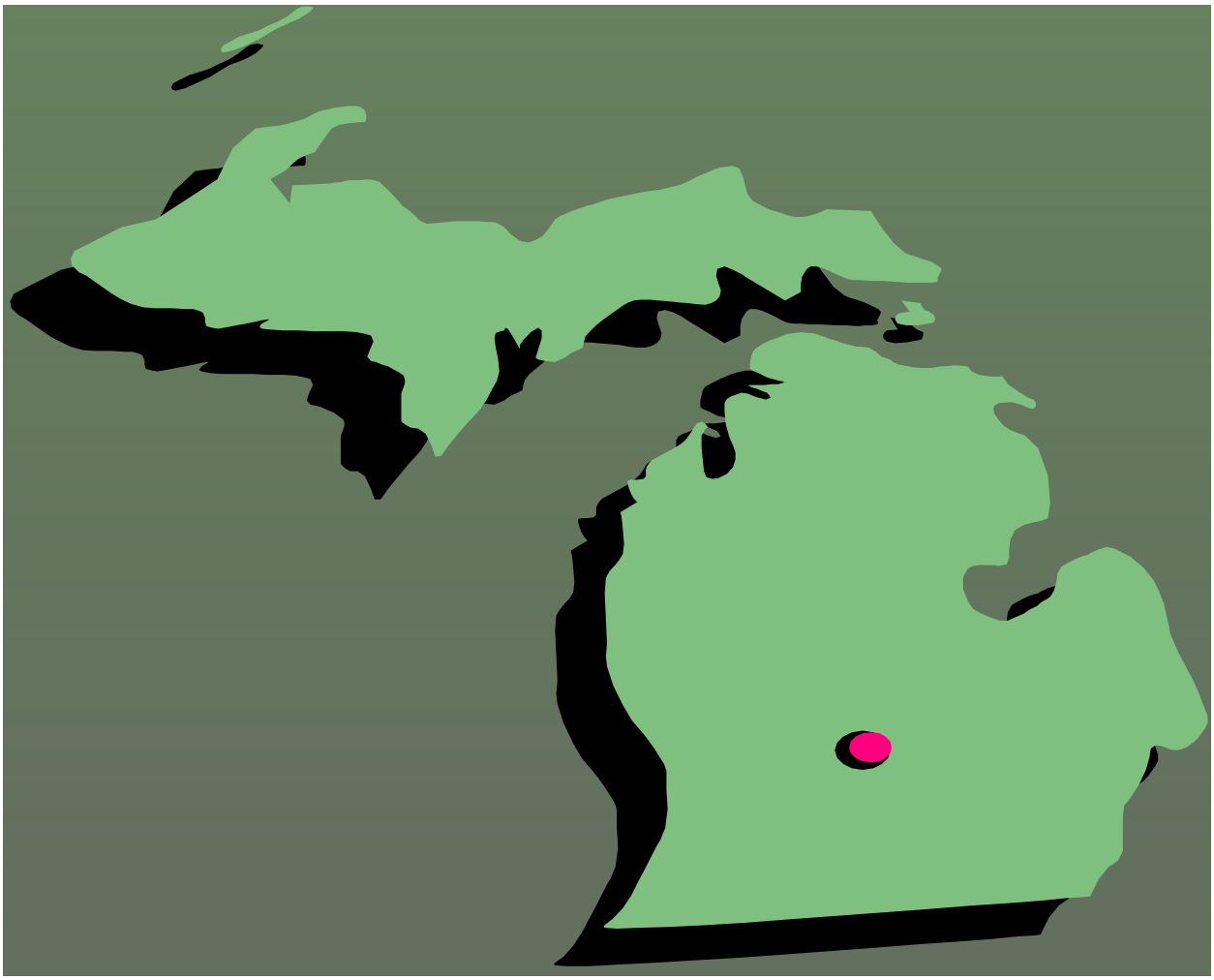
October 30, 2026

2024
Annual Report

Tracking work-related asthma in Michigan



2024 Annual Report

Tracking Work-Related Asthma in Michigan
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2024 ANNUAL REPORT

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: **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

