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**2016**  
**ANNUAL REPORT**

**TRACKING WORK-RELATED  
ASTHMA IN MICHIGAN**





# 2016 ANNUAL REPORT TRACKING WORK-RELATED ASTHMA IN MICHIGAN

## *Work-Related Asthma Surveillance Program*

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There are many resources available to help employers, employees, health care professionals and others understand more about work-related asthma. Links to these resources can be found at: [www.oem.msu.edu](http://www.oem.msu.edu).

### Acronyms

**OA** Occupational Asthma

**AA** Work-Aggravated Asthma

**POA** Possible Occupational Asthma

**RADS** Reactive Airways Dysfunction Syndrome

**LARA** MI Department of Licensing & Regulatory Affairs

**MIOSHA** Michigan Occupational Safety & Health Administration

**NAICS** North American Industrial Classification System

**NIOSH** National Institute for Occupational Safety & Health

**PEL** Permissible Exposure Limit

**REL** Recommended Exposure Limit



**This report was funded by the National Institute for Occupational Safety & Health, under cooperative agreement U60-OH008466.**

We sincerely appreciate the commitment of those health care providers who understand the public health significance of diagnosing a patient with an occupational illness, as well as the Michigan employees who took the time to share their experiences about their work and subsequent development of work-related asthma.

## *Summary*

This is the 26th annual report on work-related asthma (WRA) in Michigan.

In 2010, in a publication in the Journal of Asthma, researchers found that in a random sample of Michigan adults, 54.1% self-reported that their asthma was caused or aggravated by their work, and yet only 22% reported having a discussion with their health care provider about their concern about the effect of work on their asthma<sup>1</sup>. These same individuals were more symptomatic and had more health care usage than other Michigan adults with asthma. This study highlights the importance of health care providers considering whether their patients with asthma have work-related triggers.



**There are over 300 known asthma-causing agents used in the workplace. Thousands more substances have not been evaluated for their asthma-causing potential. The Association of Occupational & Environmental Clinics (AOEC) has a web site with an on-line look-up feature to identify asthma-causing agents. <http://www.aoecdata.org/ExpCodeLookup.aspx>**

**Part 56 of the Michigan Public Health Code requires reporting of all known or suspected occupational illnesses or work-aggravated health conditions to the Michigan Department of Licensing & Regulatory Affairs within 10 days of discovery.**

## *Summary, continued...*

- ◆ Since 2006, the number of cases identified each year has been less than the overall yearly average of 128.
- ◆ From 1988-2016, 3,509 WRA cases have been identified with MI's tracking system.
- ◆ We estimate there are 65,000-97,000 adults in MI with WRA.
- ◆ 81% of the MI WRA patients have new-onset asthma; 19% have pre-existing asthma aggravated by an exposure at work.
- ◆ MIOSHA enforcement inspections at the facilities where individuals worked who were reported with WRA revealed that, on average, almost one out of every six of the fellow workers have asthma or respiratory symptoms compatible with asthma.
- ◆ Cleaning agents (12.5%) and isocyanates (12.2%), are the most commonly reported exposures causing WRA in MI.
- ◆ Approximately 40,490 individuals in the MI workforce are employed in manufacturing where isocyanates are used.
- ◆ The average incidence rate of WRA among African Americans is 2 times greater than that of Caucasians.

## *Background*

In 1988, the State of Michigan instituted a tracking program for WRA with financial assistance from NIOSH. This is a joint project of MIOSHA (LARA) and Michigan State University (MSU), Department of Medicine, Division of Occupational and Environmental Medicine.

The reporting of an index patient is a sentinel health event that may lead to the identification of employees from the same facilities who are also at risk of developing asthma or who have developed similar breathing problems. The goal is to prevent WRA through the identification and workplace follow-up of these index patients.

## *Work-Related Asthma Tracking Procedures*

### **SOURCES TO IDENTIFY PATIENTS**

- Patients are identified through mandatory reporting of any known *or suspected* occupational illnesses, including WRA.
- ◆ **Health Care Providers** Private practice, working for industry
  - ◆ **Hospitals** ICD-9 506.0-.9 & 493, Workers' Compensation payer
  - ◆ **Workers' Compensation Agency**
  - ◆ **Poison Control Center**
  - ◆ **Reports from Co-Workers or MIOSHA Field Staff** confirmed by a health care provider
  - ◆ **Death Certificates**
  - ◆ **Clinical Laboratories for specific IgE Allergy Testing**

## WRA Tracking Procedures in Michigan

**STEP 1. IDENTIFY PATIENTS** — Occupational Disease Reports submitted to LARA are reviewed. Any known or suspected WRA cases are identified. A letter is sent to the patient to invite them to participate in a telephone interview.

**STEP 2. INTERVIEW PATIENTS** — A telephone interview with the suspected WRA patient is conducted, and medical records are obtained, including any pulmonary function test results. A physician who is board-certified in internal medicine and occupational medicine reviews all collected information.

**STEP 3. CONFIRM DIAGNOSIS OF WRA\*** — The diagnosis of WRA requires **A)** Physician diagnosis of asthma and **B)** Onset of respiratory symptoms associated with a particular job that resolve or improve away from work and **C)** Work with a known allergen, or an association between the work exposure and a decrease in peak flow or spirometry.

**STEP 4. WORKPLACE INSPECTION** — After the patient interview is completed and the work-relatedness is determined, an onsite MIOSHA workplace enforcement inspection may be conducted. **During an Inspection:** Co-workers are interviewed to determine if other individuals are experiencing similar breathing problems from exposure to the allergen. Air monitoring for any suspected allergens may be conducted. The company's health and safety program is reviewed, including its Injury & Illness log and medical program.

**STEP 5. FOLLOW-UP ACTIVITIES** — After the investigation is complete, a report of air sampling results and any recommendations is sent to the company and made available to workers. A copy of the report is also sent to the reporting physician. Letters are sent to any workers who reported breathing problems in relation to work, or new-onset asthma since working at the facility. The letters recommend they seek medical care to determine the cause of their breathing problems.

**STEP 6. ADDITIONAL FOLLOW-UP** — Outreach, educational activities, and recommendations may be developed based on the findings. An annual report summarizing the activity is completed each year.

### \*SUBCATEGORIES OF WRA

#### New Onset

- 1) Occupational Asthma (OA) if A), B), and C) are met.
- 2) Possible WRA (POA) if only A) and B) are met.
- 3) Reactive Airways Dysfunction Syndrome (RADS) if symptoms develop after an acute exposure.<sup>2</sup>

#### Exacerbation

- 4) Work-Aggravated Asthma (AA) if had asthma in the 2 years prior to job, but asthma worsens at work.

# Results

The following sections report the cumulative results of WRA surveillance from 1988 to-date.

## REPORTS

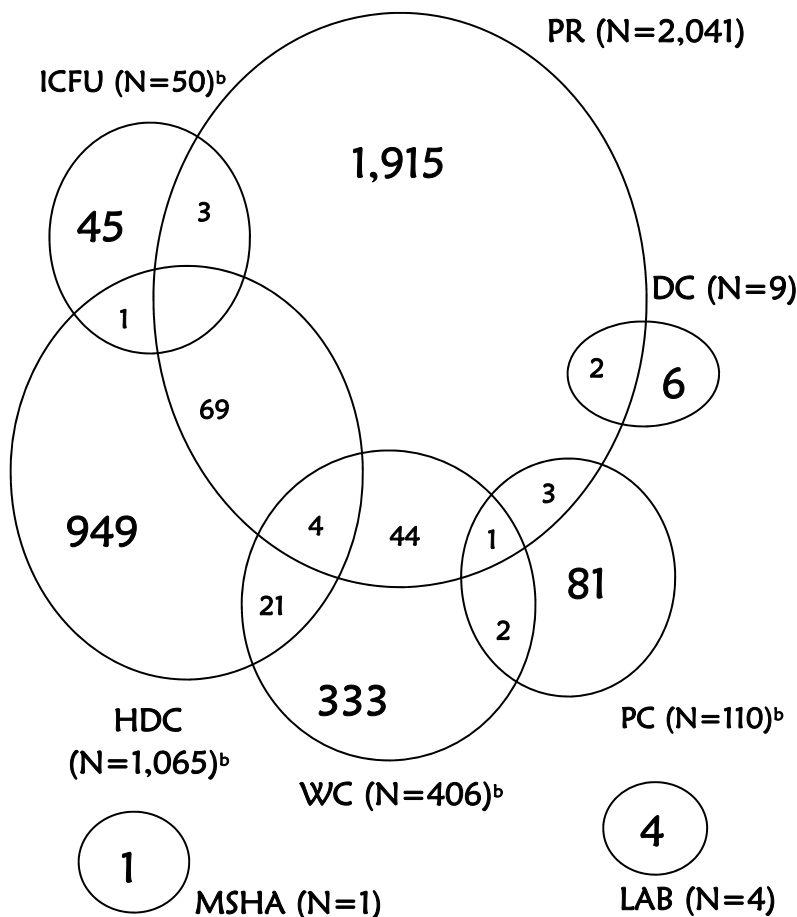
Table 1 shows that 3,509 people were confirmed with WRA between 1988—2016. The reports are divided into: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA) and Reactive Airways Dysfunction Syndrome (RADS). Ninety-two additional patients have been confirmed since last year’s report (one for 2014, 13 for 2015, and 78 for 2016). Figure 1 shows the overlap of the patients by reporting sources for 1988—2016.

**TABLE 1**  
**Number of Confirmed Cases of Work-Related Asthma by Year and Type**  
 Disease Status

YEAR	OA	POA	AA	RADS	TOTAL
1988	23	7	0	1	31
1989	43	12	3	5	63
1990	87	35	14	8	144
1991	55	30	14	16	115
1992	82	36	14	18	150
1993	75	69	13	19	176
1994	65	59	15	13	152
1995	57	34	19	17	127
1996	61	59	24	11	155
1997	53	74	19	16	162
1998	46	74	18	9	147
1999	48	65	16	12	141
2000	49	67	31	17	164
2001	50	51	20	19	140
2002	39	59	24	21	143
2003	29	64	28	23	144
2004	39	61	37	30	167
2005	43	66	21	23	153
2006	34	61	29	14	138
2007	20	41	34	28	123
2008	16	53	25	16	110
2009	20	41	31	8	100
2010	16	41	30	16	103
2011	19	26	19	3	67
2012	17	19	35	10	81
2013	15	28	36	6	85
2014	17	21	27	2	67
2015	16	21	33	13	83 <sup>a</sup>
2016	20	14	38	6	78 <sup>a</sup>
<b>Total</b>	<b>1,154</b>	<b>1,288</b>	<b>667</b>	<b>400</b>	<b>3,509</b>

<sup>a</sup>Reports are still being processed for calendar years 2015 and 2016; an increase in these totals will be reflected in next year’s annual report.

**FIGURE 1**  
**Overlap of Reporting Sources for 3,509 Confirmed Work-Related Asthma Patients: 1988-2016<sup>a</sup>**



<sup>a</sup> Ns represent the total number for that source. Reporting Source: HDC=Hospital Discharge; PR=Physician Referral; DC=Death Certificate; WC=Workers’ Compensation; ICFU=Index Case Follow-Up; MSHA=Mine Safety & Health Administration; PC=Poisson Control Center; LAB= Laboratory IgE.

<sup>b</sup> There was an overlap of PC-HDC for 20 individuals and of one individual for PC-ICFU, one individual for DC-PC, and WC-PC-HDC for one individual each.

## Demographics-Trends

The analyses conducted for the annual report were divided into 1988-1997, 1998-2007 and 2008-2016 to examine trends over time. There were 1,274 individuals reported with work-related asthma from 1988-1997, 1,461 individuals reported from 1998-2007 and 774 reported from 2008 to 2016. The trend analyses can be found along with the tables that present the overall statistics. The CHANGE column on select tables indicates the percentage of increase or decrease from 1988 to 2016.

**GENDER:** Table 2 shows a slightly higher percentage of women were reported with work-related asthma compared to men. Over time, the percentage of women reported with WRA has increased, while the percentage of men has decreased accordingly.

**RACE:** Table 3 shows there was an increase over time in the percentage of Hispanic cases of WRA, and a decrease in the percentage of Caucasian cases of WRA. The percentages of other races remained unchanged over time, although the numbers of cases of other races were quite low. The annual incidence rate for African Americans was 2.79 per 100,000 Michigan African American workers compared to 1.36 per 100,000 for Michigan Caucasian workers; this was a 2 times greater incidence (95% CI 1.182, 3.534).

TABLE 2 Gender of Work-Related Asthma Patients by Time Period					
	Time Period				
	All years	1988-1997	1998-2007	2008-2016	Change
Gender	# (%)	# (%)	# (%)	# (%)	
Female	1,842 (54)	626 (49)	800 (55)	471 (61)	+ 24%
Male	1,575 (46)	648 (51)	661 (45)	303 (39)	- 24%

TABLE 3 Race of Work-Related Asthma Patients by Time Period					
	Time Period				
	All years	1988-1997	1998-2007	2008-2016	Change
Race	# (%)	# (%)	# (%)	# (%)	
Caucasian	2,517 (74)	973 (76)	1,074 (74)	528 (68)	-11%
African American	637 (19)	239 (19)	271 (19)	147 (19)	None
Hispanic	76 (2)	24 (2)	27 (2)	25 (3)	+ 50%
Alaskan/Am Indian	26 (1)	10 (1)	13 (1)	6 (0.8)	- 20%
Asian	14 (<1)	4 (0.3)	7 (0.5)	3 (0.4)	+ 33%
Other	37 (1)	11 (1)	20 (1)	6 (0.8)	-20%
Unknown	110 (3)	13 (1)	49 (3)	59 (6)	N/A



The sooner an individual with WRA is diagnosed and removed from the agent associated with their asthma, the better the prognosis for improvement in symptoms.

## Location in State-Trends

Table 4 and Figure 2 show the average annual incidence rates of WRA among the working population, by county. The highest rates were in Luce (11.5 cases per 100,000), Clare (7.9 cases per 100,000), Huron and Genesee (5.0 cases per 100,000 each), Osceola (4.9 cases per 100,000), and Saginaw (4.8 cases per 100,000).

**TABLE 4**  
**Average Annual Incidence Rates of Work-Related Asthma**  
**Among Michigan Workers by County of Exposure: 1989-2014<sup>a</sup>**

County	Avg Annual		Cases 1989-2014	County	Avg Annual		Cases 1989-2014
	# EE's <sup>b</sup>	Inc Rate <sup>c</sup>			# EE's <sup>b</sup>	Inc Rate <sup>c</sup>	
Alcona	3,701	1.0	1	Keweenaw	934	4.1	1
Alger	4,082	1.9	2	Lake	4,078	1.9	2
Allegan	51,890	3.4	46	Lapeer	41,930	2.9	32
Alpena	13,883	3.0	11	Leelanau	10,451	1.5	4
Antrim	10,773	1.1	3	Lenawee	47,409	2.5	31
Arenac	6,827	2.3	4	Livingston	86,477	1.6	37
Baraga	3,466	3.3	3	Luce	2,678	11.5	8
Barry	28,195	0.7	5	Mackinac	5,996	1.3	2
Bay	51,280	1.8	24	Macomb	396,836	2.8	287
Benzie	7,828	1.5	3	Manistee	11,000	1.4	4
Berrien	73,886	1.5	29	Marquette	31,306	2.6	21
Branch	21,410	4.0	22	Mason	13,628	1.1	4
Calhoun	65,736	2.5	42	Mecosta	17,904	1.7	8
Cass	24,866	0.8	5	Menominee	12,260	0.3	1
Charlevoix	12,704	2.7	9	Midland	39,455	2.5	26
Cheboygan	11,260	4.4	13	Missaukee	6,220	2.5	4
Chippewa	15,632	1.0	4	Monroe	72,714	1.5	29
Clare	11,718	7.9	24	Montcalm	27,030	2.4	17
Clinton	34,384	0.9	8	Montmorency	3,781	3.1	3
Crawford	6,164	3.7	6	Muskegon	78,772	1.3	26
Delta	18,237	2.1	10	Newaygo	20,992	2.6	14
Dickinson	13,230	3.5	12	Oakland	613,059	2.6	421
Eaton	55,075	0.9	13	Oceana	12,255	1.3	4
Emmet	17,085	1.1	5	Ogemaw	8,852	3.5	8
Genesee	194,623	5.0	254	Ontonagon	3,234	1.2	1
Gladwin	10,067	1.1	3	Osceola	10,174	4.9	13
Gogebic	7,230	1.1	2	Otsego	11,317	3.4	10
Grand Traverse	42,943	1.6	18	Ottawa	123,438	0.8	25
Gratiot	18,133	2.5	12	Roscommon	9,630	2.8	7
Hillsdale	21,637	2.1	12	Saginaw	90,666	4.8	112
Houghton	15,701	1.7	7	Sanilac	19,843	3.9	20
Huron	15,387	5.0	20	Schoolcraft	3,448	2.2	2
Ingham	144,855	3.3	125	Shiawassee	33,207	0.7	6
Ionia	27,764	1.5	11	St. Clair	78,702	2.7	56
Iosco	9,639	2.0	5	St. Joseph	28,518	1.5	11
Iron	5,278	2.2	3	Tuscola	26,543	3.0	21
Isabella	33,403	2.5	22	Van Buren	36,707	0.9	9
Jackson	72,768	2.4	46	Washtenaw	178,274	3.8	174
Kalamazoo	123,404	1.5	49	Wayne	851,213	3.5	784
Kalkaska	7,816	3.9	8	Wexford	13,447	1.7	6
Kent	294,931	1.1	86	<b>All Michigan Counties<sup>d</sup></b>	<b>4,702,000</b>	<b>2.6</b>	<b>3,238</b>

<sup>a</sup> 1989 through 2014 represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2015 and 2016 is not yet complete. Therefore, 1988, 2015 and 2016 reports are not included in this table.

