the pesticide got on his skin until about an hour later, when his skin began to feel hot, burning and tingling, His cheeks also became red. He washed then, but thinks he may have spread the chemical when washing. He called poison control and lost one day of work.

MI01925 – A livestock farmer in his 50s was putting a pyrethroid insecticide (signal word: Caution) on a rope the cows walk under, so it would coat them. Some splashed on his shirt over his stomach area and on a pant leg. He forgot about it briefly, then remembered and went in to shower about 45 minutes later. He developed nausea and chest pain. He called poison control and went to an emergency department.

MI01927 – A teenaged farm hand on a seed corn farm took off the nozzles from an airblast sprayer and used an air gun to clean out plugged filters. Some diluted carbamate insecticide (signal word: Danger) splashed in his eye. He had removed the required protective eyewear (when on the phone) and forgot to put it back on. His eye was irritated and teary, the pupil contracted, so his vision became dark and blurry. He rinsed his eye and went to an emergency department where his eye was rinsed again. He was diagnosed with a chemical conjunctivitis.

MI01933 – A certified pesticide applicator in his 30s who worked for a tree removal company was injecting trees with an organophosphorous insecticide (signal word: Danger). He drilled a hole in the tree and inserted the tube. While pulling out the cap, some of the liquid splashed under his safety glasses into his eye. His eye was burning, tearing and red and his vision was blurry. He washed it immediately, called poison control, and went to an occupational health clinic where it was washed again

MI01960 – A structural pesticide applicator in his 20s was treating a basement heavily infested with paper wasps with a pyrethroid insecticide (signal word: Caution). He wore long sleeves, long pants, gloves, a respirator and a “bee suit”. As he dusted, his face mask got covered with wasps. He stepped back, and his mask got caught on something and came off. There was a lot of dust in the room and no ventilation. He inhaled dust and developed nausea, shortness of breath, a cough and a burning sensation in his throat. He called poison control and went to an emergency department.

MI02046 – A supervisor at a billing company in her 40s went in to the office to catch up on work on a Sunday. She began to have difficulty breathing, itching, nausea and eye irritation and discovered that the office had been treated for spiders the previous day with a pyrethroid insecticide (signal word: Caution). She called poison control.

MI02050 – A carpet cleaner in his 20s was cleaning a carpet that had (unknowingly to him and his partner) been treated with a pyrethroid insecticide for bed bugs. He developed shortness of

breath and eye and nose irritation. He called poison control and went to an emergency department. (See case MI02051.) This event was referred to MDA.

MI02051 – A carpet cleaner in his teens was cleaning a carpet that had (unknowingly to him and his partner) been treated with a pyrethroid insecticide for bed bugs. He developed a nose bleed, chest tightness, and felt lightheaded. He called poison control and went to an emergency department. (See case MI02050.)

MI02072 – An apartment maintenance man in his 20s spent the afternoon laying carpet in an apartment where an insecticide fogger (signal word: Caution) had been set off earlier that day. The fogger was supposed to have been applied the previous day, but the person did not get around to it until that morning. He (the carpet layer) developed a headache, nausea, diarrhea, vomiting, cough, shortness of breath and a sore throat. He called poison control and lost two days of work.

Herbicides
MI01685 – A cardiology technologist in her 30s was exposed to a chlorophenoxy herbicide (signal word: Caution) that was sprayed near an air intake. She developed a headache, twitching, pressure behind her eyes, eye irritation, nausea, dizziness, inability to concentrate, inability to put thoughts together, and memory problems. She went to the emergency department and a neurologist.

MI01690 – Event 1470. A teacher's aid in her 40s, with a history of asthma, was exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed difficulty breathing that was shallow and labored, wheezing, chest tightness, cough, diaphoresis, numb lips, flushed skin, anxiety, nausea, vomiting, and diarrhea. She was seen by the school nurse and taken to an emergency department. The school was evacuated and paramedics were called to the scene. The school contacted the fire department, which cleaned the hazardous material and the Michigan Department of Agriculture (MDA), which inspected the clean up and provided information about required integrated pest management (IPM). The school implemented new spray policies, including parental notification in advance of any spraying, posting signs, not spraying within 150 feet of the building except on weekends, and not spraying during school hours. This event was reported to NIOSH.