LEO MI Department of Labor & Economic Opportunity

MIOSHA Michigan Occupational Safety & Health Administration

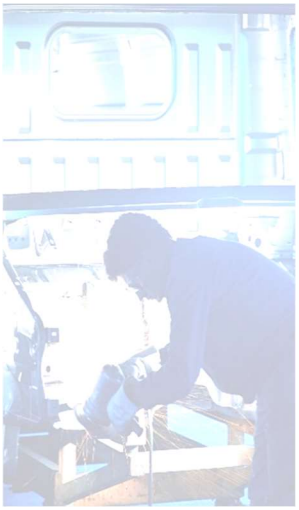
NAICS North American Industrial Classification System

NIOSH National Institute for Occupational Safety & Health

PEL Permissible Exposure Limit

REL Recommended Exposure Limit

WRA Work-Related Asthma



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 34th 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[1]. 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.

- From 1988-2024, 4,063 WRA cases have been identified with MI's tracking system.
- We estimate there are 62,000-97,000 adults in MI with WRA.
- 76% of the MI WRA patients have new-onset asthma; 24% 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 (13.5%) and isocyanates (11.8%), are the most commonly reported exposures causing WRA in MI.
- The average incidence rate of WRA among Black/African American workers is 3.3 times greater than that of White workers.



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 online lookup feature to identify asthma-causing agents at: aoec.org

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 (LEO) 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

Patients are identified through mandatory reporting of any known *or suspected* occupational illnesses, including WRA.

SOURCES TO IDENTIFY PATIENTS

- **Health Care Providers:** private practice, and those working for industry
- **Hospitals** ICD-10 J45 and 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**
- **Michigan Emergency Medical Services Information System (MI-EMSIS)**

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 Labor & Economic Opportunity *within 10 days of discovery*.

WRA Tracking Procedures in Michigan

STEP 1. IDENTIFY PATIENTS — Occupational Disease Reports submitted to LEO 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 programs are 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**

<u>New Onset</u>

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.[2]

<u>Exacerbation</u>

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.