<sup>b</sup> EE's = employees. Source: MI Dept of Tech, Mgt. & Budget, Labor Market Information, Annual Unemployment Statistics (LAUS) by County, 2002.

<sup>c</sup> Rates are based on the average number of cases per year from 1989-2014 (26 years), per 100,000 Michigan workers.

<sup>d</sup> Fifty-seven cases had an out-of-state exposure and 22 had an unknown county of exposure, for the 1989-2014 reporting period.

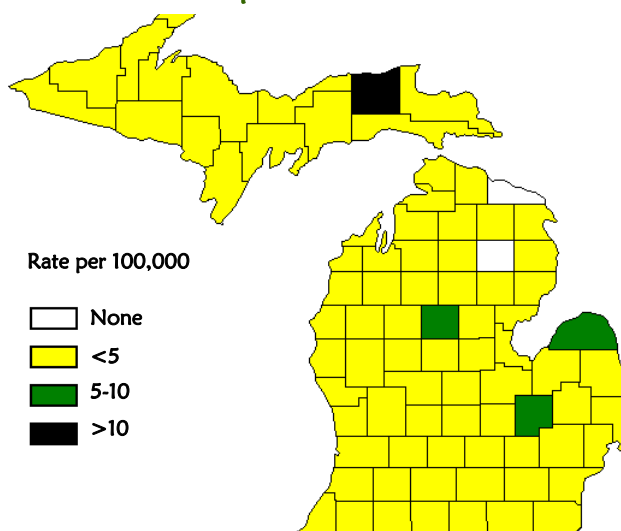


## Location in State-Trends



**TOP 10 COUNTIES:** Table 5 shows the top 10 counties with the highest overall rates of WRA that had more than one case during the 1989-2014 time period. All but one of the top 10 counties with the highest overall rates of WRA had a decrease greater than 10% in the rate of WRA over time. Many of the rates increased during the 1998-2007 time period but then decreased during the 2008-2016 time period.

**FIGURE 2**  
Average Annual Incidence Rate of WRA by County of Exposure: 1989-2014<sup>a</sup>



<sup>a</sup> 1989 through 2014 represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2015 and 2016 is not yet complete. Therefore, 1988, 2015 and 2016 reports are not included in this figure.

**TABLE 5**  
Average Annual Incidence Rate of Work-Related Asthma by County and Time Period

County	Time Period										
	All years	1988-1997		1998-2007			2008-2016			Change	
Rate	# Cases	# EE's	Rate	# Cases	# EE's	Rate	# Cases	# EE's	Rate		
Branch	4.1	7	17,699	4.0	12	21,340	5.6	4	17,032	2.6	- 35%
Cheboygan	4.6	8	9,658	8.3	2	11,422	1.8	3	9,277	3.6	- 57%
Clare	8.2	8	9,100	8.8	11	11,761	9.4	8	10,570	8.4	<10%
Genesee	5.1	83	179,394	4.6	132	191,377	6.9	45	163,453	3.1	- 33%
Huron	5.2	7	14,941	4.7	8	15,499	5.2	5	15,104	3.7	- 21%
Kalkaska	4.1	4	6,188	6.5	4	7,932	5.0	0	6,604	—	- 23%
Luce	11.9	4	2,021	19.8	2	2,660	7.5	2	2,112	10.5	- 47%
Osceola	5.1	2	9,343	2.1	10	9,938	10.1	1	8,996	1.2	- 43%
Saginaw	4.9	31	91,307	3.4	67	90,388	7.4	18	80,771	2.5	- 26%
Sanilac	4.0	5	17,992	2.8	12	19,452	6.2	3	17,315	1.9	- 32%
All MI Counties	2.7	1,274	4,258,000	3.0	1,461	4,702,000	3.1	773	4,198,000	2.0	-33%

## Type of Industry-Trends

Table 6 shows the Michigan industries by NAICS codes, with cases of work-related asthma from 1988 to 2016. The main industries were in manufacturing (57%) and health care and social assistance (12%).

The incidence rate of WRA by industry ranges from 0.1 cases per 100,000 in management of companies to a high of 9.7 cases per 100,000 in manufacturing. Industries with the next highest average annual incidence rates were: mining with 5.8 cases per 100,000 workers and health care and social assistance with 3.1 cases per 100,000 workers.

Table 7 shows the average annual incidence rates for WRA cases *within manufacturing*.

**INDUSTRIES OVER TIME:** Table 8 shows distribution across all industries for the WRA cases by time period. There was a large decrease in the percentage of WRA cases in manufacturing, which dropped from 71.6% of cases in 1988-1997 to 37.0% in 2008-2016. Increases in the percentages of cases with WRA occurred in many industry sectors, including: retail trade, administrative and support and waste management, health care and social assistance, and accommodation and food services.

**TABLE 6**  
**Number of Work-Related Asthma Patients, 1988-2016 by Primary Industrial Exposure and Average Annual Incidence Rate per 100,000 Workers, 1989-2014 (Years of Complete Reporting)**

2002 North American Industry Classification System		WRA Cases		Number of Employees <sup>a</sup>	Average Ann. Incidence Rate <sup>b</sup>	
		1988-2016			Rate	# Cases
		#	%			
11	Agriculture, Forestry, Fishing, & Hunting	24	0.7	81,664	1.1	23
21	Mining	13	0.4	8,600	5.8	13
22	Utilities	19	0.5	35,300	2.0	18
23	Construction	96	2.7	199,800	1.7	86
31-33	Manufacturing	2,005	57.1	761,400	9.7	1,919
42	Wholesale Trade	39	1.1	175,400	0.8	38
44-45	Retail Trade	109	3.1	530,700	0.7	96
48-49	Transportation & Warehousing	68	1.9	92,900	2.7	65
51	Information	24	0.7	70,400	1.3	24
52	Finance & Insurance	30	0.9	157,700	0.7	29
53	Real Estate & Rental & Leasing	17	0.5	55,700	1.1	16
54	Professional, Scientific & Technical Services	30	0.9	258,700	0.4	28
55	Management of Companies & Enterprises	1	<0.1	73,600	0.1	1
56	Administrative & Support & Waste Management	73	2.1	267,000	1.0	71
61	Educational Services	159	4.5	332,000	1.7	151
62	Health Care & Social Assistance	427	12.2	499,300	3.1	397
71	Arts, Entertainment & Recreation	30	0.9	53,500	2.2	30
72	Accommodation & Food Services	108	3.1	345,200	1.1	97
81	Other Services (except Public Administration)	80	2.3	256,100	1.1	76
92	Public Administration	139	4.0	390,400	1.3	127
00	Unknown	18	0.5	--	--	12
<b>Total</b>		<b>3,509</b>	<b>100.1<sup>c</sup></b>	<b>4,568,564</b>	<b>2.8</b>	<b>3,317</b>

<sup>a</sup>Source: MI Dept of Tech, Mgt & Budget, Labor Market Information, Industry Employment (CES), 2002. Accessed 12-17-2015. The total non-farm employment in MI, 2002: 4,486,900. Agriculture: 2002 U.S. Census of Agriculture-State Data. Selected Operator Characteristics by Race: 2002.

<sup>b</sup>Reporting in 1988 was begun mid-year, and reporting for 2015 and 2016 is not yet complete. Therefore, 1988, 2015 and 2016 reports are not included in the calculation of the annual average incidence rate. Rates are based on the average number of cases by industry from 1989-2014 (26 years), per 100,000 Michigan workers.

<sup>c</sup>Percentage does not add to 100 due to rounding.

## Type of Industry-Trends

**TABLE 7**  
**1,919 Work-Related Asthma Patients from Manufacturing Industries:**  
**1989-2014<sup>a</sup>**

	2002 North American Industry Classification System	WRA Cases #	Avg Ann Rate <sup>a</sup>	# Employees <sup>b</sup>
311	Food Mfg	63	7.6	31,900
323	Printing & Related Support Activities	19	3.6	20,200
325	Chemical Mfg	101	11.5	33,800
326	Plastics & Rubber Products Mfg	102	9.0	43,700
327	Nonmetallic Mineral Product Mfg	18	3.9	17,600
331	Primary Metal Mfg	66	9.0	28,300
332	Fabricated Metal Product Mfg	109	5.0	84,500
333	Machinery Mfg	144	6.9	79,700
334	Computer & Electronic Product Mfg	14	2.6	21,100
336	Transportation Equipment Mfg	1,134	14.7	296,900
337	Furniture & Related Product Mfg	14	1.7	31,000
	Miscellaneous Mfg (*includes NAICS: 312-16,321-322,324,335,339)	135	7.1	72,700

<sup>a</sup>Average annual incidence rate, based on cases from 1989-2014 (26 years) per 100,000 adult workers in Michigan in each industrial category, and represents years with complete reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2015 and 2016 is not yet complete. Therefore, 1988, 2015 and 2016 reports are not included in this table.

<sup>b</sup>Source: Michigan Department of Technology, Management and Budget, Labor Market Information, Industry Employment (CES), 2002. Accessed 12-17-2015.

**Workers can be exposed to sensitizing agents in any type of industry.**

**TABLE 8**  
**Industry of Work-Related Asthma Patients by Time Period**

NAICS	Industry	Time Period						Change
		1988-1997		1998-2007		2008-2016		
		#	%	#	%	#	%	
11	Agriculture, Forestry, Fishing, & Hunting	4	0.3	12	0.8	8	1.0	+ 233%
21	Mining	5	0.4	6	0.4	2	0.3	- 25%
22	Utilities	3	0.2	5	0.3	11	1.4	+ 600%
23	Construction	32	2.5	37	2.5	27	3.5	+ 40%
31-33	Manufacturing	912	71.6	809	55.4	286	37.0	- 48%
42	Wholesale Trade	23	1.8	14	1.0	3	0.4	- 78%
44-45	Retail Trade	15	1.2	48	3.3	44	5.7	+ 375%
48-49	Transportation & Warehousing	14	1.1	35	2.4	19	2.5	+ 127%
51	Information	6	0.5	11	0.8	7	0.9	+ 80%
52	Finance & Insurance	2	0.2	17	1.2	11	1.4	+ 600%
53	Real Estate & Rental & Leasing	2	0.2	11	0.8	4	0.5	+ 150%
54	Professional, Scientific & Technical Services	9	0.7	16	1.1	5	0.6	- 14%
55	Management of Companies & Enterprises	0	—	1	0.1	0	—	N/A
56	Administrative & Support & Waste Management	10	0.8	27	1.8	36	4.7	+ 488%
61	Educational Services	40	3.1	73	5.0	46	5.9	+ 90%
62	Health Care & Social Assistance	105	8.2	194	13.3	128	16.5	+ 101%
71	Arts, Entertainment & Recreation	5	0.4	11	0.8	14	1.8	+ 350%
72	Accommodation & Food Services	19	1.5	49	3.4	39	5.0	+ 233%
81	Other Services (except Public Administration)	22	1.7	31	2.1	27	3.5	+106%
92	Public Administration	44	3.5	46	3.1	49	6.3	+ 80%
00	Unknown	2	0.2	8	0.5	8	1.0	N/A

## *Type of Exposure-Trends*

Table 9 shows the exposures associated with WRA among Michigan workers. The most frequent exposures reflect the importance of the automotive manufacturing industry in the State, and the widespread use of cleaning products across all industry sectors. Most frequently identified exposures include: cleaning products, associated with 437 (12.5%) of Michigan's WRA patients, and isocyanates (MDI, TDI, HDI and others) accounting for 427 (12.2%) of the WRA case exposures. Metal working fluids (coolants) accounted for 325 (9.3%) of Michigan worker exposures.

There is ongoing interest in ingredients in cleaning products that can cause new-onset asthma and aggravate existing asthma. These products, used both in the home and in all industry sectors (services, manufacturing, etc.) can contain disinfectants, often in the form of quaternary amines, which have been repeatedly shown to cause asthma among workers who either use them or are in the area when they are being used. The Michigan WRA Tracking Program has developed a brochure on the hazards of cleaning agents. It is available at: [www.oem.msu.edu](http://www.oem.msu.edu), and can be found under the **Resources Section**.

Welding is the fifth most common cause of WRA in Michigan. Both welders themselves as well as individuals who work in the same area may be affected by welding fume. A 2011 publication highlights the morbidity and high health care costs from asthma associated with welding<sup>3</sup>.

**TOP EXPOSURES OVER TIME:** Table 10 shows the trends among the top exposures by time period. Isocyanates decreased from 19.3% of all the WRA exposures in 1988-1997 to 7.1% in 2008-2016. Cleaning agents increased from 4.6% of all the WRA exposures in 1988-1997 to 21.3% in 2008-2016. Metalworking fluids, solvent and latex rubber also decreased over time, while there was an increase in cases reported from exposure to fungus over time.

Figure 3 represents another way to look at exposures over time. It shows the number of individuals with work-related asthma by type of exposure from 1988-2015. Trends are shown for the five most common causes of WRA and all other exposures that could be grouped as either low molecular weight (i.e., chemicals, metals) or high molecular weight (i.e., organic material, plant or animal) agents. The data is grouped into 2-year time categories to give more stability to smaller numbers of cases in a single year. The number of individuals with WRA caused by metalworking fluids and other chemicals with low molecular weights appears to be trending downward. Diisocyanates were decreasing until 2010-2011. Office, and animal or plant products with high molecular weights appear unchanged. Cleaning agents appear to be trending upward until 2006-2007 and then decreasing since that time. The manufacturing industry and associated exposures have been decreasing over time.



Safety Data Sheets (SDS) can be used to identify ingredients in products that may cause asthma. However, a physician may have to write the company to find out about trade secret ingredients not specifically listed on the SDS.

**TABLE 9**  
**Top Workplace Exposures Associated with**  
**Confirmed WRA Patients: 1988-2016**

<u>Exposure Agent</u>	<u>#</u>	<u>%</u>
Cleaning Solutions	437	12.5
Isocyanates	427	12.2
Metal Working Fluids	325	9.3
Unknown (Mfg.)	257	7.3
Unknown (Office)	204	5.8
Exhaust/Smoke/Fumes	168	4.8
Welding Fume-Stainless & Other	154	4.4
Solvents	113	3.2
Paint Fumes	87	2.5
Fungus	76	2.2
Epoxy	75	2.1
Formaldehyde	66	1.9
Acids	65	1.9
Latex/Rubber	61	1.7
Fire	58	1.7
Chlorine	50	1.4
Plastic Fumes	50	1.4
Chemicals Used in Construction	49	1.4
Acrylates	39	1.1
Animal Dander	38	1.1
Cobalt	33	0.9
Flour	29	0.8
Fragrances	29	0.8
Wood Dust	27	0.8
Ammonia	24	0.7
Styrene	23	0.7
Cigarette Smoke	21	0.6
Herbicide/Pesticide	21	0.6
Fiberglass	19	0.5
Aldehydes	19	0.5
Chromium	16	0.5
Amines	15	0.4
Cosmetology Chemicals	14	0.4
Plants/Organic Matter	14	0.4
Caustics	13	0.4
Cement Dust	13	0.4
Medication	13	0.4
Rust Inhibitor	13	0.4
Grain Dust	12	0.3
Printing Inks	12	0.3
Anhydrides	11	0.3
Asphalt	11	0.3
Fire Extinguisher Powder	11	0.3
Insecticides	9	0.3
Meat Wrapper's Asthma	9	0.3
<u>Other<sup>a</sup></u>	<u>279</u>	<u>8.0</u>
<b>Total</b>	<b>3,509</b>	<b>100.2<sup>b</sup></b>

<sup>a</sup>There were 7 cases with exposure to: Heat, Enzymes, Paper Dust, Polyurethane, Sewage.

There were 6 cases each with exposure to: Azodicarbonamide, Freon, Nitrogen, Pickling Ingredients, Solder Fume, Sulfur Dioxide, Textile Lint.

There were 5 cases each with exposure to: 1,1,1 Trichloroethane, Coal Dust, Photo Developing Fluids.

There were 4 cases each with exposure to: Asbestos, Cold Air, Cooking Oil, Drywall Dust, Lime Dust, Mold Release Spray, Rose Hips, Sand, Sulfonate, Trichloroethylene, X-Ray Developing Fluids.

There were 3 cases each with exposure to: Cadmium Solder, Coal Tar, Colophony, Copier Toner, Explosion, Hydraulic Oil, Kerosene, Natural Gas, Nickel, Ozone, Pepper Gas, Polyethylene, Sludge, Zinc, Zinc Oxide.

There were 2 cases each with exposure to: Ammonium Chloride, Cellulose, Concrete Sealer, Copper Oxide, Exercise, Fertilizer, Fireproofing Chemicals, Flux, Gas and Oil Refinery Exposures, Glaze, Methamphetamine Lab, Perchloroethylene, Phosgene, Polyester, Polyvinyl Butyrate, Silicone, Sulfite, Talcum Powder, Teflon, Vinyl Acetate Acrylic, Wastewater Treatment Chemicals.