MI01691 – Event 1470. Another school employee in her 30s was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed shortness of breath, bronchospasm, pain on deep breathing, cough, diaphoresis, numb lips, swollen and sore throat, and a tingling tongue. She was seen by the school nurse and taken to an emergency department.

MI01692 – Event 1470. Another school employee in her 50s was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed shortness of breath, cough, hoarseness, swollen and sore throat, a numb tongue, itchy eyes, shakiness, dizziness, urticaria, nausea, and anxiety. She was seen by the school nurse and taken to an emergency department.

MI01693 – Event 1470. Another school employee in her 40s was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed a tingling mouth, headache, a heavy feeling in her chest, difficulty breathing, bronchospasm, and nausea. She was seen by the school nurse and taken to an emergency department.

MI01694 – Event 1470. Another school employee in her 50s was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed a red, sore, numb throat. She was seen by the school nurse and taken to an emergency department.

MI01696 – Event 1470. Another school employee was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed a headache and difficulty breathing. She was seen by the school nurse and taken to an emergency department.

MI02024 - Event 1470. A school paraprofessional in her 50s was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed a cough, tickle in her throat, and dizziness. The next day at work, she got up to make a phone call and fainted. Her coworkers were unable arouse her and she was taken to an emergency department. She lost one day of work.

MI02025 - Event 1470. A school secretary in her 40s was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed a headache, numbness in her lips and tongue, bad taste in her mouth, sore throat, and difficulty concentrating.

MI02040 – Event 1470. A teacher in her 30s was also exposed to a dipyridyl herbicide (signal word: Caution) that was sprayed outside a school in a light wind. She developed difficulty breathing, cough, headache, dizziness, nausea, watery eyes and a scratchy throat. She was seen by the school nurse.

MI01840 – A retail clerk in her 30s in the salvage unit of a discount department store picked up a leaking bag of herbicide (signal word: Caution) to throw it out. Some spilled on her hands which began to burn. She washed them and the burning became worse. Her hands became red and very chapped and the skin cracked. She called poison control.

MI01892 – A teenaged pesticide applicator for a lawn care company was driving when he noticed through the side mirror that the tank containing a mixture of herbicides was leaking due to a broken valve. He pulled over and tried to contain the spill and it got all over his legs. He said there were no decontamination supplies on the truck at the time, although they were added soon after his exposure. He went to the company doctor, who said he had poison ivy or poison oak. Four days later he went to an urgent care, where he was diagnosed with a chemical burn, with scabbing and oozing.

MI01930 – A fast food manager in his 30s was spraying sidewalk cracks with a chlorophenoxy herbicide on a windy day. When he came in, he washed his hands, but not his arm as he did not realize that he'd been exposed. The next day had a red, itchy rash with blisters on his arm. He called poison control and went to an urgent care center.

MI01970 – A mechanic in his 20s splashed an herbicide in his eye at work. His eye became red and painful. He called poison control and went to an emergency department where he was diagnosed with chemical conjunctivitis and corneal abrasion.

MI01980 – An owner of a lawn care and fertilizing company in his 30s was spraying an herbicide (signal word: Caution) with a leaky back pack sprayer. His clothing became wet and his skin was red and burning. He called poison control.

Antimicrobials
MI01679 – A grocery stock boy in his 20s was exposed to chlorine gas when bleach was added to an acid drain opener in a clogged drain. He developed a cough and sore throat and called poison control.

MI01686 – A worker in his 40s was exposed to a mixture of an acid-based disinfectant (signal word: Danger) and a basic detergent. The two chemicals were accidentally mixed together and created a foul odor in the area where he was working. The area was evacuated. He vomited three times, had difficulty breathing, and chest pain. He went to an occupational medicine clinic after the exposure and then an emergency department the next morning.