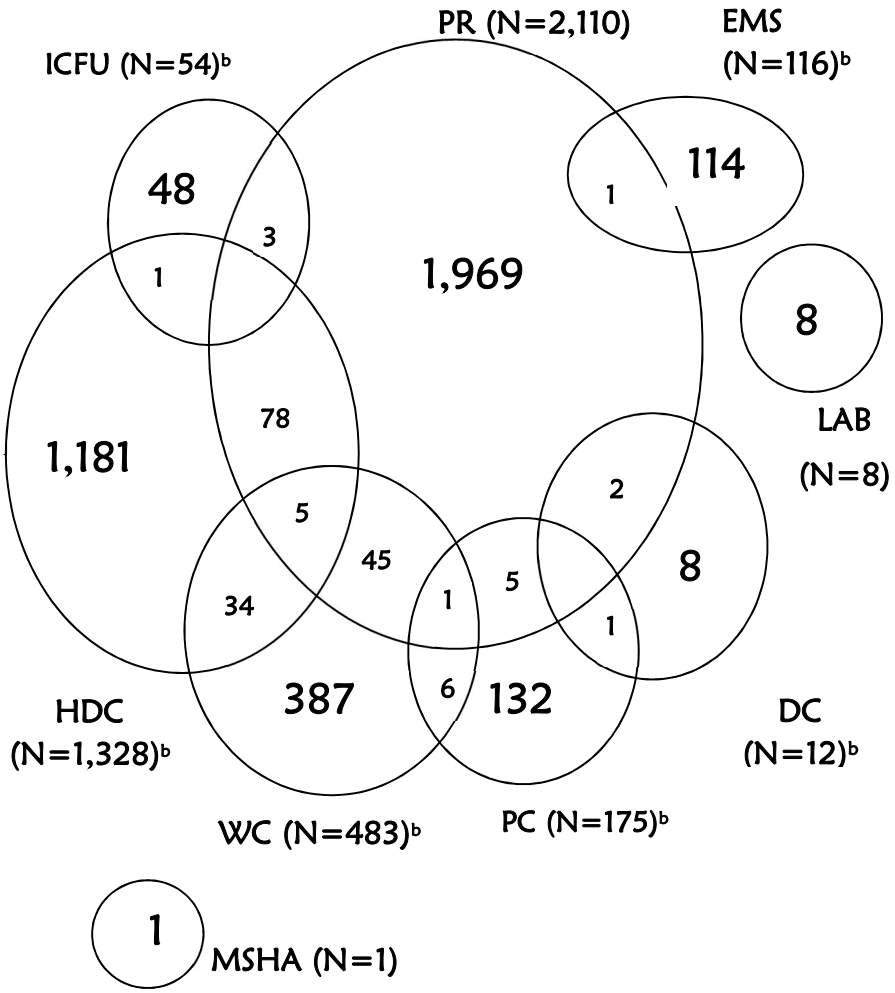
REPORTS

TABLE 1
Number of Confirmed Cases of WRA 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	81	36	14	18	149
1993	76	68	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	48	72	18	9	147
1999	49	65	16	12	142
2000	49	67	31	17	164
2001	51	50	20	19	140
2002	40	58	24	21	143
2003	30	63	28	23	144
2004	39	61	37	30	167
2005	44	65	21	23	153
2006	34	61	29	14	138
2007	20	41	34	28	123
2008	20	49	25	16	110
2009	21	40	31	8	100
2010	18	39	30	16	103
2011	21	24	19	3	67
2012	17	19	35	10	81
2013	17	25	37	6	85
2014	17	21	27	2	67
2015	16	21	33	13	83
2016	21	14	38	6	79
2017	10	24	43	5	82
2018	21	12	52	3	88
2019	18	23	41	12	94
2020	8	11	25	2	46
2021	9	10	39	4	62
2022	12	13	44	3	72
2023	5	8	44	3	60
2024	6	11	27	5	49
Total	1,262	1,381	983	437	4,063

Table 1 shows that 4,063 people were confirmed with WRA between 1988—2024. The reports are divided into: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA) and Reactive Airways Dysfunction Syndrome (RADS). Forty-nine additional patients have been confirmed since last year's report (all 49 for 2024). Figure 1 shows the overlap of the patients by reporting sources for 1988—2024.

FIGURE 1
Overlap of Reporting Sources for 4,063 Confirmed WRA Patients: 1988-2024[a]



[a] 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=Poison Control Center; LAB= Laboratory IgE. EMS= MI Emergency Medical Services (Ambulance)

[b] There was an overlap of PC-HDC for 27 individuals, an overlap of one individual each for PC-ICFU, WC-DC, EMS-HDC, WC-PR and WC-ICFU, and an overlap of WC-PC-HDC for two individuals.

Demographics – Trends

The analyses conducted for the annual report were divided into 1988-1997, 1998-2007, 2008-2017 and 2018-2024 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, 857 reported from 2008 to 2017 and 471 reported from 2018-2024. The trend analyses can be found along with the tables that present the overall statistics. The "Change in Percentage" column on select tables indicates the percentage of increase or decrease in the percentages from the 1988-1997 to the 2018-2024 time periods.

GENDER: Table 2 shows that a higher percentage of women were reported with work-related asthma compared to men. In the 1998-2007 and 2008-2017 periods, the percentage of women reported with WRA increased, while the percentage of men decreased. The percentage by gender in 2018-2024 is similar to the percentage in 1988-1997.

RACE: Table 3 shows there was an increase over time in the percentage of Black/African American cases of WRA, and a decrease in the percentage of White 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 was 3.13 per 100,000 Michigan Black/African American workers compared to 0.94 per 100,000 Michigan White workers; this was a 3.3 times greater incidence (95% CI 1.924, 5.784). Historically, in our surveillance program, Hispanic ethnicity was not collected. To date, we have identified 98 cases of WRA of Hispanic ethnicity, although that is likely an undercount because of incomplete data.