There was 1 case each with exposure to: 1,3-Dichloro-2-Propanol, 1,3 Dichloro 5 5-Dimethyl Hydrantoin, Agent Orange, Ammonium Bifluoride, Barbeque Smoker, Benzoate Esters, Blood, Blue Prints, Calcium Carbonate, Calcium Chloride (used in Cherry Brine), Capsaicin, Car Window Sealant, Carbon Dioxide, Catheter Demonstration Chemical, Ceramic Powder, Crude Oil, Cyanide, Deck Stain, Desert Storm, Dry Ice, Eggs, Ethylene Oxide, Flares, Gortex, Heated Polyvinyl Chloride, Heated Vinyl, Iodine, Isopropyl Alcohol, Methanol, Mica, Monoammonium Phosphate, Ninhydrin, Nonylphenol polyethylene glycol ether, Nylon-polyhexamethylene Adipamide, Odor, Phenol, Pigment, Plasma Cutting, Plating Chemicals, Platinum, Polyolefin, Potassium Aluminum Fluoride, Polybutadiene, Soda Ash, Sodium Acetate, Sodium Chlorite, Soot, Stress, Swimming Pool Shock, Tetrahydrofuran, Titanium Tetrachloride, Tuberculosis Vaccine, White Lithium, Wood Smoke, World Trade Center Exposure, Zinc Borate.

<sup>b</sup>Percentage does not add to 100 due to rounding.

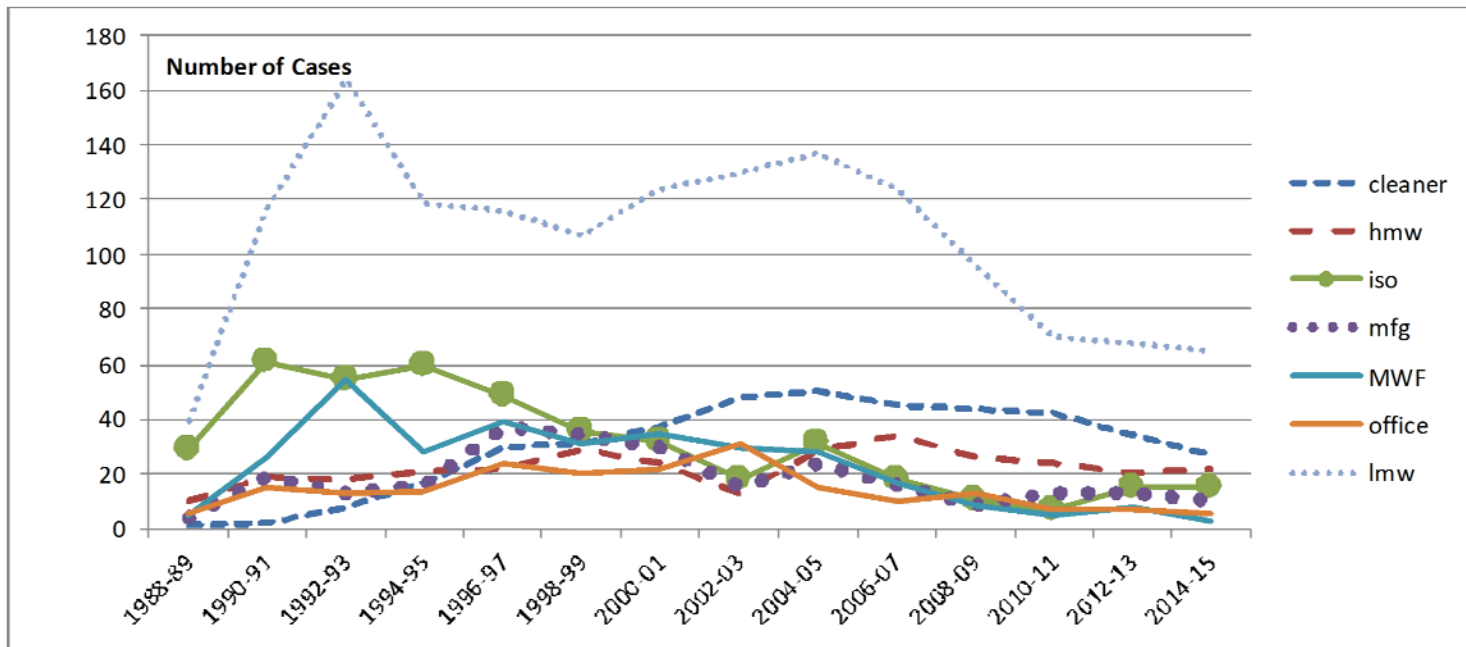
**TABLE 10**  
**Top Workplace Exposures of Work-Related Asthma Patients by Time Period**

Exposure Type	Time Period				
	All Years	1988-1997	1998-2007	2008-2016	Change
	# (%)	# (%)	# (%)	# (%)	
Cleaning Agents	437 (12.5)	59 (4.6)	213 (14.6)	165 (21.3)	+ 363%
Isocyanates	427 (12.2)	246 (19.3)	126 (8.6)	55 (7.1)	- 63%
Metalworking Fluids	325 (9.3)	153 (12.0)	144 (9.9)	28 (3.6)	- 70%
Welding Fume	154 (4.4)	63 (4.9)	62 (4.2)	29 (3.7)	- 24%
Solvents	113 (3.2)	51 (4.0)	52 (3.6)	10 (1.3)	- 68%
Paint	87 (2.5)	18 (1.4)	49 (3.4)	20 (2.6)	+ 86%
Fungus	76 (2.2)	0	41 (2.8)	35 (4.5)	+ 61%
Epoxy	75 (2.1)	33 (2.6)	28 (1.9)	14 (1.8)	- 31%
Formaldehyde	66 (1.9)	33 (2.6)	19 (1.3)	14 (1.8)	- 31%
Acids	65 (1.9)	27 (2.1)	24 (1.6)	14 (1.8)	- 14%
Latex/Rubber	61 (1.7)	25 (2.0)	33 (2.3)	3 (0.4)	- 80%



**FIGURE 3**

**WRA Patients by the Five Most Common Types of Exposures<sup>a</sup> and All of the Other High and Low Molecular Weight Compounds, Trend by 2-Year Time Periods: 1988-2015**



<sup>a</sup>Cleaner=cleaning agents, hmw=high molecular weight agents, iso=diisocyanates, mfg=manufacturing agents, MWF=metal working fluids, office=office exposures, lmw=low molecular weight agents.

## Medical Results-Trends

**SMOKING STATUS** Table 11 shows patients’ cigarette smoking status. Slightly less than 20% of patients were smoking when their asthma developed. This is slightly lower than the state average for 2016 (20.7%) (source, CDC BRFSS results, www.cdc.gov). **SMOKING STATUS OVER TIME:** Table 12 shows the change in cigarette smoking status over time. There was an increase in the percentage of WRA patients who never smoked over time, corresponding with decreases among those who ever or currently smoked cigarettes.

**ALLERGIES AND ASTHMA** Forty-four percent of WRA patients had a family history of allergies (data not shown). Fifteen percent of the asthma patients had a personal history of allergies and asthma (Table 13). Forty-six percent had no history of allergies or asthma.

**HEALTH CARE USAGE** Sixty-five percent of the WRA patients had at least one visit to the Emergency Department (ED) in their lifetime for their work-related asthma, and 35% had at least one hospitalization for their work-related asthma (Table 14). The average number of ED visits was 5.5 and the average number of hospitalizations was 3.7.

**WORK-RELATED ASTHMA DEATHS:** Fortunately, a very small percent (0.01-0.02%) of asthma patients die from asthma. From 2003 to 2008, we have identified eight work-related asthma deaths.

There were no work-related asthma deaths identified in calendar years 2009 through 2014 and in 2016. There was one work-related asthma death in 2015. Case ID OA3828 in the Case Narratives Section (page 33 of the 2015 Annual Report, Tracking WRA in Michigan www.oem.msu.edu) details the events of this WRA death. In addition, we have published articles on some of the work-related asthma deaths<sup>4,5</sup>.

**TABLE 11**  
**Cigarette Smoking Status of 3,383<sup>a</sup>**  
**Confirmed WRA Patients: 1988-2016**

	Smoking Status						TOTAL
	Current		Ex-Smoker		Non-Smoker		
	#	% <sup>b</sup>	#	%	#	%	
OA	242	21.1	442	38.5	463	40.3	1,147
POA	189	15.2	505	40.7	546	44.0	1,240
AA	127	20.8	165	27.0	320	52.3	612
RADS	105	27.3	143	37.2	136	35.4	384
All	663	19.6	1,255	37.1	1,465	43.3	3,383

<sup>a</sup>Missing data on 126 patients.

<sup>b</sup>Percents may not add to 100 due to rounding.

**TABLE 12**  
**Cigarette Smoking Status of Work-Related Asthma Patients by Time Period**

	Time Period				
	All Years	1988-1997	1998-2007	2008-2016	Change
<b>Smoking Status</b>	<b># (%)</b>	<b># (%)</b>	<b># (%)</b>	<b># (%)</b>	
Current	663 (20)	243 (20)	295 (21)	125 (17)	- 15%
Ex-Smoker	1,255 (37)	540 (43)	479 (34)	236 (32)	- 26%
Non-Smoker	1,465 (43)	463 (37)	632 (45)	370 (51)	+ 38%
Total	3,383	1,246	1,406	731	

The percentage of Michigan adult smokers has varied over time, from a high of 27.4% in 1998, to a low of 20.5% in 2010, an increase in 2011 to 23.3%, and a decrease to 20.7% in 2016.

Source:  
[www.cdc.gov](http://www.cdc.gov)

## Medical Results-Trends

**TABLE 13**  
**Personal History of Allergies or Asthma Among 3,205<sup>a</sup> Confirmed WRA Patients: 1988-2016**

	Personal History of...							
	Allergies & Asthma		Asthma Only		Allergies Only		No Allergies or Asthma	
	#	%	#	%	#	%	#	%
OA	60	5.5	53	4.9	325	30.0	645	59.6
POA	83	7.2	55	4.8	402	34.7	617	53.3
AA	330	52.1	273	43.1	13	2.1	18	2.8
RADS	17	5.1	35	10.6	82	24.8	197	59.5
All	490	15.3	416	13.0	822	25.6	1,477	46.1

<sup>a</sup>Missing data on 304 patients.

**TABLE 14**  
**Health Care Usage Among Confirmed WRA Patients: 1988-2016**

Lifetime History of Health Care Usage			
ED Visit <sup>a</sup>		Hospitalized <sup>b</sup>	
Yes	No	Yes	No
# (%)	# (%)	# (%)	# (%)
2,151 (65)	1,137 (35)	1,096 (35)	2,033 (65)
Range		Range	
1-300 visits		1-200 hospitalizations	
AVG 5.5 ±15.0		AVG 3.7±10.0	

<sup>a</sup>Missing data on 221 patients.

<sup>b</sup>Missing data on 380 patients.

### SYMPTOMS

Two thousand seven hundred eighty-seven (2,787) of the patients with WRA had persistence of their asthma symptoms (Table 15). Higher percentages of those *still exposed* continued to have breathing problems and take asthma medicine compared to those *no longer exposed*. Higher percentages of those *no longer exposed* had improved breathing and were taking less medicine.

**SYMPTOMS OVER TIME:** Approximately 70% of the cases were no longer exposed to the agent associated with their WRA and this did not change over time. Among those still exposed to the agent associated with their WRA, there was a trend of less symptom improvement for those still experiencing breathing problems (Table 16). During 1988-1997, 34% of those with breathing problems reported their symptoms were improving, compared to 50% among those no longer exposed; during 2008-2016, 24% of those still exposed reported an improvement in symptoms, compared to 46% among those no longer exposed. Also among those still exposed, there was a decrease among those reporting the need for less asthma medication among those still exposed, with 21% reporting the need for less asthma medication during 1988-1997 compared to 30% among those no longer exposed, and 15% reporting the need for less asthma medication during 2008-2016, compared to 32% among those no longer exposed.

**TABLE 15**  
**Persistence of Symptoms and Medication Use in 3,182 Confirmed WRA Patients: 1988-2016**

Still Exposed?	Total	Breathing Problems Still Present?				Still Taking Asthma Medications?			
		Yes		Less		Yes		Less	
		#	%	#	%	#	%	#	%
Yes	924	884	95.7	271	29.3	805	87.1	165	17.9
No	2,258	1,903	84.3	1,077	47.7	1,772	78.5	652	28.9
Total	3,182 <sup>a</sup>	2,787		1,348		2,577		817	

<sup>a</sup>Information missing on 327 individuals.

Individuals with work-related asthma are often exposed to low levels of a sensitizer for a long period of time before their breathing problems develop.



## Medical Results-Trends

**TABLE 16**  
**Persistence of Symptoms and Medication Use in Confirmed Work-Related Asthma Patients**  
**by Time Period**

Time Period	Still Exposed?	Total	Breathing Problems Still Present?				Still Taking Asthma Medications?			
			Yes #	%	Less #	%	Yes #	%	Less #	%
1988-1997	Yes	339	326	96.2	116	34.2	288	85.0	72	21.2
	No	852	705	82.7	422	49.5	633	74.3	251	29.5
	Total	1191	1031		538		921		323	
1998-2007	Yes	389	376	96.7	109	28.0	336	86.4	64	16.5
	No	923	828	89.7	432	46.8	760	82.3	246	26.7
	Total	1312	1204		541		1096		310	
2008-2016	Yes	196	182	92.9	46	23.5	181	92.3	29	14.8
	No	483	370	76.6	223	46.2	379	78.5	155	32.1
	Total	679	552		269		560		184	
Change	Yes			-3%		-31%		+9%		-30%
	No			-7%		-7%		+6%		+9%

### PULMONARY FUNCTION TESTING

The percentage of WRA patients who had different types of pulmonary function testing over all and by time period is listed below (Table 17). There was a decrease in the percentage of patients who had pre-post bronchodilatation and a methacholine challenge test over time. Too few individuals had peak flow monitoring at work and home, pre-post work-shift testing or specific antigen challenge testing to calculate changes over time.

**TABLE 17**  
**Pulmonary Function Testing of Work-Related Asthma Patients by Time Period**

Test Type	Time Period				
	All Years (%)	1988-1997 (%)	1998-2007 (%)	2008-2015 (%)	Change
Pre-post Bronchodilatation	53	54	54	48	- 11%
Methacholine Challenge	18	25	16	12	- 52%
Peak Flow Monitoring at Work & Home	3	3	3	5	<sup>a</sup>
Pre-post Work-shift	3	2	4	3	<sup>a</sup>
Specific Antigen Challenge	<1	0.9	0.3	—	<sup>a</sup>

<sup>a</sup>Not calculated because the number of individuals with testing was too small.

## Workplace Investigations-Trends

### WORKERS' COMPENSATION

Over all the years of reports, 49% of individuals with work-related asthma applied for workers' compensation benefits; among those, 37% were awarded, 18% were denied and 45% were pending approval.

**WORKERS' COMPENSATION OVER TIME:** The percentage of WRA patients who applied for workers' compensation benefits did not change at all across the time periods: 1988-1997, 1998-2007 and 2008-2016. All time periods showed 49% of patients applying for workers' compensation benefits. However, there were differences in the outcomes of applying for benefits, with an increase in the percentage awarded benefits increasing over the three time periods from 37% to 33% to 45% in the most recent time period. The percentage of claims denied also increased over the time periods, from 16% to 17% to 23% in the most recent time period. Accordingly, the percentage of claims pending approval decreased from 48% to 50% to 31% in the most recent time period.

### INDUSTRIAL HYGIENE

A total of 796 workplace inspections have been conducted since 1988 (Table 18); 123 of those facilities had been inspected more than once. Four inspections have been completed since last year's report.

Air sampling was conducted during 574 inspections (Table 19); 30 (5.3%) of the 567 facilities with a MIOSHA standard for the presumed causal agent were above the enforceable permissible exposure limit.

**TABLE 18**  
**Status of Facilities Where Confirmed WRA Patients Were Exposed to the Suspected Causal Agent: 1988-2016**

<u>Inspection Status</u>	<u># Patients Represented</u>	<u>Companies</u>	
		<u>#</u>	<u>%</u>
Inspected	1,254	796 <sup>a</sup>	31.9
No Follow-up Planned	2,028	1,494	59.8
Scheduled for Inspection	17	17	0.7
Out of Business	79	70	2.8
No Longer Use Occupational Allergen	27	26 <sup>b</sup>	1.0
<u>Sent Company Letter to Check Exposures<sup>d</sup></u>	<u>104</u>	<u>96</u>	<u>3.8</u>
<b>Total</b>	<b>3,509</b>	<b>2,499<sup>c</sup></b>	<b>100.0</b>

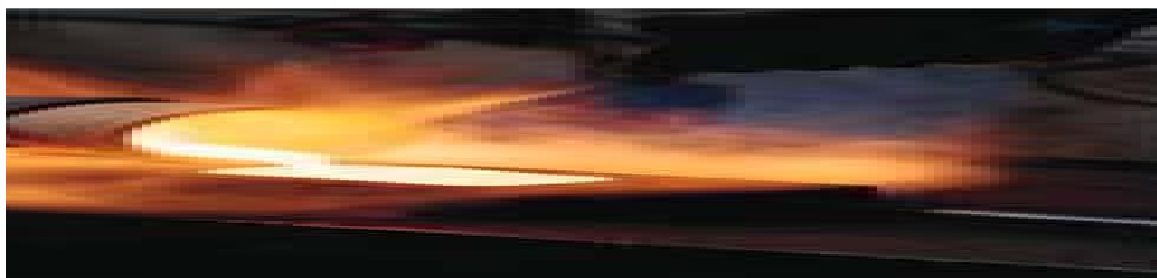
<sup>a</sup>796 inspections were conducted in 673 different workplaces.