MI01714 – A cleaner in her 50s at a sleep clinic was cleaning keyboards with an alcohol and phenol disinfectant spray and an alcohol and quaternary ammonium disinfectant wipe (both with signal word: Caution). She felt shaky, dizzy, and lightheaded and called poison control.

MI01722 – A box stacker in his teens in a fruit processing plant was exposed to chlorine fumes. Chlorine was added to the wash water to kill bacteria and citric acid was added to keep the pH low. The pH was not tested and chlorine fumes were created. The worker developed a cough, trouble breathing, pain on deep breathing, headache, stridor, and irritated eyes. He went to an emergency department. Four other individuals also went to the emergency department (MI01723-26). The employer hired an air quality person and had the fire department check the plant out. They aired out the plant and stopped adding citric acid. The employer has replaced the citric acid system with a new system.

MI01723 – A box stacker in his teens in a fruit processing plant was exposed to chlorine fumes. (See MI01722). He developed a cough, his lungs hurt, his eyes burned, he had trouble breathing, and pain on deep breathing. He went to an emergency department and missed one day of work.

MI01724 – A quality control checker in her teens in a fruit processing plant was exposed to chlorine fumes. (See MI01722). She developed a cough, trouble breathing, chest tightness, and red, itchy eyes. She went to an emergency department.

MI01725 – A box stacker in his teens in a fruit processing plant was exposed to chlorine fumes. (See MI01722). He developed eye irritation, a cough, difficulty breathing, chest pain, and wheezing. He went to an emergency department.

MI01726 – A line supervisor in her 30s in a fruit processing plant was exposed to chlorine fumes. (See MI01722). She developed a cough, her lungs hurt, and she had eye irritation. She went to an emergency department.

MI01736 – A teenaged lifeguard at a fitness club poured some acid into a measuring cup to adjust the pH of a spa. She accidentally knocked into something and spilled the acid into a bucket that contained pool chlorine that was going to be used to mop floors. The resultant chlorine gas caused a cough, shortness of breath, sore throat, nasal irritation, headache, dizziness, and tearing. MDCH sent safety information to her and her employer.

MI01756 – A hospital cleaner in her 50s cleaned a patient's room with a sodium hypochlorite disinfectant (signal word: Caution). The door was closed and she was exposed for two to three minutes. She developed a red face, a burning sensation in her eyes, throat and tongue, and a hoarse voice. She went to an emergency department.

MI01773 – A custodian in his 20s at a preschool was cleaning sinks when a bleach container fell off a counter and bleach splashed in his eye and on his face and chest. He developed a red, painful, tearing eye, throat irritation and a rash. His workplace called poison control and he went to an emergency department. He was not wearing eye protection.

MI01782 – A program director of a child care center in her 30s was exposed to ammonia fumes when a coworker poured more ammonia than intended while cleaning something in the kitchen. She developed a stuffy nose, cough, and sneezing and called poison control.

MI01792 – A maintenance supervisor in his 40s for an apartment community was exposed to chlorine gas when a coworker grabbed muriatic acid in an unmarked bottle, thinking it was bleach, and used it to fill up a bleach container. This created a vapor cloud in the shop where approximately five people were working. He stayed to rinse it down the drain. He developed coughing, wheezing, shortness of breath, chest tightness, and a sore throat. He called poison control, went to a health care clinic and then an emergency department. See MI01793-96.

MI01793 – A maintenance worker for an apartment community was exposed to chlorine gas when he grabbed muriatic acid in an unmarked bottle, thinking it was bleach, and used it to fill up a bleach container. This created a vapor cloud in the shop where approximately five people were working. He developed coughing and shortness of breath. See MI01792.

MI01794 – A maintenance worker for an apartment community was exposed to chlorine gas when a coworker grabbed muriatic acid in an unmarked bottle, thinking it was bleach, and used it to fill up a bleach container. This created a vapor cloud in the shop where approximately five people were working. He developed coughing and shortness of breath. See MI01792.