TABLE 2
Gender of WRA Patients by Time Period

		Time Period				
	All years	1988-1997	1998-2007	2008-2017	2018-2024	Change in Percentage
Gender	# (%)	# (%)	# (%)	# (%)	# (%)	
Female	2,193 (54)	626 (49)	800 (55)	519 (61)	248 (53)	+8%
Male	1,870 (46)	648 (51)	661 (45)	338 (39)	223 (47)	- 8%

TABLE 3
Race of WRA Patients by Time Period

		Time Period				
	All years	1988-1997	1998-2007	2008-2017	2018-2024	Change in Percentage
Race	# (%)	# (%)	# (%)	# (%)		
White	2,941 (72)	997 (78)	1,093 (75)	602 (70)	249 (53)	-32%
Black/African American	811 (20)	239 (19)	272 (19)	162 (19)	138 (29)	+53%
Alaskan/Am Indian	34 (1)	10 (1)	13 (1)	7 (1)	4 (1)	None
Asian/Pacific Isl	16 (<1)	4 (0.3)	7 (0.5)	4 (0.5)	1 (<1)	NA
Other	58 (1)	11 (1)	27 (1)	13 (2)	7 (1)	None
Unknown	203 (5)	13 (1)	49 (3)	69 (8)	72 (15)	N/A

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 (8.4 cases per 100,000), Clare (6.7 cases per 100,000), Huron (4.7 cases per 100,000), Montmorency and Osceola (each with 4.4 cases per 100,000), Genesee (4.1 cases per 100,000), Saginaw (4.0 cases per 100,000) and Baraga (3.7 cases per 100,000).

TABLE 4

Average Annual Incidence Rates of WRA Among Michigan Workers by County of Exposure: 1989-2024[a]

County	Avg Annual # EE's[b]	Rate[c]	Cases 1989-2024	County	Avg Annual # EE's[b]	Rate[c]	Cases 1989-2024
Alcona	3,978	0.7	1	Keweenaw	964	2.9	1
Alger	4,114	2.0	3	Lake	3,769	1.5	2
Allegan	52,902	3.0	57	Lapeer	41,143	2.8	42
Alpena	13,799	2.2	11	Leelanau	10,985	2.0	8
Antrim	11,031	1.3	5	Lenawee	46,375	2.4	40
Arenac	7,095	3.1	8	Livingston	89,656	1.3	42
Baraga	3,771	3.7	5	Luce	2,635	8.4	8
Barry	29,443	1.0	11	Mackinac	5,898	2.4	5
Bay	51,775	1.7	32	Macomb	388,397	2.4	333
Benzie	8,447	1.6	5	Manistee	11,232	1.0	4
Berrien	73,214	1.2	32	Marquette	33,712	2.1	25
Branch	20,932	3.6	27	Mason	13,856	1.4	7
Calhoun	65,698	2.6	61	Mecosta	18,832	1.5	10
Cass	25,950	0.5	5	Menominee	12,279	0.2	1
Charlevoix	13,166	2.1	10	Midland	39,876	2.5	36
Cheboygan	11,581	3.1	13	Missaukee	6,182	2.2	5
Chippewa	16,095	1.2	7	Monroe	73,426	1.5	40
Clare	11,936	6.7	29	Montcalm	24,664	2.1	19
Clinton	35,981	0.8	10	Montmorency	3,818	4.4	6
Crawford	6,276	2.7	6	Muskegon	84,078	1.0	30
Delta	19,019	1.8	12	Newaygo	21,694	2.3	18
Dickinson	13,639	3.1	15	Oakland	587,558	2.3	479
Eaton	55,973	0.6	13	Oceana	13,473	1.9	9
Emmet	18,242	1.2	8	Ogemaw	9,015	3.4	11
Genesee	194,390	4.1	290	Ontonagon	3,244	0.9	1
Gladwin	9,853	0.8	3	Osceola	9,470	4.4	15
Gogebic	7,182	1.2	3	Otsego	11,552	2.9	12
Gd Traverse	46,122	1.6	26	Ottawa	129,733	1.1	50
Gratiot	18,546	2.1	14	Roscommon	9,910	2.5	9
Hillsdale	20,594	2.0	15	Saginaw	91,100	4.0	131
Houghton	16,560	1.5	9	Sanilac	20,628	3.1	23
Huron	15,887	4.7	27	Schoolcraft	3,634	1.5	2
Ingham	143,187	3.1	158	Shiawassee	33,709	0.7	8
Ionia	28,891	1.3	14	St. Clair	76,672	2.3	64
Iosco	10,137	1.6	6	St. Joseph	29,431	1.6	17
Iron	5,562	2.0	4	Tuscola	26,745	2.6	25
Isabella	36,135	2.3	30	Van Buren	38,392	0.8	11
Jackson	72,370	2.2	57	Washtenaw	181,088	3.3	213
Kalamazoo	126,692	1.5	68	Wayne	812,369	3.2	923
Kalkaska	8,175	3.1	9	Wexford	13,687	1.4	7
Kent	305,783	1.2	136	***All Counties[d]***	**4,684,000[e]**	**2.3**	**3,947**