<sup>b</sup>Eight companies that no longer use the suspected causal agent were previously inspected.

<sup>c</sup>Represents 2,376 different facilities.

<sup>d</sup>The company was sent information on how to address potential exposures including indoor air issues in their workplace that may be causing respiratory health problems.

It is difficult to track illness among temporary workers, due to the transient nature of their work and the ambiguity of responsibility for reporting their occupational illnesses.



## Workplace Investigations-Trends

**TABLE 19**  
**Air Monitoring Results from 796**  
**Workplace Inspections: 1988-2016**

<u>Air Sampling – NIOSH Standard</u>	<u>#</u>	<u>%</u>
Above NIOSH Standard	69	8.7
Below NIOSH Standard	476	59.8
No NIOSH Standard	31	3.9
Unknown (no report yet)	2	0.3
Did Not Sample for an Allergen	29	3.6
<u>Did Not Sample</u>	<u>189</u>	<u>23.7</u>
<b>Total</b>	<b>796</b>	<b>100.0</b>

<u>Air Sampling – MIOSHA Standard</u>	<u>#</u>	<u>%</u>
Above MIOSHA Standard	30	3.8
Below MIOSHA Standard	537	67.5
No MIOSHA Standard	7	0.9
Unknown (no report yet)	2	0.3
Did Not Sample for an Allergen	31	3.9
<u>Did Not Sample</u>	<u>189</u>	<u>23.7</u>
<b>Total</b>	<b>796</b>	<b>100.1<sup>a</sup></b>

<sup>a</sup>Percentage does not add to 100 due to rounding.

### AIR MONITORING

Table 20 shows the suspected causal agents that were above the NIOSH and/or MI-OSHA limits. The top four allergens found to be above the NIOSH REL were:

- ◆ Formaldehyde
- ◆ Cobalt
- ◆ Styrene
- ◆ Metal Working Fluids

The top four suspected causal agents found to be above the MIOSHA enforceable PEL were:

- ◆ Welding Fume
- ◆ Cobalt
- ◆ Styrene
- ◆ Glutaraldehyde

**TABLE 20**  
**Suspected Causal Agents Above the MIOSHA Permissible Exposure Limit (PEL)**  
**and/or NIOSH Recommended Exposure Limit (REL): Michigan 1988-2016**

<u>Asthma-Causing Agents</u>	<u>Above NIOSH REL</u>		<u>Above MIOSHA PEL</u>	
	<u>#</u>	<u>%</u>	<u>#</u>	<u>%</u>
Formaldehyde	28	41.8	1	3.4
Cobalt	8	11.9	6	20.7
Styrene	6	9.0	4	13.8
Metal-Working Fluids	5	7.5	1	3.4
Glutaraldehyde	4	6.0	3	10.3
HDI	4	6.0	No PEL	--
MDI	3	4.5	0	--
Wood Dust	3	4.5	2	6.9
Chromic Acid	1	1.5	1	3.4
Ethylene Oxide	1	1.5	0	--
Phthalic Anhydride	1	1.5	1	3.4
Starch	1	1.5	0	--
Total Dust (Dry Plant Materials)	1	1.5	0	--
Total Dust (Grinding on Fiberglass)	1	1.5	1	3.4
Welding Fume (Total Particulate)	No REL	--	7	24.1
<u>Flour Dust</u>	<u>No REL</u>	<u>--</u>	<u>2</u>	<u>6.9</u>
<b>TOTAL</b>	<b>67</b>	<b>100.2<sup>a</sup></b>	<b>29</b>	<b>99.7<sup>a</sup></b>

<sup>a</sup>Percentages do not add to 100 due to rounding.

**Workers exposed to asthma-causing agents BELOW permissible limits are developing work-related asthma.**

## Co-Worker Interviews at Workplace Investigations-Trends

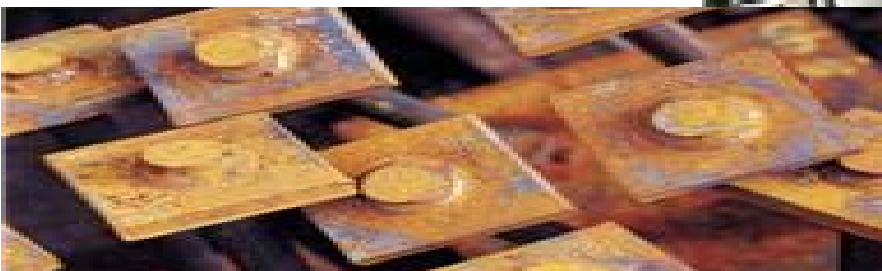
Co-workers were interviewed during 613 of the 796 inspections. Workers had daily or weekly breathing symptoms associated with work or new onset asthma since beginning to work at 397 of the 613 (65%) companies. The average percentage of co-workers with symptoms in these 397 companies was 20.4%. All 1,665 co-workers from the remaining 216 companies reported no daily or weekly breathing symptoms associated with work. One thousand five hundred ninety-eight (1,598) of the 10,373 (15.4%) co-workers interviewed had symptoms consistent with work-related asthma (Table 21). Over time, the percentage of co-workers with breathing problems has decreased.

The MIOSHA Injury and Illness Logs (Form 300) kept by employers listed 585 workers from 136 companies with asthma or asthma-like symptoms. Only 10 workers identified in the interviews with daily or weekly chest tightness, shortness of breath or wheezing were also listed on the MIOSHA Log. Combining the information from the interviews and Injury and Illness Log, a total of 2,183 symptomatic workers were identified during the 796 MIOSHA enforcement inspections.

**TABLE 21**  
**Breathing Symptoms Among Co-Workers of the**  
**3,509 Confirmed WRA Patients:**  
**1988-2016 and by Time Period**

<u>Symptoms</u>	<u>ALL</u>	
	<u>#</u>	<u>%</u>
Daily or Weekly SOB, Wheezing or Chest Tightness	1,598	15.4
Workers Interviewed	10,373	
<b>BY TIME PERIOD:</b>		
1988-1997		17.9
1998-2007		11.9
2008-2016		10.6
Workers on OSHA Log	585	
# Companies Inspected	796	
# Companies w/Ee on Log	136	17.1
<b>BY TIME PERIOD:</b>		
1988-1997		17.4
1998-2007		19.5
2008-2016		8.6
Total Workers w/Symptoms <sup>a</sup>	2,183	

<sup>a</sup>Ten individuals were identified both on the co-worker questionnaire and the OSHA Log.



## Michigan Workforce Exposed to Select Causes of WRA

The United States Environmental Protection Agency (EPA) requires reporting by manufacturers, mines or electrical utilities that have at least 10 employees and use any one of 650 different chemicals in amounts greater than 10,000 pounds per year. Queries of reportable chemicals can be generated to identify state-level statistics.

We identified Michigan's isocyanate-using companies in the EPA Toxic Release Inventory (TRI) to estimate the number of workers employed by manufacturers potentially exposed to isocyanates, one of the most commonly reported causes of WRA in Michigan (Table 22). Our estimate under-counts non-manufacturing-exposed employees such as at auto body paint shops because the EPA does not include non-manufacturing establishments. Conversely, our estimate over-counts manufacturing employees because we included the total number of employees at each facility that reported isocyanates, even though not all workers at these facilities would have worked with or around isocyanates.

Another source to identify chemical exposures associ-

ated with WRA comes from the Michigan Department of Environmental Quality (DEQ). The chemicals listed in the Michigan Facilities' Guide to SARA Title III, Emergency Planning and Release Reporting (December 2007, 6th edition) are subject to reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313, triggered by threshold amounts of 25,000 pounds manufactured or processed or 10,000 pounds otherwise used at Michigan facilities.

Unlike the EPA TRI data, all companies must report if they meet the threshold amount of chemical used; there are no limitations to reporting based on the type of facility or the number of individuals employed.

Between the two reporting sources, there were 111 companies that reported using isocyanates in 2016, which is similar to the 112 companies in 2015. The number of workers employed in companies that use isocyanates, the total number of workers in these counties, and the percentage of workers by county who work in facilities where isocyanates are used is listed in Table 22. The 40,490 workers potentially exposed to isocyanates in 2016 is up from the 39,587 potentially exposed in 2015.

**TABLE 22**  
**Michigan Workers Employed in Manufacturing Facilities in 2016**  
**Where Isocyanates are Used, by County**

County	Company Name <sup>c,d</sup>	# Workers Employed <sup>a</sup> by Isocyanate-Using Facilities	Total # Workers in the County <sup>b</sup>	% Workers Potentially Exposed to Isocyanates
ALLEGAN	HAWORTH INC YAN FENG AUTOMOTIVE INTERIORS PMSC MOTUS INTEGRATED TECHNOLOGIES—MAPLEWOOD	2,890	58,855	4.9
BARRY	BRADFORD WHITE CORP	1,100	29,495	3.7
BAY	QUANTUM COMPOSITES INC	25	49,020	0.1
BERRIEN	LECO CORP NILES STEEL TANK VAIL RUBBER WORKS INC	875	70,085	1.2
CALHOUN	COMCAST URETHANE CONVERIS FLEXIBLES US	173	61,268	0.3
CHARLEVOIX	EAST JORDAN FOUNDRY	504	12,325	4.1
CLARE	LEAR FARWELL PLANT	300	11,072	2.7
CLINTON	RAMPF GROUP	10	38,976	<0.1
CRAWFORD	WEYERHAEUSER	125	4,957	2.5

*Table 22, continued...*

County	Company Name <sup>c,d</sup>	# Workers Employed <sup>a</sup> by Isocyanate-Using Facilities	Total # Workers in the County <sup>b</sup>	% Workers Potentially Exposed to Isocyanates
DICKINSON	GREDE, LLC IRON MOUNTAIN LOUISIANA-PACIFIC-SAGOLA OSB	580	11,846	4.9
EATON	ALLIANCE INTERIORS AXSON N AMERICA GM LANSING DELTA TWP	1,185	54,506	2.2
GENESEE	ASI PACKAGING COMPANY LANDAAL PACKAGING SYSTEMS	88	172,109	0.1
HILLSDALE	DOW CHEMICAL	45	20,089	0.2
HURON	VALLEY ENTERPRISES	265	15,158	1.7
INGHAM	HUNTSMAN ADVANCED MATERIALS S GROUP AUTOMOTIVE WILLIAMSTON PRODUCTS INC	290	142,425	0.2
ISABELLA	DELFIELD CO. UNIFIED BRANDS	900	33,666	2.7
JACKSON	CERTAINTEED MILSCO MICHIGAN SEAT TAC MFG	1,090	70,750	1.5
KALAMAZOO	AZON USA PARKER HANNIFIN CORP-HYDRAULIC SYS STRYKER INSTRUMENTS	3,260	126,566	2.6
KENT	CLIPPER BELT LACING CO GRAND RAPIDS FOAM TECHNOLOGIES HB FULLER LACKS WHEEL TRIM SYSTEMS LEON INTERIORS NA FUELS SYSTEM REMFG PLASAN CARBON COMPOSITES PURFORMS INC RICHWOOD INDUSTRIES INC UNIVAR USA	1,580	337,766	0.5
LENAWEE	ANDERSON DEVELOPMENT INSULSPAN INTEVA PRODUCTS	480	45,142	1.1
LIVINGSTON	ANTOLIN-HOWELL	400	95,768	0.4
LUCE	LOUISIANA-PACIFIC CORP-NEWBERRY SIDING	111	2,239	5.0
MACOMB	AXALTA COATING SYSTEMS CHRYSLER STERLING HTS ASSY FAURECIA INTERIOR SYSTEMS INTERNATIONAL CASTING CORP MOON ROOF GROUP OF MI NEXEO SOLUTIONS NJT ENTERPRISES ROMEO RIM INC SHELBY FOAM SYSTEM WOLVERINE BRONZE	4,567	412,449	1.1
MARQUETTE	ARGONICS—MI PLANT	60	31,395	0.2
MASON	GREAT LAKES CASTING	225	13,435	1.7
MECOSTA	WOLVERINE WORLD WIDE	540	18,017	3.0
MIDLAND	CENTRAL WAREHOUSE –MIDLAND DOW CHEMICAL CO– 1790 BLDG & 1100 BLDG	2,005	39,062	5.1
MISSAUKEE	TJ'S WAREHOUSE	4	6,602	0.1

Table 22, continued...

County	Company Name <sup>c,d</sup>	# Workers Employed <sup>a</sup> by Isocyanate-Using Facilities	Total # Workers in the County <sup>b</sup>	% Workers Potentially Exposed to Isocyanates
<b>MONTCALM</b>	AGA MARVEL KENT FOUNDRY	274	26,421	1.0
<b>MUSKEGON</b>	DIVERSIFIED MACHINE-MONTAGUE	400	73,162	0.5
<b>OAKLAND</b>	ARMALY SPONGE AXSON TECH USA BEHR AMERICA, MAHLE EAGLE INDUSTRIES EXOTIC RUBBER & PLASTICS CORP FANUC ROBOTICS—CORP HDQTRS ITW ENGINEERED POLYMERS LYMTAL INTERNATIONAL INC RECTICEL UREPP N AMERICA	1,564	624,840	0.3
<b>OCEANA</b>	BARBER STEEL FOUNDRY CORP	80	11,411	0.7
<b>OTTAWA</b>	EAGLE PACKAGING INTEX TECHNOLOGIES IZZY PLUS MAGNA MIRRORS ROYAL TECH	1,328	150,038	0.9
<b>SAGINAW</b>	GLASTENDER NEXTEER AUTOMOTIVE CORP POREX TECHNOLOGIES SAGINAW METAL CASTING OPERATIONS STC	4,040	83,808	4.8
<b>SANILAC</b>	GRUPO ANTOLIN MIDWEST RUBBER CO NUMATICS SANDUSKY MAIN TRELLEBORG YSH INC (VIBRACOUSTIC)	784	18,191	4.3
<b>ST CLAIR</b>	IAC PORT HURON IAC ST CLAIR	470	70,017	0.7
<b>ST JOSEPH</b>	IAC MENDON	800	27,900	2.9
<b>VAN BUREN</b>	BASF CORP SPECIAL-LITE INC	182	33,401	0.5
<b>WASHTENAW</b>	EXTANG CORP FAURECIA INTERIOR SYSTEMS	1,800	184,359	1.0
<b>WAYNE</b>	ALPHA RESINS BASF CORP—LIVONIA PLANT BASF CORP—WYANDOTTE PLANT BAY LOGISTICS CHRYSLER JNAP CYGNET AUTOMATED CLEANING EFTEC EQ DETROIT NORTHFIELD MFG INC PLASTOMER CORP WINDSOR MACHINE & STAMPING (US) LTD WOODBIDGE CORP	4,641	729,654	0.6
<b>WEXFORD</b>	REC BOAT HOLDINGS-CRUISER PLANT	450	13,826	3.3
<b>TOTAL</b>		<b>40,490</b>	<b>4,032,071</b>	<b>1.0</b>

<sup>a</sup>Source: 2016 Michigan Manufacturers' Directory.

<sup>b</sup>Source: Michigan Labor Market Information, Data Explorer, [www.milmi.org](http://www.milmi.org) accessed October 29, 2018.

<sup>c</sup>Source: U.S. Environmental Protection Agency, Toxics Release Inventory, Michigan Companies Using Isocyanates in 2016, data accessed October 29, 2018.

<sup>d</sup>Source: MI Dept of Environmental Quality, FOIA Request for SARA Title III Emergency Planning & Release Reporting of isocyanates, for calendar year 2016, received January 17, 2018.

## *Michigan Workforce Exposed to Select Causes of WRA, continued*

Table 23 summarizes the companies, by county, using other chemicals that are known to cause asthma and those that are irritants and capable of causing Reactive Airways Dysfunction Syndrome. Those that can cause asthma are: Bisphenol A, Cobalt, Epichlorohydrin, Formaldehyde, Methyl Acrylate, Methyl Methacrylate, Phthalic and Maleic Anhydride and Styrene. Ammonia and Chlorine are classified as irritants. These companies were identified through the MI DEQ SARA Title III Emergency Planning and Release Reporting for calendar year 2016.