MI01795 – A maintenance worker for an apartment community was exposed to chlorine gas when a coworker grabbed muriatic acid in an unmarked bottle, thinking it was bleach, and used it to fill up a bleach container. This created a vapor cloud in the shop where approximately five people were working. He developed coughing and shortness of breath. See MI01792.

MI01796 – A maintenance worker for an apartment community was exposed to chlorine gas when a coworker grabbed muriatic acid in an unmarked bottle, thinking it was bleach, and used it to fill up a bleach container. This created a vapor cloud in the shop where approximately five people were working. He developed coughing and shortness of breath. See MI01792.

MI01815 – A worker in her 20s mixed bleach and ammonia at work, which produced chloramine gas. She developed a cough and shortness of breath and called poison control.

MI01821 – A hair stylist in her 30s reached for a bottle of a quaternary ammonium disinfectant (signal word: Danger) that was on a shelf. The cap was loose and it spilled on her face, chest and arms. Some got in her mouth, and her mouth tingled. She also had a red, painful chemical burn on her chest, with small areas that formed scabs. She called poison control. The hair salon moved the storage area to a flat open space lower down.

MI01828 – A nursing home employee in her 30s inhaled an acid shower cleaner. She developed a cough and sore throat. Her supervisor called poison control.

MI01837 – A hospital janitor in her 20s was splashed in the right eye with a quaternary ammonium disinfectant (signal word: Danger). She irrigated the eye immediately, but it was red and burning. She went to the emergency department where it was irrigated again. She had an injected conjunctiva and a corneal abrasion. She lost one day of work.

MI01838 – A sales person for a tanning salon in her teens was wiping down the tanning beds between customers. The quaternary ammonium disinfectant (signal word: Danger) had been prepared by an inexperienced worker and may not have been diluted enough. She developed a sore throat, cough, and nausea. She called poison control and went to an occupational health clinic. Respiratory protection was not required.

MI01847 – A hospital cleaner in her 40s was cleaning a hospital tray. Her rag was wet, and when it hit the lip of the tray some quaternary ammonium chloride disinfectant (signal word: Caution) splashed in her eye. Eye protection was not required. Her eye became red, irritated, and dry. She went to the emergency department and was diagnosed with a corneal abrasion. She thinks if they were allotted more time to clean they could be more thorough and careful.

MI01850 – A teenage restaurant worker got some bleach splashed in her eye. It was red and burning and she went to an emergency department on advice from poison control.

MI01884 –A man in his 40s was cleaning. He had a sponge with bleach and Pine Sol on it. He squeezed the sponge and it splashed back in his face, getting in both eyes. He went to an emergency department where he was diagnosed with corneal abrasions. He was referred to an ophthalmologist.

MI01888 – A teenager mixed ammonia and bleach, which produced chloramine gas, while cleaning at work. He was dizzy and coughed. He called poison control.

MI01897 – A teenaged stocker at a drug store was mopping the stock room. He ran out of “Pine Sol”, so he added bleach to the bucket. He was in the room with the doors shut for about three hours. He developed eye irritation, a cough and wheeze, and altered taste. The altered taste lasted about two weeks. He called poison control and went to an occupational medicine clinic.

MI01902 – A registered nurse in her 50s at an outpatient surgery center got 90% phenol on her fingertips. They initially blanched, then became red and irritated and started to peel. She called poison control and was treated on-site.

MI01903 – A cleaner in her 20s mixed ammonia, bleach, and Lysol to clean a room in a medical walk-in clinic. She had a history of asthma. She developed shortness of breath and chest tightness from the resultant chloramine gas. She was treated on site and called poison control.

MI01914 – A staff member in her 50s at rehabilitation home was helping a resident clean his bathtub. She'd given him some bleach (2 oz) to use if the other cleaner did not work. When she wasn't looking, he added it to an area bubbling with “The Works”, producing chlorine gas. She developed a cough, sore throat, and chest tightness and went to an occupational health clinic. Now the housekeeping staff is in charge of all cleaning above the normal scum type.