[a] 1989 through 2024 represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete and are not included in this table.

[b] EE's =employees. Source: MI Dept of Tech, Mgt, & Budget, Labor Market Information, Annual Unemployment Statistics (LAUS) by County, 2006. Accessed 8/7/2026.

[c] Rates are based on the average number of cases per year from 1989-2024 (36 years), per 100,000 Michigan workers.

[d] Sixty-one cases had an out-of-state exposure and 24 had an unknown county of exposure, for the 1989-2024 reporting period.

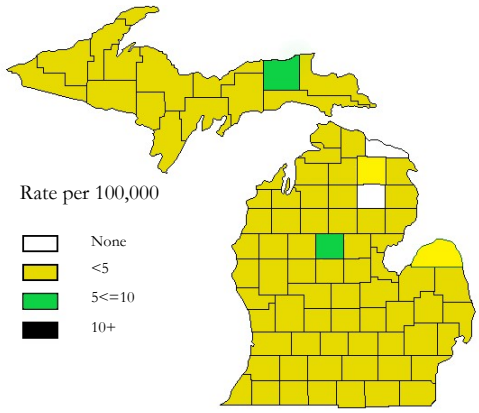
[e] Total is rounded up.

Type of Industry – Trends



TOP COUNTIES: Table 5 shows the top 10 counties with the highest overall rates of WRA that had more than one case during the 1989-2024 time period. Eight of the top counties with the highest overall rates of WRA had a decrease over time, while two counties, Huron and Osceola, had an increase in the rate of WRA over time. In five of the counties, the rates increased during the 2018-2024 time period and in four counties the rate decreased during the 2018-2024 time period.

FIGURE 2
Average Annual Incidence Rate of WRA by County of Exposure: 1989-2024[a]



[a] 1989 through 2024 represent complete years of reporting. Reporting in 1988 is incomplete and not included in this figure.

TABLE 5
Average Annual Incidence Rate[a] of WRA per 100,000 Workers by County and Time Period

		Time Period				
	All Years	1988-1997	1998-2007	2008-2017	2018-2024	
County	Rate	Rate	Rate	Rate	Rate	Change in Percentage
Baraga	3.7	3.6	5.6	3.3	3.5	-3%
Branch	3.6	4.0	5.6	2.9	2.2	-45%
Clare	6.7	8.8	9.4	7.5	4.4	- 50%
Genesee	4.1	4.6	6.8	3.1	2.2	- 52%
Huron	4.7	4.7	5.2	3.3	8.2	+ 74%
Luce	8.4	19.8	7.5	9.4	--	- 53%
Montmorency	4.4	--	5.3	11.0	4.4	-17%
Ogemaw	3.4	3.0	11.3	1.3	2.8	- 7%
Osceola	4.4	2.1	9.8	1.1	3.1	+ 48%
Saginaw	4.0	3.4	7.4	2.3	2.8	- 18%
All MI Counties	2.3	3.0	3.1	2.0	1.5	- 50%

[a] Denominator source (data not shown): MI Dept. of Tech. Mgt & Budget, Labor Market Information, Annual Unemployment Statistics (LAUS) by County, for the 1988-1997 time period were calculated using 1992 employment data, for 1998-2007 using 2002 employment data, for 2008-2017 using 2012 data, and for 2018-2024 using 2021 data, accessed 10/27/2026.