Additional chemical exposures associated with WRA in Michigan can be found in a 2015 report at: [http://www.oem.msu.edu/userfiles/file/Resources/2015\\_MIWorkforceExposedSelectAsthmaCausingAgents.pdf](http://www.oem.msu.edu/userfiles/file/Resources/2015_MIWorkforceExposedSelectAsthmaCausingAgents.pdf)

**TABLE 23**

### Michigan Facilities by County, Reporting Toxic Chemicals to the MI Dept. of Environmental Quality (DEQ) in 2016, Under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA)<sup>a</sup>

**SUBSTANCES CAPABLE OF CAUSING ASTHMA:**

**Acrylates, Anhydrides, Bisphenol A, Cobalt, Epichlorohydrin, Formaldehyde & Styrene**

**SUBSTANCES CAPABLE OF CAUSING REACTIVE AIRWAYS DYSFUNCTION SYNDROME: Ammonia & Chlorine**

**A=Ammonia, B=Bisphenol A, CH=Chlorine, CO=Cobalt, E=Epichlorohydrin, F=Formaldehyde, MA=Maleic Anhydride, M=Methyl Acrylate, MMA=Methyl Methacrylate, P=Phthalic Anhydride, S=Styrene**

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
<b>ALGER</b>	NEENAH PAPER - MICHIGAN INC	A	<b>BAY</b>	WEST BAY COUNTY REGIONAL WASTEWATER	CH
<b>ALLEGAN</b>	BIRDS EYE FOODS LLC	A, CH	<b>BENZIE</b>	GRACELAND FRUIT, INC.	A
	CHS INC-HAMILTON FARM BUREAU	A		PLATTE RIVER ST FISH HATCHERY	F
	CSD	A		SMELTZER ORCHARD COMPANY	A
	DOUGLAS MARINE CORP	S	<b>BERRIEN</b>	ADVANCE PRODUCTS CORP	A
	HUDSONVILLE CREAMERY & ICE CREAM	A		BENTON HARBOR	A
	JBS PLAINWELL, INC.	A		BUCHANAN AGRONOMY & PETROLEUM	A
	OTSEGO, CITY WELLS #3, #4, #5 & WWTP	CH		BUCHANAN WATER & WWTP	CH
	SHERMAN WILLIAMS CO- HOLLAND	A		COLOMA FROZEN FOODS INC	A
	TIARA YACHTS INC	S		FREEZER/REPACK CTR	A
	WATER RENEWAL	CH		GREG ORCHARDS & PRODUCE INC	A
<b>ANTRIM</b>	BFI ELK RAPIDS	A		HANSON COLD STORAGE	A
	JORDAN RIVER NAT FISH HATCHERY	F		LEITZ FARMS	A
<b>ARENAC</b>	WHITESTONE PUMPING STATION	CH		NCP COATINGS	A, P
<b>BARRY</b>	CALEDONIA FARMERS ELEVATOR	A		NEW BUFFALO WATER PLANT	CH
<b>BAY</b>	BAY CITY MUNICIPAL WATER TREATMENT PLANTS	CH		NILES, CITY - DECKER, FORT & FRONT WELLS & IRON REMOVAL	CH
	BAY CARBON INC	CH		OLD EUROPE CHEESE, INC.	A
	MERSEN USA BN. CORP.	CH		SAINT JOSEPH WATER PLANT	CH
	QUANTUM COMPOSITES, INC.	S		SANDVIK MATERIALS TECHNOLOGY	A



Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
<b>BRANCH</b>	QUINCY	CH	<b>GD TRAV- ERSE</b>	CENTREICE	A
	REAL ALLOY RECYCLING	CH		CENTURY SUN METAL TREATING	A
	REAL ALLOY SPECIFICATIONS	CH		CHERRY GROWERS INC	A
	WATER TREATMENT PLT/COLDWATER	CH		HILLSHIRE BRANDS, TRAVERSE CITY	A
<b>CALHOUN</b>	ALBION PLANT	A		MICHIGAN PLANT	A
	ANATECH, LTD.	F		TCS TRAVERSE COLD STORAGE LLC	A
	BATTLE CREEK WATER & WWTP	CH		TRAVERSE CITY	CH
	MARSHALL CITY WATER	CH	<b>GENESEE</b>	A RAGNONE TREATMENT PLANT	CH
	MUSASHI AUTO PARTS-MICHIGAN INC	A		FLINT WATER PLANT	CH
	POST FOODS - BATTLE CREEK	CH		HENDERSON ROAD PUMP STATION	CH
	PRAIRIE FARMS DAIRY, INC.	A		KOEGEL MEATS INC.	A
	RBT J SWALWELL WWTP	CH		STOKES STEEL TREATING CO	A
	WOODWORTH INC	A		WATER POLLUTION CONTROL FAC	CH
<b>CASS</b>	THE MENNEL MILLING CO. OF MI	CH		WOODWORTH INC. FLINT	A
	UNION HIGH SCHOOL	F	<b>GRATIOT</b>	ALMA WASTEWATER PLANT	CH
<b>CHEBOYGAN</b>	CHEBOYGAN WELLHOUSE #4 & #7 & WWTP	CH		ASHLEY SITE	A
<b>CHIPPEWA</b>	PENDILLS CREEK NFH	F		CITY OF ST. LOUIS WWTP	CH
	SULLIVAN CREEK NFH	F		NH3 TANK	A
<b>CLINTON</b>	CROP PRODUCTION SERVICES 622	A	<b>HILLSDALE</b>	BEF FOODS INC.	A
	MAHLE ENGINE COMPONENTS USA, INC.	A		CONAGRA FOODS INC	A
	MARTIN BROWER	A		HILLSDALE WWTP	CH
	MICHIGAN MILK PRODUCERS ASSOC	A		PRATTVILLE FERTILIZER & GRAIN	A
	SAVE-A-LOT LTD	A		THE ANDERSONS LITCHFIELD FARM	A
	SCCMUA	CH	<b>HOUGHTON</b>	MICHIGAN-AMERICAN WATER CO	CH
	WASTEWATER TREATMENT FACILITY	CH		KOPPERS PERFORMANCE CHEM- ICALS	A
<b>CRAWFORD</b>	ARCTIC GLACIER INC	A	<b>HURON</b>	BAD AXE WWTP	CH
<b>DELTA</b>	VERSO	A, CH		COOPERATIVE ELEVATOR	A
<b>EATON</b>	AXSON NORTH AMERICA INC.	S		DOW AGROSCIENCES LLC	A
	ETM ENTERPRISES INC.	S		FARMERS CO-OP GRAIN CO.	A
	LANSING PLANT	A, CH		HARBOR BEACH WATER WORKS & WWTP	CH
	MEIJER LANSING DISTRIBUTION	A		THUMB TOOL & ENGINEERING	A
	SP KISCH IND	A	<b>INGHAM</b>	ALDI INC - WEBBERVILLE	A
<b>EMMET</b>	ODEN STATE FISH HATCHERY	F			

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
<b>INGHAM</b>	ARCTIC GLACIER—LANSING	A	<b>KALAMA-ZOO</b>	CITY OF KALAMAZOO- STATIONS #28,#39	CH
	AURORA SPECIALTY CHEMISTRIES	E		HAVILAND PRODUCTS COMPANY	F
	CREMER FARM CENTER, INC.	A		KALAMAZOO WATER DIV/STA #1-#5, #8, #9, #11, #12, #14, #17, #18, #22, #24, #25, #31	CH
	DYE WATER CONDITIONING PLANT	A		KLC-2	A
	E LANSING-MERIDIAN WATER & SEWER	A		KNAPPEN MILLING CO	CH
	JORGENSEN FARM ELEVATOR	A		PHARMACIA & UPJOHN LLC	A, CH, E, F
	LANSING MINT RD.	A		PRECISION HEAT TREATING COMPANY	A
	MASON P.O.T.W. PLANT	CH		RICHARD-ALLAN SCIENTIFIC	F
	MICHIGAN STATE UNIVERSITY	A, CH		WESTERN MICHIGAN UNIVERSITY	A
	NITREX INC - MICHIGAN OPERATION	A	<b>KENT</b>	29th STREET WAREHOUSE	S
	SYMMETRY MEDICAL INC-LANSING	CO		ARKEMA INC.	B,P,S
	THE ANDERSONS WEBBERVILLE	A		BODYCOTE- GRAND RAPIDS	A
	WATER TREATMENT PLANT	CH		BRENN'TAG GREAT LAKES LLC	F
<b>IONIA</b>	BELDING TANK TECHNOLOGIES, INC	S		BRETON INDUSTRIAL PARK WAREHOUSE	B,S
	CARGILL KITCHEN SOLUTIONS	A		CHASE STORAGE & CHASE ORCHARDS	A
	FARM DEPOT 3 LTD	S		COCA-COLA GRAND RAPIDS	A
	GALLAGHERS	A		COUNTRY FRESH LLC	A
	HERBRUCKS POULTRY RANCH	A		EAGLES ICE CENTER	A
	PORTLAND WWTP	CH		FINISHMASTER INC #990 DIST CR	S
	STAHLIN ENCLOSURES	S		FORTY-FOURTH STREET FACILITY	A
	THK RHYTHM AUTOMOTIVE	A		FRUIT RIDGE APPLE CO	A
	TWIN CITY FOODS	A, CH		GM COMPONENTS HOLDINGS, LLC	A
<b>IOSCO</b>	HURON SHORE REGIONAL UTILITY A	CH		GORDON FOOD SERVICE	A
	ROSE ICE COMPANY	A		GRANDVILLE	A, CH
	TAWAS UTILITY AUTHORITY WWTP	CH		HEEREN BROS	A
	TIP-TOP SCREW MFG IN	A		JACK BROWN PRODUCE INC	A
<b>JACKSON</b>	CITY OF JACKSON WATER TREATMENT	CH		KENT QUALITY FOODS INC	A
	COVENTRY PARK	CH		KING MILLING COMPANY	CH
	GRASS LAKE ENGINEERING FAC.	A		LACKS TRIM SYSTEM - AIRLANE PLANT	F
	INDUSTRIAL STEEL TREATING	A		LACKS WHEEL SYSTEMS	F
	JCC WELL HOUSE	CH		LOWELL WWTP & WATER TREATMENT	CH
	KIMMEL ROAD WELL HOUSE	CH		MICHIGAN NATURAL STORAGE CO	A
	MEADOW HEIGHTS WELL	CH		MICHIGAN TURKEY PRODUCERS	A
	SOUTHVIEW PUMP STATION	CH		MONROE, LLC	MMA
	WESTCHESTER PUMP STATION	CH		NBHX TRIM USA	S
<b>KALAMA-ZOO</b>	BELL'S BREWERY	A		NORTH RIDGE ORCHARD	A
				PATTERSON ICE CENTER	A

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
<b>KENT</b>	PLASTIC PLATE INC (KRAFT)	F	<b>MACOMB</b>	AXALTA COATING SYSTEMS	B,M,MMA,S
	REMICO STREET FACILITY	CH, F		BOSCOS PIZZA	A
	S1	A		CARBIDE TECHNOLOGIES	A
	SPARTA FACILITY	A		EVERFRESH / LA CROIX BEVERAGES	A
	SPARTAN NASH DISTRIBUTION	A		EXCO EXTRUSION DIES INC	A
	SUPERIOR SEAFOOD INC.	A		FORMSPRAG LLC	A
	SUPERIOR STONE PRODUCTS INC	MMA, S		GM WARREN LLC TECHNICAL CENTER	A
	SYSCO GRAND RAPIDS, LLC	A		METALLURGICAL PROCESSING CO	A
	THE HOME CITY ICE CO	A		NITRO-VAC HEAT TREATING	A
	UNIVAR USA	B		NORBROOK PLATING	A
	VI-CHEM CORPORATION	S		REINHART FOODSERVICE LLC	A
VILLAGE OF SPARTA WWTP & WATER DEPT	CH	RIVIERA BUILDING 2	A		
WYOMING CLEAN WATER PLANT	CH	SPECIALTY STEEL TREATING, INC.	A		
<b>KEWEENAW</b>	SUSANS FARM	A	<b>MAR-QUETTE</b>	TURRI'S ITALIAN FOODS, INC	A
	YOUNG'S FARMS	A		KI SAWYER WWTP	CH
<b>LAPEER</b>	LAPEER PLATING & PLASTICS	F	<b>MASON</b>	HOUSE OF FLAVORS INC	A
<b>LEELANAU</b>	CHERRY GROWERS-PLT 2	A		JOS. SANDERS INC	A
<b>LENAWEE</b>	ADC MAIN PLANT	MA,MMA,S		LUDINGTON WASTEWATER PLANT	CH
	AIRGAS CARBONIC, INC	A		MICHIGAN FOOD PROCESSORS	A
	CROP PRODUCTION SVCS 634 & 641	A		NORON COMPOSITE TECHNOLOGIES	MMA,S
	DAIRY FARMERS OF AMERICA	A	<b>MECOSTA</b>	LEPRINO FOODS COMPANY REMUS	A
	WAR-AG FARMS SERVICES LLC	A		UNITED STATES MARBLE INC.	S
	WELLHOUSE #3 #8—#12 & #14	CH	<b>MENOMINEE</b>	L.E. JONES COMPANY	CO
WILBUR-ELLIS COMPANY - MUNSON	A		MENOMINEE WATER & WWTP	CH	
<b>LIVINGSTON</b>	AMERICAN COMPOUNDING SPECIALTIES	MA	<b>MIDLAND</b>	CITY OF MIDLAND - WATER & WWTP	CH
	ASAHI KASEI PLASTICS NA	MA		DOW- MICHIGAN OPERATIONS	A, CH, S
	CHEMCO PRODUCTS, INC.	F		MIDLAND STORE	A
	COR-MET INC	CO		TRINSEO, LLC MICHIGAN OPERATIONS	MMA,S
	GORDON FOOD SERVICE	A	<b>MONROE</b>	ADVANCED HEAT TREAT CORP	A
	GREEN OAK DC	A		DETROIT EDISON - MONROE POWER PLT	A
	PEPSI HOWELL	A		GUARDIAN INDUSTRIES CORP	A
	WATER PLANT & WWTP	CH		HOME CITY ICE COMPANY- Toledo	A
<b>LUCE</b>	NEWBERRY WWTP	CH		INDEPENDENT DAIRY INC	A
<b>MACKINAC</b>	MACKINAW ISL. WATER TREATMENT	CH		MAYBEE FARMERS INC	A
	ST IGNACE WATER PLANT	CH		MEIJER NEWPORT DISTRIBUTION	A
				OTTAWA LAKE CO-OP ELEVATOR	A

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
<b>MUSKEGON</b>	BAYER CROPSCIENCE USA	A	<b>OAKLAND</b>	VILLAGE OF MILFORD-IRON REMOVAL PLANT	CH
	COLE'S QUALITY FOODS, INC.	A		WATERFORD IRON REMOVAL 5-1, 12-1, 14-1, 16-1 & 2, MS-1, 19-1, 24-1, 25-1 & 2, 28-1,31-1	CH
	GMI COMPOSITES, INC	S		WOODWORTH INC PONTIAC	A
	HOWMET CORP - PLT 5	B	<b>OCEANA</b>	2ND STREET STORAGE	A
	L-3 COMBAT PROPULSION SYSTEMS	A		ARBRE FARMS CORPORATION	A
	PARAMELT (M. ARGUESO)	B		HART DIVISION	A
	SNAPPY APPLE FARMS INC	A		MICHIGAN FREEZE PACK	A
	SUN CHEMICAL CORPORATION	A		OCEANA CTY FREEZER STORAGE	A
	WEBB CHEMICAL SERVICE CORP	F		PETERSON FARMS MAIN CAMPUS	A
<b>NEWAYGO</b>	GERBER PRODUCTS COMPANY	A	<b>OGEMAW</b>	SANDVIK HARD MATERIALS	CO
<b>OAKLAND</b>	BEHR AMERICA INC (MAHLE)	A	<b>OSCEOLA</b>	ADVANCED FIBERMOLDING	S
	CHEMICAL BLENDING	F		VENTRA EVART, LLC	F
	CHOR INDUSTRIES	A		YOPLAIT REED CITY	A
	COMMERCIAL STEEL TREATING	A	<b>OTSEGO</b>	GAYLORD	CH
	DEPOR INDUSTRIES	B,F	<b>OTTAWA</b>	ALLENDALE PLANT	A
	DETROIT SKATING CLUB	A		BOAR'S HEAD PROVISIONS CO INC	A
	DETROIT STEEL TREATING CO.	A		BODYCOTE-HOLLAND	A
	ENGINEERED HEAT TREAT INC	A		BROWN'S FARM	A
	FARMINGTON HILLS ICE ARENA	A		CREME CURLS BAKERY, INC.	A
	GENERAL MOTORS - PROVING GD	CH		DIETRICH ORCHARDS	A
	HAZEL PARK VIKING ARENA	A		GEORGETOWN ICE CENTER	A
	JOHN LINDELL ICE ARENA	A		GOOD FRUIT STORAGE	A
	LAKELAND ARENA	A		HLC2-HUDSONVILLE	A
	MACDERMID INCORPORATED	F		J.B.SIMS GENERATING STATION	CH
	MATHESON VALLEY	A		JOHN F. DONNELLY PLANT	A
	NOVI ICE ARENA	A		LEO DIETRICH & SONS	A
	OERLIKON	A		MEAD JOHNSON AND CO LLC	CH
	ONYX-ROCHESTER ICE ARENA	A		MICHIGAN CELERY PROMOTION	A
	RMT WOODWORTH, SOUTHFIELD	A		MIEDEMA PRODUCE INC.	A
	SPECIALTY STEEL TREATING INC	A		POLYPLY COMPOSITES LLC.	S
	STONE SOAP COMPANY INC	F		QUINCY STREET, INC	A
	SUBURBAN ICE TRAINING CENTER	A		RYDER HOLLAND LOGISTIC CTR	A
	SULZER METCO (US) INC	CO		SUPERIOR SALES INC	A
	SUN STEEL TREATING INC	A		VERTELLUS HLTH SPEC PROD.	A,MA
	US FOODS INC.	A		ZEELAND FACILITY	A
	VILLAGE OF HOLLY WWTP	CH		ZEELAND FARM SERVICES, INC	A
			<b>SAGINAW</b>	ADVANCED MICRONUTRIENT PRODUCTS INC	A