MI01923 – A high school pool technician in his 50s was exposed to pool chlorine for 10 – 15 minutes due to problems with the air exchange or with the pool chemical equipment. He developed shortness of breath, chest pain, throat and eye irritation, shallow breathing, and tachypnea. He went to an occupational health clinic and was taken by ambulance from there to a hospital emergency department. MDCH referred this case to MIOSHA which cited two violations, one of which was serious, and proposed $3250 in fines.

MI01928 – A farmworker in his 30s cleaned out a hog barn with bleach and water in a pressure washer. When doing this in the enclosed barn he developed a cough, difficulty breathing, and respiratory tract irritation. He called poison control.

MI01954 – A hospital housekeeper in her 40s poured bleach into her bucket while in a closet. She developed a cough, burning chest, eye irritation and trouble breathing. She went to the emergency department.

MI01959 – A teenage teacher assistant at a preschool was washing tables in the cafeteria. A child was helping to wash tables and he threw a rag in bucket of diluted quaternary ammonium disinfectant (signal word: Danger). It splashed up into her eye. She was not wearing required eye protection and her eye became red and burned. She called poison control.

MI01967 – An assistant manager in a drug store tried to deodorize a dumpster that is connected to the store through a shoot because customers complained of the odor. He first put bleach down the shoot. That didn't work, so later he put down toilet bowl cleaner, then tried to rinse it down

with water. That is when he breathed in fumes and developed a cough, shortness of breath, a burning sensation in his lungs, a hoarse voice, decreased air movement in his lungs, and dizziness. He called poison control and then went to an emergency department.

MI01969 – A teenaged dishwasher was changing the sodium hypochlorite solution, taking a line from the dishwasher out of an old bucket and putting into a fresh bucket. Some splashed in his eye. His eye became red and was burning and tearing. He rinsed his eye at work and went to an emergency department where it was rinsed again. He was diagnosed with a corneal burn.

MI01973 – A worker in his 20s at a wastewater treatment plant was exposed to chlorine. He developed a cough, wheezing, diaphoresis, anxiety, tachycardia, and vomiting. He went to an emergency department.

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MI01975 – A school custodian in his 40s was pouring pool chlorine into the deep end of a pool. Some splashed between his face and his safety glasses into his left eye. Safety glasses or goggles were required; he now wears goggles. He is a certified pool operator. He rinsed his eye at work and went to an occupational health clinic where it was rinsed again. It was burning and tearing and he had blurred vision for about a day. He was diagnosed with a chemical conjunctivitis.

MI01978 – A forklift driver at a food processing plant in his 40s was cleaning equipment with diluted bleach. He wore gloves and eye protection, but must have gotten some on his hands. Then, on the way home he rubbed his eyes. They ‘puffed up’ so he could hardly see, and were tearing. He called poison control and went to an urgent care clinic.

MI01979 – A cleaner in his 30s was exposed to fumes of at least two disinfectants at work. They were not mixed but he walked into a bathroom cleaned by someone else with an excessive amount of phenolic disinfectant (signal word: Warning). He also cleaned walls with a quaternary ammonium disinfectant (signal word: Caution). He vomited after entering the bathroom and had a persistent cough, sore throat and shortness of breath. He went to an emergency department several days after the bathroom exposure.

MI01989 – A fire-fighter in her 30s responded to an explosion when a new formulation of Trichloro-S-Triazinetrione was mixed with calcium hypochlorite at a mobile home swimming pool. She was wearing fire-fighter turn out gear but developed skin and eye irritation. She went to a hospital emergency department. Eight other people were injured (see MI01990) and the area was evacuated.

MI01990 – A fire-fighter in his 50s responded to an explosion when a new formulation of Trichloro-S-Triazinetrione was mixed with calcium hypochlorite at a mobile home swimming pool. (See MI01989.) He was wearing fire-fighter turn out gear but developed skin and eye irritation. He went to a hospital emergency department.

MI02007 – A cleaner in her 50s mixed an acid cleaner with a bleach containing cleaner. She developed shortness of breath and a hoarse voice and went to her doctor.