Table 6 shows the Michigan industries by NAICS codes, with cases of work-related asthma from 1988 to 2024. The main industries were in manufacturing (55%) 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 10.2 cases per 100,000 in manufacturing. Industries with the next highest average annual incidence rates were: mining with 7.1 cases per 100,000 workers and utilities with 3.2 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 42.9% in 2018-2024. There were also decreases in mining, wholesale trade, information and educational services. There were increases in all other industries from 1988-1997 to 2018-2024.

TABLE 6
Number of WRA Patients, 1988-2024 by Primary Industrial Exposure and Average Annual Incidence Rate per 100,000 Workers, 1989-2024

2002 N American Industry Classification System		WRA Cases 1988-2024		Number of Employees[a]	Average Ann. Incidence Rate[b]	
		#	%		Rate	# Cases
11	Agriculture, Forestry, Fishing, & Hunting	47	1.2	79,404	1.6	47
21	Mining	14	0.3	5,449	7.1	14
22	Utilities	23	0.6	20,098	3.2	23
23	Construction	118	2.9	154,728	2.1	117
31-33	Manufacturing	2,235	55.0	599,847	10.2	2,211
42	Wholesale Trade	45	1.1	171,650	0.7	44
44-45	Retail Trade	138	3.4	472,032	0.8	138
48-49	Transportation & Warehousing	90	2.2	114,359	2.2	90
51	Information	25	0.6	57,049	1.2	25
52	Finance & Insurance	36	0.9	145,290	0.7	36
53	Real Estate & Rental & Leasing	20	0.5	52,502	1.1	20
54	Professional, Scientific & Technical Svcs	34	0.8	295,160	0.3	34
55	Mgt of Companies & Enterprises	2	<0.1	61,059	0.1	2
56	Administrative & Support & Waste Mgt	104	2.6	290,471	1.0	104
61	Educational Services	175	4.3	344,234	1.4	174
62	Health Care & Social Assistance	499	12.3	582,008	2.4	498
71	Arts, Entertainment & Recreation	35	0.9	51,504	1.9	35
72	Accommodation & Food Services	134	3.3	372,503	1.0	134
81	Other Services (except Public Admin)	100	2.5	136,541	2.0	99
92	Public Administration	159	3.9	172,227	2.5	157
00	Unknown	30	0.7	--	--	30
Total		4,063		4,242,534	2.6	4,032

[a]Source: Agriculture: 2017 U.S. Census of Agriculture-State Data, total farm employment accessed 8/10/2026. Denominator source for all other industries: Bureau of Labor Statistics -QCEW, 2016. Accessed 8/10/2026.

[b]Reporting in 1988 was begun mid-year and is not included in the calculation of the annual average incidence rate. Rates are based on the average number of cases by industry from 1989-2024 (36 years), per 100,000 Michigan workers.

TABLE 7
2,211 WRA Patients from Manufacturing Industries: 1989-2024[a]

2002 North American Industry Classification System		# WRA Cases	Avg Ann Rate[a]	# Employees[b]
311	Food Mfg	89	6.8	36,408
323	Printing & Related Support Activities	20	3.9	14,304
325	Chemical Mfg	120	11.3	29,592
326	Plastics & Rubber Products Mfg	128	8.6	41,567
327	Nonmetallic Mineral Product Mfg	22	5.8	10,528
331	Primary Metal Mfg	74	9.4	21,913
332	Fabricated Metal Product Mfg	133	4.6	80,225
333	Machinery Mfg	165	6.4	72,028
334	Computer & Electronic Product Mfg	17	2.4	19,575
336	Transportation Equipment Mfg	1,252	19.3	180,153
337	Furniture & Related Product Mfg	20	2.5	22,002
	Miscellaneous Mfg (*includes NAICS: 312-16,324,339)	171	19.2	31,188

[a]Average annual incidence rate, based on cases from 1989-2024 (36 years) per 100,000 adult workers in Michigan in each industrial category. Reporting in 1988 was begun mid-year and is incomplete and not included in this table.
[b]Source: Bureau of Labor Statistics -QCEW, 2016. Accessed 8/10/2026.