*Table 23, continued...*

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
SAGINAW	BRIDGEPORT WWTP	CH	VAN BU-REN	FRUIT BELT CANNING COMPANY INC	A
	BUENA VISTA WWTP	CH		GRAND JUNCTION FACILITY	A
	DOW CORNING CORPORATION - HEALTHCARE IND MFG	A		HARTFORD WAREHOUSE	A
	FRANKENMUTH CITY OF WATER & WWTP	CH		IQF FACILITY	A
	HI-TECH STEEL TREATING, INC.	A		LAWRENCE FREEZER CORP.	A
	NEXTEER AUTOMOTIVE	A		PAW PAW RIVER PRODUCE	A
	THOMSON AEROSPACE & DEFENSE	A		PAW-PAW PLANT	A
	WATER & WWTP, SAGINAW CHARTER TWP	CH		RYDER PAW PAW LOGISTIC CTR	A
	WINFIELD SOLUTIONS LLC	A		SHAFER LAKE FRUIT, INC	A
SANILAC	CROSWELL WATER PLANT	CH	WASHTENAW	SILL FARMS MARKET, INC	A
	DGP INCORPORATED	S		ST. JULIAN WINE COMPANY INC	A
	LAKE HURON PUMP STATION	CH		WELCH FOODS, INC.	A
	MIDWEST RUBBER CO.	CH		ANN ARBOR, CITY OF WPP	A
SHIAWASSEE	AIRGAS SPECIALTY PRODUCTS - OWOSSO	A	WAYNE	ANN ARBOR ICE CUBE	A
	HARVEST MILLS	A		ARBOR HILLS ENERGY LLC	A
	MACHINE TOOL & GEAR, INC.	A		ARCTIC GLACIER INC	A
	MICHAEL BENJAMIN	A		CHELSEA MILLING CO	CH
ST CLAIR	DUNN PAPER, INC.	CH	WAYNE	CROP PRODUCTION SERVICES	A
	LK HURON WATER TREATMENT	CH		DAPCO INDUSTRIES	A
	Z F MARYSVILLE AXLE DRIVES	A		ELECTRO ARC MFG. COMPANY	A
ST JOSEPH	ABBOTT NUTRITION - STURGIS	A	WAYNE	UNIVERSITY OF MICHIGAN	A
	AQUATIC CO.	S		3M DETROIT ABRASIVES	F
	MENDON UNIT 635	A		A&R PACKING CO INC	A
	MICHIGAN MILK PRODUCERS	A		ARCTIC COLD STORAGE	A
	STURGIS WWTP	CH		ARCTIC EDGE ICE ARENA	A
	THREE RIVERS WWTP	CH		BASF CORPORATION	MMA, S
TUSCOLA	CARO WWTP	CH	WAYNE	BODYCOTE THERMAL PROCESSING	A
	CASS CITY WWTP	CH		BRENNTAG GREAT LAKES LLC	A
	FARM DEPOT	S		C. F. BURGER CO	A
VAN BU-REN	ALBERMARLE CORP.	A	WAYNE	CANTON	A
	ALLOY STEEL TREATING CO INC	A		CANTON RENEWABLES	A
	CITY OF SOUTH HAVEN, WWTP	CH		CARDINAL HEALTH	F
	COCA COLA REFRESHMENTS	A		CHRYSLER-JEFFERSON NORTH ASSY	E, F
	DECATUR	A		CLASSIC PLATING	A

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
WAYNE	COOPER HEAT TREATING LLC	A	WAYNE	NORTHEAST WATER PLANT	CH
	COSTCO WHOLESALE	A		PEPSI BOTTLING GROUP	A
	COUNTRY FRESH, LLC - LIVONIA	A		POLYCHEMIE INC	F
	CREST INDUSTRIES INC	S		PRAXAIR DISTRIBUTION INC	A,CH
	DAIRY FRESH FOODS INC	A		PVS TECHNOLOGIES, INC.	CH, F
	DEARBORN ICE SKATING CENTER	A		S & F FOODS	A
	DETROIT PRODUCTION CENTER	A		SANTEMP	A
	DETROIT WWTP	CH		SMX MANUFACTURING	A
	DRDC	M		SOUTHWEST WATER PLANT	CH
	DYNAMIC SURFACE TECHNOLOGIES INTERNATIONAL	A		SPRINGWELLS WATER TREATMENT PLT	CH
	EDDIE EDGAR ARENA	A		SYSCO DETROIT, LLC	A
	FAYGO BEVERAGES INC.	A		TRENTON CHANNEL POWER PLANT	A
	FREEZER & DRY STORAGE LLC	A		TRENTON, CITY OF WWTP	CH
	FREEZER SERVICES OF MI LLC	A		UNIVAR USA—ROMULUS	MA
	FRITZ PRODUCTS	CH		USA HOCKEY ARENA	A
	HOME CITY ICE COMPANY - DETROIT	A		WATER WORKS PARK PLANT	CH
	INLAND WATERS POLLUTION CONTROL, INC.	S		WESTLAND MANUFACTURING	MMA, S
	JCI JONES CHEMICALS INC.	CH		WOLVERINE PACKING COMPANY DIST PLT & LAMB & VEAL PLANT	A
	KENNEDY RECREATION CENTER	A		YACK ARENA	A
LINCOLN DISTRIBUTING	S	WEXFORD	AAR MOBILITY SYSTEMS	F	
MASTRONARDI PRODUCE	A		CADILLAC	CH	
MCGEAN-ROHCO, INC.	F		FOUR WINNS-CRUISER DIVISION	MMA, S	
MCLANE FOOD SERVICE - PLYMOUTH	A		FOUR WINNS-SPORT DIVISION	S	
MICHIGAN DAIRY	A		HARING TOWNSHIP WATER SUPPLY	CH	

<sup>a</sup>Source: Michigan Department of Environmental Quality (DEQ). Michigan Facilities' Guide to SARA Title III, Emergency Planning and Release Reporting, December 2007, 6th edition. The chemicals listed in this table are subject to reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) section 313, which is triggered by threshold amounts of 25,000 pounds manufactured or processed or 10,000 pounds otherwise used at facilities in Michigan. The companies listed in this table were current as of calendar year 2016 from a report generated by the Michigan DEQ on 1/17/18.

## Discussion

The consensus in the medical literature is that the true number of WRA cases is much greater than what is actually reported in public health surveillance systems, including Michigan's. The American Thoracic Society (ATS) released a consensus statement in 2003 that estimates in 15% of adults with asthma, the asthma is caused by work exposures.<sup>6</sup> In 2011, a second ATS consensus statement estimated 21.5% of adults with asthma have work-aggravated asthma.<sup>7</sup> The combined estimates from these consensus statements would indicate that 36.5% of all adult asthma is work-related.

For the years 2008-2010, 52.5% (95% CI 48.2-56.8%) of Michigan adults who were ever employed and currently have asthma reported that a health care provider told them or they told a health provider their asthma was caused or made worse by exposures at work.<sup>1</sup> Table 24 shows how this percentage varied by age, gender, race, annual income and education. Among those individuals who responded their asthma was caused or made worse by work, only 22% had a discussion about work's effect on their asthma with their health care provider.<sup>1</sup> At minimum, the data suggest that providers are not addressing concerns of their patients and probably missing the identification of WRA triggers. Because of the frequency in which work exposures are a factor in adults with asthma, the American College of Chest Physicians Consensus Statement concluded that: "The substantial prevalence of WRA supports consideration of the diagnosis in all who present with new-onset or worsening asthma, followed by appropriate investigations and intervention including consideration of other exposed workers."<sup>10</sup>

National data showed that individuals with work-related asthma had higher mean numbers of days with asthma symptoms. Individuals with more days of symptoms were more likely to not be able to work or perform usual activities.<sup>8</sup>

On average, from 1989-2014, 128 cases each year are reported to the Michigan Department of Licensing and Regulatory Affairs (LARA) with confirmed WRA. In recent years, the number of reports has decreased. More recently, 70-80 reports have been confirmed each year. The number of individuals with exposure to a

known occupational sensitizer (disease category OA) shows a downward trend since the 1990s. The reason for this trend is unknown and may be related to changes in reporting sources or to the success of workplaces in better controlling their employees' exposures to known sensitizers.

Based on responses from the 2005 BRFSS random sample of Michigan residents, we estimate that up to 62,000 (95% CI 42,000-83,000) Michigan adults have their asthma caused or aggravated by work.<sup>1</sup> Based on the medical literature we would estimate that there are 97,500 Michigan adults with WRA.<sup>6</sup> Using capture-recapture analysis, we estimate 228-801 adults in Michigan develop WRA each year.<sup>9</sup> Table 24 shows the characteristics of Michigan adults with asthma attributable to work, based on a telephone survey. These characteristics are similar to that found in the cases of WRA identified through our surveillance system.

Workers who are reported are generally young to middle-age Caucasian men and women, with the greatest number being reported from the Detroit metropolitan area. However, the rate of WRA in African Americans is 2 times greater than among Caucasians. Based on an analysis conducted for previous annual reports, factors from the WRA surveillance data that would contribute to greater morbidity among African Americans include: a greater likelihood to continue to be exposed to the workplace agent, having a longer time of exposure before leaving work, and being less likely to receive Workers' Compensation.

As companies trim costs, more temporary workers are being hired on an as-needed basis. The transient nature of temporary work underscores the potential for undercounting of cases of WRA when employees move from job to job, especially those jobs that have a high potential for exposure to sensitizing agents.

Individuals in the Michigan workforce develop their asthma from exposure to agents in the manufacturing sector, particularly automobiles, machinery, metals, chemicals, and rubber and plastics. The predominant causes of WRA are cleaning products (12.5%), isocyanates (12.2%) and metal working fluids (9.3%). Until recently, metal working fluids were the second most frequently reported exposure, and until this year isocyanates were the most frequently reported exposure.

The trend of fewer individuals with the known causes of WRA such as isocyanates, metal-working fluids and high molecular weight compounds would suggest improvements in controls when these agents are used since the number of facilities using isocyanates has increased. The increase in cases secondary to office settings and in services, and the increase in WRA secondary to cleaning agents suggests that exposures in these situations have proven more difficult to control (Figure 3) as well as increased workers in service industries.

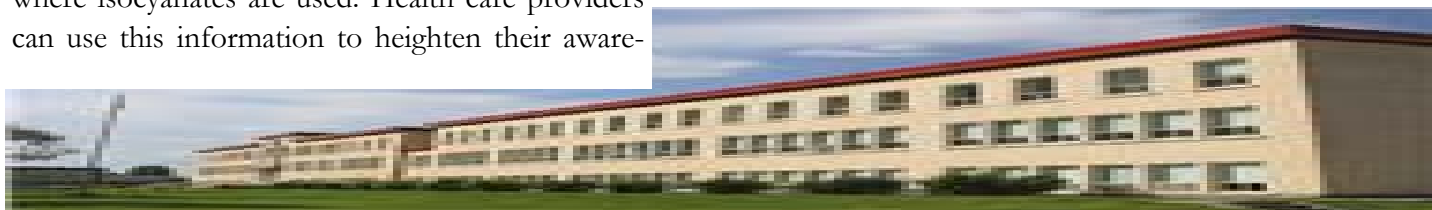
Cleaning agents are one of the major exposures associated with work-related asthma. Because of concern about the hazards of cleaning agents, not just concern about their potential to cause or aggravate asthma, individual companies have begun to list the ingredients of their products (Unilever, Procter & Gamble and SC Johnson). In a move that will provide even greater information about the ingredients of cleaning agents, New York State has promulgated a rule that covers all soaps and detergents sold in New York that contain a surfactant as a wetting or dirt emulsifying agent and are used primarily for domestic or commercial cleaning purposes, including but not limited to the cleansing of fabrics, dishes, food utensils and household and commercial premises. The rule will require manufacturers to list ingredients intentionally added to cleaning products on their webpage, that are present above trace quantities, by July 1, 2019. Fragrance and nonfunctional ingredients, such as byproducts and contaminants, must be disclosed by July 1, 2020.

We updated the table first presented in the 2002 Work-Related Asthma Annual Report (Table 22) on the number of manufacturing workers in companies that use isocyanates. In Allegan, Dickinson, Luce, Midland and Saginaw counties, approximately 5% of the work force is employed in facilities where isocyanates are used. Health care providers can use this information to heighten their aware-

**TABLE 24**

**Proportion of Asthma Attributable to Work Among Michigan Adults Who Were Ever Employed and Who Currently Have Asthma, Michigan Asthma Call Back Survey, 2008-2010 Combined**

AGE in years	Proportion, %	95% Confidence Interval
18-34	39.9	29.6-51.1
35-64	61.8	57.5-65.9
>=65	43.8	38.3-49.5
<b>GENDER</b>		
Male	54.7	46.3-62.8
Female	51.4	46.5-56.2
<b>RACE</b>		
White	50.5	45.7-55.2
Black	58.9	46.7-70.1
<b>ANNUAL INCOME</b>		
<\$20,000	60.6	51.1-69.3
\$20,000-\$34,999	60.3	50.6-69.1
\$35,000-\$49,999	51.4	41.2-61.5
\$50,000-\$74,999	54.7	42.2-66.7
>=\$75,000	44.8	37.8-52.0
<b>EDUCATION</b>		
< High School	62.6	46.7-76.3
High School Graduate	57.4	49.1-65.3
Some College	51.1	43.4-58.7
College Graduate	48.7	41.7-55.8





ness of potential exposures to isocyanates among their patients with asthma.

Table 23 shows selected agents by county and company that have been associated with WRA. Health care providers can use this table as an initial step in evaluating possible exposure for their patients if they work at one of the facilities listed.

Asthma symptoms may persist despite removal from the precipitating work exposures (Tables 15 & 16). Studies show that the sooner an individual is removed from the exposure after symptoms develop, the more likely the individual's symptoms will resolve.<sup>10</sup> On the average, among the 2,258 individuals who are no longer exposed to the causal agent, almost three years elapse from onset of respiratory symptoms at work to date last exposed. We do not have data on how much of this delay is secondary to the individual not seeking medical care and how much is related to the physician not recommending that the individual leave the exposure.

Data from the United Kingdom estimated that when medical care and lost time are factored in, the work-related asthma costs were 100 million dollars per year with 49% of the cost borne by the patient, 48% by the State and only 3% by the employer.<sup>11</sup> We do not have cost estimates for Michigan, but given the fact that only 49% of individuals applied for Workers' Compensation benefits and we do not have universal health insurance as in the United Kingdom, we suspect that the individual patients in Michigan bear a high percentage of the costs associated with work-related asthma.

Personal habits like cigarette smoking and individual susceptibility measured through personal or family history of allergies do not predict who develops WRA. About 50% of the WRA patients identified through the Michigan Tracking System have no personal or family history of allergies and 80% are not smoking cigarettes at the time their asthma symptoms develop (Tables 11,13).

Although most facilities where the patient developed asthma were in compliance with exposure standards, there were high percentages of symptomatic co-workers identified in those facilities. It is possible that either air sampling was not conducted under similar enough conditions as the exposures associated with the development of the index cases' asthma, such as spills or leaks,

or that the current standards are not protective enough.

We identified 1,598 fellow workers with symptoms compatible with WRA (Table 21). Five hundred eighty-five individuals were listed on the MIOSHA Injury and Illness Log (Form 300) as having WRA or symptoms compatible with WRA. There was only an overlap of 10 individuals of co-workers reporting symptoms on co-worker interviews and those being reported on the MIOSHA Log. Part of the reason for the lack of overlap is that half of the symptomatic individuals indicate they have never seen a doctor for their respiratory symptoms.

Medical monitoring is particularly relevant to reducing the burden of work-related causes of asthma. The longer a person with asthma remains exposed, the more likely their asthma will become a chronic problem.<sup>10</sup> A review of companies using isocyanates showed that only 32% were providing periodic medical surveillance.<sup>12</sup>

The percentages of individuals reported with work-related asthma that this surveillance system documented with breathing tests performed in relation to work was less than 10%. This reflects the standard of medical care in the United States where the diagnosis of WRA is made from the patient's history. More frequent use of objective pulmonary function testing performed in relation to work would allow health care providers to feel more confident when they should advise their patients to leave their work exposure.

Cessation of exposure is the most important aspect of treatment; patients who are removed from exposure the soonest have the best prognosis.<sup>10</sup> Effective asthma treatment requires that the health care providers consider a patient's asthma triggers. Many times, the health care provider reacts to concerns that their patient raises about workplace exposures, rather than proactively inquiring whether their patient has triggers at work that contribute to their respiratory symptoms. One of the factors related to a 2005 death caused by isocyanate exposure was that the primary care physician waited until the patient requested a medical restriction, rather than instruct-

ing the patient at an earlier time that he needed to be removed from any further exposure to isocyanates at work.

The report of a patient with known or suspected WRA is a sentinel health event that is critical to effective occupational disease surveillance. Case reporting from physicians offers the opportunity for the most timely workplace interventions, compared to receiving reports from hospitals.