MI02011 – A line technician in his 20s cleaned up a bottle of bleach that broke on the line. He did not wear any gloves and developed draining blisters on his knuckles and palms. He called poison control.

MI02013 – An animal caretaker in a college biology laboratory was cleaning animal cages with a phenolic disinfectant (signal word: Danger) without wearing the required gloves. Her hands became red and irritated and she called poison control.

MI02016 – A worker in his 30s was using a bleach solution to clean a building. He was exposed to the fumes for two to three hours. He developed a cough, difficulty breathing, throat and lung irritation and wheezing. He called poison control and went to an emergency department.

MI02021 – A cleaner in her 30s opened a container in which someone had mixed a quaternary ammonium chloride disinfectant with bleach. She inhaled the resultant chloramine fumes and developed burning in her mouth, nose, and eyes, a cough, sore throat, headache, dizziness, and difficulty breathing. She called poison control and went to an emergency department twice. She lost two days of work.

MI02049 – A restaurant employee in his teens mixed bleach and “Lime-A-Way”. The resultant gas caused him to feel nauseous, lightheaded and have a headache. He went to an urgent care center.

MI02059 – A restaurant employee in his 30s mixed “Lime-A-Way” and bleach. He began coughing and developed shortness of breath, hypertension, and tachycardia. He went to an emergency department. (See MI02060.)

MI02060 – A restaurant employee in her 30s was present when a coworker mixed Lime-A-Way and bleach. She developed a headache and throat irritation and called poison control. (See MI02059.)

MI02062 – A fire fighter in his 40s was mopping a floor and some quaternary ammonium disinfectant (signal word: Danger) splashed in his eye. He did not rinse it out for about an hour. His eye was irritated and he went to an occupational health clinic and an emergency department. He was diagnosed with a chemical keratitis and referred to an eye specialist.

MI02066 – A department store employee in her 20s washed dishes with a sanitizer. Both of her hands became red with small bumps. She called poison control.

MI02074 – A car wash owner in his 40s poured acid and bleach down the tracks to clean them. He developed a cough, shortness of breath, salivation and vomiting. He called poison control and went to a doctor a week later.

MI02078 – A hospital unit clerk in her 50s was walking by someone mopping and smelled the quaternary ammonium disinfectant (signal word: Danger) that he was using. She developed a cough, difficulty breathing, and chest tightness. She could smell and taste the product for several hours after it dried. She went to the employee health clinic and then the emergency department.

MI02082 – A customer service representative in his 50s was eating his lunch at his desk. It included garlic chives, and the smell bothered his coworkers. He was asked to remove his lunch from the area, but the phone rang again, so he remained at his desk. One coworker handed his neighboring coworker a disinfectant, thinking it was an air freshener. The neighboring coworker sprayed it over the cube wall. He smelled it, then felt a mist and looked up. He then got sprayed in the face with the disinfectant containing quaternary ammonium chloride and alcohol (signal word: Warning). His eyes and face were irritated and he felt dizzy and disoriented. He called poison control and the police.

MI02086 – A film teacher in his 20s cleaned his laptop screen with a quaternary ammonium disinfectant (signal word: Caution). A couple of days later, he noticed a film on the screen and wiped it off. He then ate a sandwich, without washing his hands. His throat was burning, his stomach was queasy, and he had a bad taste in his mouth. He called poison control.

MI02092 – A chef in his 40s was doing a food demonstration. Someone had packed a quaternary ammonium disinfectant (signal word: Danger) in an unlabeled drink bottle. He took a sip and swallowed it. He developed a burning throat, nausea, uncontrollable vomiting, and diarrhea. He called poison control.

MI02098 – A house cleaner in her 20s worked with a quaternary ammonium disinfectant (signal word: Danger), but thought it may also have been mixed with bleach. She accidentally spilled some on her face. She developed a numb face, dizziness, and fainted. She went to an emergency department and called poison control.

MI2099 – A hospital worker in her 40s splashed a sterilant in her eye. It became red and painful. She went to an emergency department and was diagnosed with a corneal abrasion.