Reporting can be done online at [www.oem.msu.edu](http://www.oem.msu.edu), via email at [ODREPORT@ht.msu.edu](mailto:ODREPORT@ht.msu.edu), via fax at 517-432-3606, via telephone at 1-800-446-7805, or mailed to MIOSHA, Technical Services Division, PO Box 30649, Lansing, MI 48909-8149. Reporting forms can be found online at [www.oem.msu.edu](http://www.oem.msu.edu) or by call the toll free number, 1-800-446-7805.

With continued support and increasing awareness of WRA by physicians and other health professionals, we can continue to provide timely intervention in the workplace, offer suggestions for reducing workplace exposures even if they are below the current permissible exposure limits, document the need for the development of new standards, identify new occupational allergens, and prevent co-workers from developing disease.

The potential that 54% of Michigan adults with asthma report work causes or aggravates their work-related asthma emphasizes the importance that health care providers and all asthma initiatives planned on surveillance and education, both for health care providers and the public address the importance of work exposures in diagnosing and managing asthma in adults.

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# APPENDIX

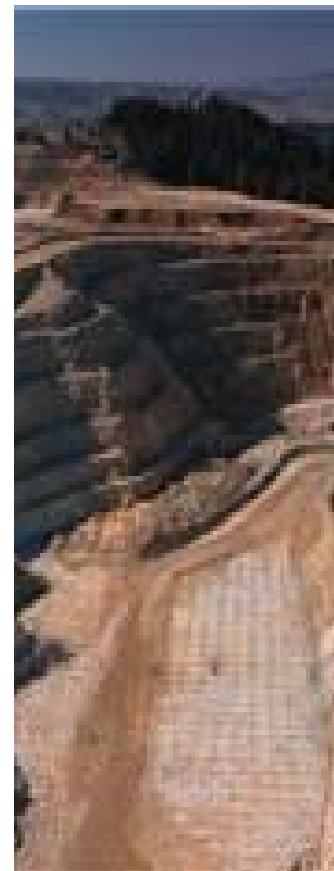
## 2016 PATIENT NARRATIVES BY TYPE OF INDUSTRY & EXPOSURE

Abbreviations:

- OA = Occupational Asthma with Exposure to a Known Sensitizer
- POA = Possible Occupational Asthma, Work-related Symptoms, but Exposure is not a Known Sensitizer
- AA = Aggravated Asthma (Pre-Existing Asthma Exacerbated at Work)
- RADS = Reactive Airways Dysfunction Syndrome

*The patient narratives that follow are based on information collected from interviews and medical records of patients reported with work-related asthma.*

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## MANUFACTURING

### Exposure to Isocyanates

OA3889. A male in his 30s developed work-related asthma after four years of exposure to toluene diisocyanate (TDI). He was a de-molder at an automotive foam parts manufacturer. He experienced wheezing, chest tightness, shortness of breath and a cough, and was prescribed Albuterol, Advair and Prednisone. On spirometry, his FVC was 94% of predicted, FEV1 was 88% of predicted, and his FEV1/FVC was 70% of predicted. He had two trips to the emergency room. He described his work area as having no proper ventilation, especially in the spring and winter when the outside doors of the factory were closed. Over ten years since his asthma was diagnosed, the factory added a new ventilation system and provided respirators. Since these changes, his asthma improved and he required less asthma medication. He was a lifelong non-smoker.

OA3897. A female in her 30s developed work-related asthma shortly after beginning to work at an automotive door and console manufacturer. She was exposed to glue containing isocyanates when she ran glue on materials. She wore a mask and gloves. She experienced wheezing, shortness of breath, a cough and chest tightness. She was prescribed Dulera, Prednisone and Albuterol. She continued to work at this job; her asthma worsened and she required a greater amount of asthma medication. She was a lifelong non-smoker.

AA3800. A female in her 50s experienced an exacerbation of her pre-existing asthma after working in human resources in a polymer plant. She was exposed to isocyanates from the plant's research and development lab located on the floor below her office. She experienced wheezing, cough, chest tightness and short-

ness of breath. She was prescribed albuterol, Proventil, an oral steroid and Pulmicort. On spirometry, FVC was 97% of predicted, FEV1 was 97% of predicted and FEV1/FVC was 79% of predicted. She left this job six months later. Her symptoms improved 6 months later and she required less medication. She was a lifelong non-smoker.

OA3899. A male in his 50s developed work-related asthma after working in an automotive interior parts manufacturer for five years. He was exposed to isocyanates used for gluing fabrics. He developed wheezing, cough, shortness of breath and chest tightness. He was prescribed Flovent and Singulair. On spirometry, FVC was 74% of predicted, FEV1 was 67% of predicted and FEV1/FVC was 70% of predicted. He was treated once in an emergency department. Five months after his diagnosis, he was reassigned. His symptoms improved and he required less medication. He previously smoked one pack of cigarettes a day for 40 years.

OA3763. A male in his 60s developed work-related asthma after working for 22 years as a supervisor in a car interior manufacturer. He was exposed to isocyanates and formaldehyde. He developed wheezing, chest tightness and shortness of breath. He was prescribed Dulera, Advair and Pro-Air. On spirometry, FVC was 88% of predicted, FEV1 was 89% of predicted, and FEV1/FVC was 100% of predicted. He continued to work this job. His symptoms remained unchanged and he required the same amount of asthma medication. He previously smoked two packs of cigarettes a day for 27 years.

OA3914. A female in her 50s developed work-related asthma after working for a truck parts manufacturer. She was exposed to isocyanate in glue. She developed wheezing, cough, and shortness of breath. She was prescribed Pro-Air and Symbicort. She continued to work this job. She was a lifelong non-smoker.

AA3893. A male in his 40s experienced an exacerbation of his pre-existing asthma after his first day on the job at a foam pillow manufacturer. The foam was isocyanate-based. He developed cough and shortness of breath. He was treated the following day in the emergency department, and was prescribed Duo-neb and Prednisone. He left this job in the same month. He was a lifelong non-smoker.

OA3968. A female in her 30s developed work-related asthma after working in an injection molding plant for automotive parts manufacturing. She was exposed to isocyanates and developed wheezing and a cough. She was treated in the emergency department and admitted to intensive care. She continued to work this job. She was a current smoker.

OA3850. A female in her 20s developed work-related asthma after working for two months with isocyanate-based foam in the manufacture of water heaters. She developed wheezing, a cough, chest tightness, and shortness of breath. She was prescribed Singulair and Albuterol. She left this job four months later and was no longer exposed. Her asthma improved and required no asthma medication. She was a current smoker.

### **Exposure to Metal Working Fluids**

AA3906. A female in her 50s experienced an exacerbation of her pre-existing asthma when she was exposed to metal working fluids in her job at an automotive parts manufacturing plant. The exposure happened less than six months after she began working there. She continued to work at this facility.

OA3860. A male developed work-related asthma in his 20s. He worked at an automotive manufacturing facility where he was exposed to metal working fluids. He first experienced wheezing and a cough, and then almost 30 years later he developed chest tightness and shortness of breath. He was prescribed Albuterol. He did not use a respirator. He retired after over 30 years at the facility, and since then his asthma worsened. He stopped taking asthma medication because it made him feel nervous. He formerly smoked a pack of ciga-

rettes a day from his late teens till his early 60s. On spirometry, his FVC was 78% of predicted, FEV1 was 81% of predicted, and his FEV1/FVC was 78% of predicted.

OA3861. A male developed work-related asthma in his 30s from exposure to metalworking fluids at an auto parts manufacturer. He did not wear a respirator. He had worked at the company for several months before he developed a cough and shortness of breath. He was prescribed an inhaler and was given several breathing treatments. He was subsequently fired from this job for a non-medical reason. Since that time, his asthma improved and he no longer required asthma medication. He was a lifelong non-smoker.

### **Exposure to Cobalt**

OA3777. A male in his 40s developed work-related asthma after working in maintenance for five years at a heat treatment plant where he was exposed to cobalt. He developed wheezing, cough, chest tightness and shortness of breath. He was prescribed Anoro and Albuterol. On spirometry, FVC was 78% of predicted, FEV1 was 70% of predicted, and FEV1/FVC was 88% of predicted. He continued to work this job. His asthma was unchanged and he required the same amount of asthma medication. He was a lifelong non-smoker.

### **Exposure to Welding & Soldering Fume**

AA3878. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to welding fume at the automotive parts manufacturer where she worked in the shipping department. She sought medical treatment for her asthma with 12 trips to the emergency room and four hospitalizations. After working in this environment for 15 years, she quit this job because of her asthma. Since then, she required a greater amount of asthma medication. She formerly smoked a pack of cigarettes a day from her early teens to her late 40s. On spirometry, her FVC was 75% of predicted, FEV1 was 49% of predicted, and her FEV1/FVC was 52% of predicted.

AA3870. A female in her 20s experienced an exacerbation of her pre-existing asthma at a tool and die company. She was placed at this company through a temporary employment agency. She was a welder and exposed to welding fume. She did not wear a mask or respirator. Approximately four months after working at the company, she required treatment at an emergency department for her cough, shortness of breath and chest tightness. She continued to work at the company, and used Albuterol as needed. She smoked a half a pack of cigarettes a day since her early teens.

POA3770. A male in his 30s developed work-related asthma after working for one month as a welder for an auto parts manufacturer. He developed shortness of breath from exposure to welding fume. On spirometry, FVC was 91% of predicted, FEV1 was 85% of predicted, and FEV1/FVC was 92% of predicted. One year later he left on sick leave and was no longer exposed. His asthma improved and he required no asthma medication. He previously smoked a quarter pack of cigarettes a day for two years from his late teens to his early 20s.

### **Exposure to Miscellaneous Chemicals and Dusts**

AA3907. A female in her 20s with pre-existing asthma began working for an automotive parts manufacturer. Exposure to smoke in the plant triggered her asthma. Less than a year later, she no longer worked at this facility.

AA3872. A female in her 30s was placed by a temporary employment agency at a steel heat treat plant that made parts for the automotive industry and the military. Her job assignment was as a parts stacker and sorter. She also used a degreaser to clean the machines. She experienced wheezing, chest tightness, a cough and

shortness of breath after working at the plant for two months. She was treated in the emergency department with Albuterol and steroids. After this, the temporary employment agency thought it best if she stopped working at the plant. She did not find new employment. Since this exposure, her asthma improved and she required less asthma medication. She was a lifelong non-smoker.

AA3908. A male in his 40s experienced an exacerbation of his pre-existing asthma while working as a door installer at an automotive manufacturer. He had only worked there about six months when he experienced shortness of breath from smoke in the body shop at the plant.

AA3882. A female in her late teens with childhood asthma experienced an exacerbation of her asthma after she was hired at an automotive parts manufacturing facility through a temporary agency. She had worked for one month when the headliner material in a press caught on fire. She sought treatment at an emergency department. She was fired from this job but found new employment. Since then her asthma improved and she did not require asthma medication. She smoked a pack of cigarettes a day, since her early teens.

AA3836. A female in her 20s experienced an exacerbation of her pre-existing asthma at her job in a manufacturing plant. She was exposed to an unknown gas. She developed wheezing, cough, shortness of breath and chest tightness. She was treated in an emergency department and prescribed Albuterol. She continued to work this job. She was a current smoker since her teens.

RADS3798. A male engineer in his 60s developed Reactive Airways Dysfunction Syndrome (RADS) after exposure to fumes in an expired ABC fire extinguisher used during a welding fire at a manufacturing facility. He developed cough, shortness of breath and chest tightness. He was prescribed a nebulizer and a rescue inhaler. On spirometry, FVC was 60% of predicted, FEV1 was 68% of predicted and FEV1/FVC was 113% of predicted. He continued to work this job and his symptoms worsened. He previously smoked two packs of cigarettes a day for 34 years.

POA3795. A male in his 50s developed work-related asthma after working as a press operator in a plastics manufacturer. His symptoms began within the same month of starting employment. He developed wheezing, cough, chest tightness and shortness of breath. He was prescribed Albuterol inhaler, Albuterol nebulizer and Advair. Four years later, he quit on his physician's advice. His symptoms worsened. He previously smoked one pack of cigarettes a day for 20 years from his teens to his 30s.

POA3923. A male in his 50s developed work-related asthma after working as a die designer for 27 years at an automotive manufacturer. He was exposed to cast iron dust and developed a cough and wheezing. He was prescribed Pro-Air and Albuterol. He continued to work this job and remained exposed. His asthma improved and he required no asthma medication. He was a lifelong non-smoker.

AA3760. A male in his 30s experienced an exacerbation of his pre-existing asthma after working for seven years on the assembly line at an automotive manufacturer. He was exposed to smoke when contractors removed old machinery from the facility. He developed a cough, wheezing, chest tightness and shortness of breath. He was prescribed Prednisone, Advair, DuoNeb, Ventolin and Singulair. Six months later he was reassigned and no longer exposed. His asthma improved and he required less asthma medication. He was a current smoker.

OA3764. A male in 40s developed work-related asthma after working for two years at an auto parts manufacturer. He was exposed to chrome plating chemicals. He developed wheezing, a cough, and shortness of breath. He was prescribed Advair, ProAir and Singulair. Two years later, he left this job and was no longer exposed. His asthma remained unchanged and he required the same amount of asthma medication. He pre-

viously smoked two and a half packs of cigarettes a day for 20 years from his late teens to his late 30s.

AA3954. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to smoke from a fire at an automotive manufacturing facility. A malfunctioning robot caught on fire in the assembly area. She was a lifelong non-smoker.

AA3949. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to an unknown substance at a meat packaging plant. She required treatment at an emergency department, with Albuterol and Atrovent. She was a non-smoker.

AA3930. A male in his 30s experienced an exacerbation of his pre-existing asthma from exposure to smoke from a fire as well as fumes from a fire extinguisher at an automotive manufacturing facility. He was treated at an emergency department. On spirometry, his FVC was 82%, FEV1 was 70% of predicted, and FEV1/FVC was 85% of predicted. He formerly smoked cigarettes.

AA3787. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to construction dust and paint near her workstation at an automotive manufacturing facility. She was assigned to a different area away from the construction and her asthma improved. She was a lifelong non-smoker.

POA3785. A female in her 60s developed work-related asthma. She was a metal press operator at an automotive parts manufacturer. She was exposed to welding fume, metal working fluids and paint for two years before she developed wheezing, a cough, shortness of breath and chest tightness. She was prescribed a nebulizer, Pro-Air and Flovent. She was reassigned to a different facility and since that time her asthma improved and she was able to discontinue her asthma medication. On spirometry, her FVC was 77%, FEV1 was 70% of predicted, and FEV1/FVC was 89% of predicted. She was a lifelong non-smoker.

### **Exposure to Indoor Air Contaminants**

POA3858. A male in his 60s developed work-related asthma after working for 17 years as a supervisor in a machine shop. He was exposed to mold and developed a cough, wheezing, chest tightness and shortness of breath. He was prescribed Albuterol and Prednisone. He was treated once in the emergency department and admitted for inpatient care. He quit the same month following his physician's recommendations. His asthma improved and he no longer required medications. He was a lifelong non-smoker.

## **EDUCATIONAL SERVICES**

### **Exposure to Cleaning Products**

OA3855. A female in her 20s developed work-related asthma from exposure to bleach after working for three years for a company that trained individuals with impairments. She developed wheezing, chest tightness, shortness of breath and a cough. She was hospitalized in an ICU for four days, and prescribed a nebulizer and Claritin. On spirometry, her FVC was 107% of predicted, FEV1 was 102% of predicted, and her FEV1/FVC was 84% of predicted. Shortly after her asthma diagnosis, she quit this job because of her lung problems. Since then her asthma improved although she still required the same amount of asthma medication. She smoked a pack of cigarettes per day.

### **Exposure to Indoor Air Contaminants**

POA3802. A female in her 40s developed work-related asthma from exposure to painting fumes after having been a painter for 17 years at a university. She developed wheezing, cough, chest tightness, and shortness of breath. She was prescribed Anoro, Albuterol, Spiriva, and Ventolin. On spirometry, her FVC was 83% of

predicted, FEV1 was 70% of predicted, and FEV1/FVC was 85% of predicted. She continued to work four additional years until she was placed on disability. After she was placed on disability, her asthma worsened and she required a greater amount of asthma medication. She quit smoking in her 40s after having smoked a pack per day since the age of 15.

### **Exposure to Animal Dander**

OAA3825. A female in her 20s developed work-related asthma within one month of working with swine at a university. She developed cough, chest tightness and shortness of breath. Her symptoms resolved after she left this job one year later. She was a lifelong non-smoker.

OAA3771. A female in her 30s developed work-related asthma after working with mice for two years as a research assistant at a university. She developed wheezing and a cough. She was prescribed Albuterol. On spirometry, FVC was 88% of predicted, FEV1 was 90% of predicted, and FEV1/FVC was 101% of predicted. Two years later she was reassigned and no longer exposed. Her symptoms resolved and she no longer required asthma medications. She was a lifelong non-smoker.

## **HEALTH CARE SERVICES**

### **Exposure to Disinfectants**

AA3894. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to a newly introduced disinfectant at the hospital where he just began working in environmental services. He developed shortness of breath when working directly with this chemical. He required a greater amount of asthma medication. He was allowed to return to work by the employee health services and told to use a fan. He was a lifelong non-smoker.

AA3894. A male in his 20s experienced an exacerbation of his pre-existing asthma after working as an environmental service technician at a hospital. He used Oxycide for cleaning and disinfecting. He developed shortness of breath. He was prescribed Albuterol. He was a lifelong non-smoker.

AA3863. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to a newly introduced disinfectant at the hospital where she worked in housekeeping. She was told by her supervisors that she “would get used to it.”

AA3887. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to bleach at the hospital where she was a housekeeper. The exacerbation occurred after her supervisor sprayed undiluted bleach in a bathroom. She quit this job because she could no longer be around bleach. Since she left, her asthma improved although her asthma medication requirements remained unchanged. She was a lifelong non-smoker.

OAA3856. A female in her 40s developed work-related asthma after working as a nurse. She had been working this job for 9 years when she was exposed to bleach. She developed wheezing, cough, chest tightness and shortness of breath. She was prescribed Pro-Air, Spiriva, Qvar and Prednisone. She was awarded workers' compensation. Her symptoms remained unchanged and she required the same amount of medication. She was a lifelong non-smoker.

EA3919. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to bleach during her work for an ambulance service. A patient she treated had bleach on them, which triggered wheezing, shortness of breath, a cough and chest tightness. Her asthma improved after this incident. She was



a lifelong non-smoker.

OA3862. A female in her 40s developed work-related asthma from exposure to floor cleaners in the surgical room at a hospital. She developed a cough, wheezing, shortness of breath and chest tightness. She was treated in the hospital with Dulera and Albuterol. She was placed on sick leave. She was a lifelong non-smoker.

### **Exposure to Other Cleaning Products**

AA3794. A female in her 50s experienced an exacerbation of her pre-existing asthma shortly after starting work in food service for an assisted living facility. She was exposed to a mixture of bleach and oven cleaner. She developed cough, wheezing, shortness of breath and chest tightness. She was prescribed Symbicort, Xopenex, and Singulair. On spirometry, FVC was 52% of predicted, FEV1 was 51% of predicted, and FEV1/FVC was 97% of predicted. She continued to work this job, her symptoms worsened and she required more asthma medications. She previously smoked half pack of cigarettes a day for 24 years from her 20s to her 40s.

### **Exposure to Indoor Air Contaminants and Miscellaneous Chemicals and Dusts**

AA3881. A female in her 60s who worked as a surgical instrument cleaner at a hospital, experienced an exacerbation of her pre-existing asthma from exposure to a co-worker's perfume. This was an ongoing problem, despite the hospital having a "no scent" policy. She continued to work, her asthma worsened and she required a greater amount of asthma medication. On spirometry, her FVC was 73% of predicted, FEV1 was 54% of predicted, and her FEV1/FVC was 57% of predicted. She formerly smoked over a half a pack of cigarettes a day from her late teens till her late 30s.

AA3851. A female nurse in her 50s experienced an exacerbation of her pre-existing asthma from exposure to raw sewage and mold at the hospital where she worked. This exposure triggered her wheezing, chest tightness and shortness of breath and she was treated at the emergency department with Albuterol and steroids. After this incident, the air system was upgraded and the moldy carpets were replaced. Since then, her asthma improved and she required less asthma medication. She was a lifelong non-smoker.

AA3884. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to a patient's essential oil. She worked in a dentist office. This one-time exposure caused her to seek treatment at a local clinic. Since that time, her asthma improved and she required less asthma medication. She was a lifelong non-smoker.

RADS3840. A female in her 40s developed RADS after exposure to construction dust at a client's apartment building. She had worked as a home health aide for four months. She developed wheezing, cough, chest tightness, and shortness of breath 24 to 48 hours after exposure to construction dust. She was prescribed Albuterol and Prednisone. Seven months later, she was reassigned and was no longer exposed. Her symptoms were unchanged one year later. On spirometry, her FVC was 101% of predicted, FEV1 was 109% of predicted, and FEV1/FVC was 109% of predicted. She was a lifelong non-smoker.

AA3799. A female in her 40s experienced an exacerbation of her pre-existing asthma after working as a biller in a hospital. She was exposed to dust, plants and perfumes in her poorly ventilated work area. She worked there for 21 years. She experienced wheezing, cough, chest tightness and shortness of breath. She was prescribed Prednisone, an Albuterol inhaler, an Albuterol nebulizer and Singulair. On spirometry, FVC was 72% of predicted, FEV1 was 76% of predicted and FEV1/FVC was 125% of predicted. Eight months later she went on sick leave. Her symptoms were worse one year later and she required more medication. She was a lifelong non-smoker.

POA3753. A female in her 40s developed work-related asthma after working for four years as a biller in a hospital. She was exposed to dust from office renovations and developed wheezing, chest tightness and shortness of breath. She was prescribed Advair, Albuterol, Spiriva and Singulair. On spirometry, FVC was 111% of predicted, FEV1 was 119% of predicted, and FEV1/FVC was 106% of predicted. Two years later she was reassigned and no longer exposed. She continued to work this job, her asthma improved, and she required less asthma medication. She was a lifelong non-smoker.

AA3829. A female in her 30s experienced an exacerbation of her pre-existing asthma one month after she started to work at a pharmacy. She was exposed to construction dust during renovations. She developed a cough, chest tightness and shortness of breath. She was prescribed Albuterol. Once the construction work was completed, her asthma improved and she required less asthma medication. She was a current smoker.

POA3761. A male in his 40s developed work-related asthma after four months as a respiratory tech at a hospital. He was exposed to lilacs in a patient room. He developed wheezing, cough, chest tightness and shortness of breath. He was prescribed Albuterol, Singulair, Xopenex, Dulera, Prednisone and Symbicort. On spirometry, FVC was 81%, FEV1 was 84% of predicted, and FEV1/FVC was 104% of predicted. He continued to work this job and was still exposed to flowers within the hospital. His symptoms worsened and he required more medication. He was a lifelong non-smoker.

AA3830. A female in her 50s experienced an exacerbation of her pre-existing asthma from exposure to a lubricant that was sprayed near her workstation at a hospital. The exposure triggered a cough and wheezing. This was a one-time exposure. Since then her asthma remained unchanged and she required the same amount of asthma medication.

## **WHOLESALE & RETAIL SERVICES**

### **Exposure to Isocyanates**

OA3876. A male developed work-related asthma in his 40s from exposure to isocyanate-containing automotive paint. His job was to repair automotive bodies to prepare them for the car auction. He did this job for over a year before he developed wheezing, cough, shortness of breath and chest tightness. He was prescribed Albuterol. He had one visit to the emergency room. He ultimately quit this job because of his asthma, and upon the advice of his doctor. Since then, his asthma improved and he required less asthma medication. He smoked a pack of cigarettes a day since his late teens.

### **Exposure to Cleaning Agents**

AA3768. A male in his 60s experienced an exacerbation of his pre-existing asthma after working as a driver for an auto parts retail store. He had been working this job for one month. He was exposed to fumes when he mixed tire cleaner and an acid while cleaning floors. He developed wheezing and shortness of breath. He was prescribed Albuterol and a nebulizer. On spirometry, FEV1 was 70% of predicted, FVC was 69% of predicted, and FEV1/FVC was 77% of predicted. Within the month, chemicals were substituted and he was no longer exposed. His symptoms worsened but he required the same amount of medication. He was a lifelong non-smoker.

### **Exposure to Indoor and Outdoor Air Contaminants and Miscellaneous Chemicals and Dusts**

AA3912. A male in his 40s experienced an exacerbation of his pre-existing asthma after putting out a fire.

He worked at a large hardware store. He developed wheezing. He was treated in an emergency department following this incident. He was prescribed Albuterol and Prednisone. He continued to work this job, and his symptoms improved.

AA3940. A female in her 30s who worked in a pharmacy experienced an exacerbation of her pre-existing asthma after a car caught fire in the drive-through lane of the pharmacy. She developed wheezing, cough, and shortness of breath. She was treated in the emergency department and prescribed Albuterol and Prednisone. She continued to work this job. She was a lifelong non-smoker.

AA3934. A female in her 50s experienced an exacerbation of her pre-existing asthma after working as a night shift stocker in a grocery store. She was exposed to smoke when papers on top of a freezer caught fire. She developed wheezing, cough, and shortness of breath. She was treated in the emergency department and prescribed Albuterol and Prednisone. She continued to work this job. She was a lifelong non-smoker.

## **OFFICE/INDOOR AIR**

### **Exposure to Indoor Air Contaminants**

POA3749. A female in her 40s developed work-related asthma after working in administration for a car parts supplier. Her symptoms began within the same month of starting employment. There was water damage in her office. She developed chest tightness and shortness of breath. She was prescribed Combivent. On spirometry, FVC was 86% of predicted, FEV1 was 93% of predicted, and FEV1/FVC was 106% of predicted. She left this job four years later. Since then her symptoms decreased and she required less asthma medication. She previously smoked half a pack of cigarettes a day for 16 years.

## **CONSTRUCTION**

### **Exposure to Miscellaneous Chemicals and Dusts**

AA3902. A male in his 60s experienced an exacerbation of his pre-existing asthma while refinishing wood floors. He was sanding and varnishing the floors which triggered his asthma and resulted in hospitalization. He was treated with Albuterol and Dulera. He recently started smoking cigarettes, after having quit two years prior.

POA3843. A male in his 40s developed work-related asthma the same month he started working for an electrical company doing painting and sanding. He developed a cough, wheezing, chest tightness and shortness of breath. He was prescribed Aerospan and Ventolin. One year later he quit this job upon his physician's advice. His symptoms remained the same and he required more asthma medication. He was a lifelong non-smoker.

AA3837. A male in his 20s experienced an exacerbation of his pre-existing asthma after exposure to dust while working in a crawlspace doing home foundation repair. He developed a cough and shortness of breath. He was treated in the emergency department where he was prescribed Albuterol. He previously smoked cigarettes.

POA3991. A male in his 30s developed work-related asthma from exposure to construction dust while working to deconstruct an old hotel. He developed wheezing, shortness of breath and chest tightness soon after beginning this job. He initially wore a paper mask and then switched to a respirator. He was reassigned to a different job, upon his request, because of his breathing problems. Since ending the exposure, his asthma

improved and he did not require asthma medication. He was a lifelong non-smoker.

## **FOOD SERVICES**

### **Exposure to Miscellaneous Substances**

POA3880. A female restaurant employee in her 40s developed work-related asthma from wood smoke used in the broiler for cooking. She had worked four years at the restaurant with no breathing problems until the introduction of this new cooking method. Within a month of its introduction, she developed wheezing, a cough and shortness of breath. She was prescribed Albuterol and Atrovent. She quit this job after the development of her asthma, on the advice of her doctor. Since that time, her asthma improved and she required less asthma medication. She was a lifelong non-smoker.

POA3849. A female in her 60s developed work-related asthma after working as a menu specialist for a food distributor. The carpeting in her work area was wet. She worked as a menu specialist for 17 years. She developed wheezing, a cough and shortness of breath. She was prescribed Duo-neb, Albuterol, Symbicort and Prednisone. Five months later, she was reassigned and was no longer in this work environment. Her symptoms improved one year later. She was lifelong non-smoker.

AA3853. A female fast food restaurant worker in her 20s experienced an exacerbation of her pre-existing asthma after the ventilation fan stopped working and she was exposed to cooking fumes. She developed chest tightness and was treated in the emergency department. She was prescribed Pro-Air. The ventilation was repaired within the same week and her symptoms improved.

AA3952. A female in her 20s experienced an exacerbation of her pre-existing asthma from fire extinguisher fumes at a fast food restaurant. She was treated at an emergency department for wheezing and difficulty breathing with Albuterol, Atrovent, and a nebulizer of Prednisone. She was a non-smoker.

## **PUBLIC SERVICES**

### **Exposure to Cleaning Agents**

AA3898. A female firefighter in her 30s experienced an exacerbation of her pre-existing asthma when she was exposed to muriatic acid while putting out a fire. The exposure triggered her wheezing, shortness of breath, a cough and chest tightness, and she was treated in an emergency department with Albuterol and a nebulizer. On spirometry, her FVC was 121% of predicted, FEV1 was 113% of predicted, and her FEV1/FVC was 79% of predicted. Her asthma improved after her treatment at the hospital. She was a lifelong non-smoker.

RADS3857. A male firefighter in his 30s developed RADS after working for two years. He was exposed to chemicals in a house fire that he was told were safe, so he removed his mask. He immediately developed wheezing, a cough, chest tightness and shortness of breath. He was hospitalized and prescribed Prednisone, Albuterol and Budesonide. On spirometry, his FVC was 91% of predicted, FEV1 was 92% of predicted, and his FEV1/FVC was 84% of predicted. His asthma improved and he required less asthma medication. He continued to work as a firefighter. He was a lifelong non-smoker.

### **Exposure to Miscellaneous Substances**

AA3820. A female corrections officer in her 30s experienced an exacerbation of her pre-existing asthma from exposure to steam from showers. She developed wheezing, a cough, chest tightness and shortness of breath. She was prescribed Albuterol, Atrovent, Prednisone, Singulair, and Breo. She continued to work

this job and was still exposed. Her asthma improved but she required more asthma medication. She was a lifelong non-smoker.

## **MISCELLANEOUS SERVICES & INDUSTRIES**

### **Exposure to Disinfectants**

AA3807. A female in her 40s experienced an exacerbation of her pre-existing asthma after working for 13 years for an insurance agency. A coworker cleaned her desk with bleach wipes. She experienced wheezing, a cough, chest tightness and shortness of breath. On spirometry, FVC was 110% of predicted, FEV1 was 117% of predicted, and FEV1/FVC was 81% of predicted. She was treated in the emergency department, and prescribed Albuterol, Advair, Symbicort and Qvar. She continued to work this job and was occasionally still exposed. Her asthma remained unchanged and she required the same amount of asthma medication. She was a lifelong non-smoker.

### **Exposure to Cleaning Products**

OA3901. A female in her 30s developed work-related asthma from exposure to bleach. Over several months she helped clean off the moldy surfaces of an old building. She developed wheezing, chest tightness, a cough and shortness of breath, and was prescribed Qvar, Symbicort, Zyrtec and Albuterol. On spirometry, her FVC was 97% of predicted, FEV1 was 91% of predicted, and her FEV1/FVC was 77% of predicted. She lost her job shortly after her diagnosis. Her employer stated they could not accommodate her issues with mold. Since that time, her asthma improved although she required a greater amount of asthma medication. She was a lifelong non-smoker.

POA3877. A female in her 50s developed work-related asthma from exposure to an industrial laundry detergent that contained 5-10% citric acid and 10-30% fluorosilicic acid. She transferred the detergent in a bucket and breathed in a cloud of fumes. She immediately experienced shortness of breath, wheezing and a cough. She was prescribed Albuterol, ProAir and Qvar in the emergency department. She was a lifelong non-smoker.

### **Exposure to Animal Dander**

OA3931. A male in his 30s developed work-related asthma after working as a rabbit caretaker for a lab animal supplier. He developed a cough and shortness of breath. He was prescribed Albuterol. On spirometry, FVC was 60% of predicted, FEV1 was 63% of predicted, and FEV1/FVC was 106% of predicted. He continued to work this job. He previously smoked one pack of cigarettes a day for 5 years.

### **Exposure to Miscellaneous Substances**

POA3824. A female in her 50s developed work-related asthma after working as a gate attendant at an apartment complex for 22 years. She was exposed to automotive exhaust and cleaners including oven cleaner, bleach, and tile cleaner. She developed wheezing, a cough and shortness of breath. She was prescribed an inhaler. She continued to work this job, her symptoms worsened but she remained on the same medications. She was a previous smoker, having smoked one pack of cigarettes a day for 25 years from her teens to her 40s.

RADS3838. A male in his 20s developed RADS after exposure to an unknown chemical waste. He worked as a millwright at an industrial chemical waste disposal facility for four years. He developed wheezing, a cough, shortness of breath and chest tightness. He was prescribed Symbicort, Albuterol and a three-week

course of Prednisone. On spirometry, FVC was 64% of predicted, FEV1 was 61% of predicted and FEV1/FVC was 78% of predicted. Eight months after the chemical exposure he left this job. His symptoms improved but he required the same amount of medication. He was a lifelong non-smoker.

RADS3854. A male in his 20s developed RADS after exposure to fumes from a fire extinguisher after a stage performance fire. He had worked as a music teacher for three years before this incident. He developed wheezing, a cough, chest tightness and shortness of breath. He was treated in the emergency department and prescribed Albuterol and steroids. The same month, he was out on workers' compensation and no longer exposed. His asthma remained unchanged and he required the same amount of asthma medication. He was a lifelong non-smoker.

RADS3839. A male in his 60s developed RADS after exposure to a herbicide while cleaning out a warehouse. He had worked at this job for one year. He developed wheezing, a cough, chest tightness and shortness of breath. He was prescribed Symbicort, ProAir and Advair. On spirometry, FVC was 65% of predicted, FEV1 was 66% of predicted, and FEV1/FVC was 76% of predicted. The same month, he was reassigned and was no longer exposed. His asthma worsened and he required more asthma medication. He previously smoked half a pack of cigarettes a day for four years, from his late teens to his early 20s.

POA3916. A male in his 40s developed work-related asthma after exposure to a building fire while working in maintenance. He developed wheezing, a cough, chest tightness and shortness of breath. He was prescribed Albuterol. He was treated multiple times in the emergency department for his asthma and required hospitalization for management. He continued to work this job. His asthma remained unchanged and he continued to require asthma medication. He was a current smoker.