MI02105 – A machine programmer in his 50s was present when his supervisor decided to clean a tank by mixing an acid cleaner with bleach. He developed a sore throat, congestion and a headache and called poison control. The fumes were still present the next day, and eventually the company discarded the tank.

MI02124 – An apartment cleaner in her 50s cleaned a shower with a sodium hypochlorite disinfectant (signal word: Danger). She rinsed it and thought the drain was clear. She then used an acid disinfectant (signal word: Danger) to clean rust spots. The products mixed in the drain to form chlorine. She inhaled the fumes and developed shortness of breath, cough, wheezing, decreased air movement, sinus drainage, headache, and a red throat. She went to an emergency department.

MI02135 – A worker in recycling in his 20s got some bromine chloride on his hands. He developed a headache, felt dizzy, his fingers tingled, and his hands were red and burning. He went to an urgent care center.

Animal Repellent
MI01966 – A hospital histology technician in her 30s was working in an unventilated area when a coworker sprinkled some pellets on the floor to repel mice. She developed a sharp pain in her right nostril radiating to the side of her head, tingling of her forehead, headache, dizziness, ringing ears, and a runny nose. She went to the emergency department. The case was referred to MDA.

Mixtures
MI01822 – A grower in her 40s at a greenhouse had a brief exposure to insecticide (signal word: Caution) spray mist when she walked into a greenhouse that had not been posted. The next day she was applying a combination of two fungicides, both signal word: Caution. The hose connection leaked, and some got on her clothes. Then the hose burst, and she got splashed in the face and eyes. She was wearing glasses, but some got in her eyes anyway. She washed with water from another hose, but no eye wash station was available. She developed red, irritated eyes, with crusting the next two mornings, and itchy skin. She went to an emergency department. She also contacted MIOSHA and they referred the case to MDA. Several violations were found.

Appendix 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 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 tests per specimen (e.g. red blood cell acetylcholinesterase, plasma pseudocholinesterase, serum 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 2009 are presented.

Results

In 2009 laboratories reported 352 test results on 253 individuals. Thirty-four (13.7%) of these individuals met criteria for follow-up, including 32 (94.1%) with a low test result and two (5.9%) with a 20% change from the first reported test. Table 14 shows the reason for the cholinesterase test. Thirteen (38.2%) of the 34 individuals were tested because of potential work-related pesticide exposure.

Table 14

Persons with Abnormal Laboratory Cholinesterase Tests, 2009 (N=34)		
Reason for Test	**Number**	**Percent**
Occupational	13	38.2
Non-Occupational		
Surgery	*10*	
Suicide attempt with pesticide	*1*	
Other	*4*	
Total non-occupational	15	44.1
Unknown	6	17.7
Total	34	100.0

Follow-up of the work-related cases identified six employers among the 13 work-related cases.

Table 15

Employers Identified, 2008 (N=6)		
Employer	**Number**	**Percent**
Large Chemical Company	7	53.8
Fire Department	1	7.7
Twp Fire Department	1	7.7
University Hospital	1	7.7
Federal Agency	1	7.7
Tree Service	1	7.7
Total	13	100.0

Twelve of the 13 work-related test results were low; in eight of these the test was a baseline test upon employment, before any possible exposure. Three of these low test results were part of routine monitoring. One came with a note from the laboratory that said “Caution in interpretation of results. Received Packed cells. The hematocrit used in RBC cholinesterase calculation (75.9) may not be accurate.” The plasma test for this individual was normal. We were unable to contact the last person with a low test result and the person with a 20% increase from the previous test and therefore have no information about possible pesticide exposures on these two individuals.

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. We will continue to routinely interview individuals with low test results or those who have a 20% change in their results. If symptomatic individuals are identified, they will be included in the pesticide illness/injury surveillance system.

The cholinesterase laboratory reporting system has the potential to identify exposures at an early stage prior to symptoms to review work practices and thus prevent exposure, symptoms, and disease.

Jennifer M. Granholm, Governor
Janet Olszewski, Director

MDCH is an equal opportunity employer, services, and programs provider.