TABLE 8
Industry of WRA Patients by Time Period

		Time Period								
		1988-1997		1998-2007		2008-2017		2018-2024		
NAICS	Industry	#	%	#	%	#	%	#	%	Change in Percentage
11	Agr, Forestry, Fishing, & Hunting	4	0.3	12	0.8	8	0.9	22	4.7	+ 1467%
21	Mining	5	0.4	6	0.4	2	0.2	1	0.2	- 50%
22	Utilities	3	0.2	5	0.3	11	1.3	3	0.6	+ 200%
23	Construction	32	2.5	37	2.5	30	3.5	19	4.0	+ 60%
31-33	Manufacturing	912	71.6	809	55.4	313	36.5	202	42.9	- 40%
42	Wholesale Trade	23	1.8	14	1.0	3	0.4	6	1.3	- 28%
44-45	Retail Trade	15	1.2	48	3.3	51	6.0	22	4.7	+ 292%
48-49	Transportation & Warehousing	14	1.1	35	2.4	21	2.5	20	4.2	+ 282%
51	Information	6	0.5	11	0.8	7	0.8	1	0.2	- 60%
52	Finance & Insurance	2	0.2	17	1.2	15	1.8	2	0.4	+ 100%
53	Real Estate & Rental & Leasing	2	0.2	11	0.8	6	0.7	1	0.2	N/A
54	Professional, Scientific & Tech Svcs	9	0.7	16	1.1	6	0.7	4	0.8	+ 14%
55	Mgt of Companies & Enterprises	0	—	1	0.1	1	0.1	0	--	N/A
56	Admin & Support & Waste Mgt	10	0.8	27	1.8	40	4.7	29	6.2	+ 675%
61	Educational Services	40	3.1	73	5.0	50	5.8	12	2.5	- 19%
62	Health Care & Social Assistance	105	8.2	194	13.3	145	16.9	53	11.3	+ 38%
71	Arts, Entertainment & Recreation	5	0.4	11	0.8	15	1.8	4	0.8	+ 100%
72	Accommodation & Food Services	19	1.5	49	3.4	42	4.9	23	4.9	+ 227%
81	Other Svcs (except Public Admin)	22	1.7	31	2.1	29	3.4	19	4.0	+ 135%
92	Public Administration	44	3.5	46	3.1	51	6.0	19	4.0	+ 14%
00	Unknown	2	0.2	8	0.5	11	1.3	9	1.9	N/A

Type of Exposure – Trends

Table 9 shows the exposures associated with WRA among Michigan workers. The most frequent exposures reflect the widespread use of cleaning products across all industry sectors and the importance of the automotive manufacturing industry in the State. Most frequently identified exposures include cleaning products, associated with 550 (13.5%) of Michigan's WRA patients, and isocyanates (MDI, TDI, HDI and others) accounting for 479 (11.8%) of the WRA case exposures. Metal working fluids (coolants) accounted for 338 (8.3%) 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, can contain disinfectants, often 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 and can be found under the **Resources Section.**

Welding is the fifth most common cause of WRA in Michigan (not including unknown manufacturing and unknown office exposures). Both welders themselves as well as individuals who work in the same area may be affected by welding fume. A previous publication highlighted the morbidity and high health care costs from asthma associated with welding[3].

TOP EXPOSURES OVER TIME: Table 10 shows the trends among the top exposures by time period. Isocyanates decreased from 19.9% of all the WRA exposures in 1988-1997 to 5.7% in 2018-2024. Cleaning agents increased from 4.6% of all the WRA exposures in 1988-1997 to 20.0% in 2018-2024. Metalworking fluids, solvents, latex rubber, welding fume, formaldehyde and acids also decreased over time, while there was an increase in cases reported from exposure to epoxy, fungus and paint fumes 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 1988-2024. 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 metal-working fluids and other chemicals with low molecular weights appears to be trending downward although diisocyanates showed a slight increase after 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.

EMERGING EXPOSURES: In Michigan, medical marijuana became legal in 2008 and recreational marijuana in 2018. With legalization came the opening of multiple facilities that grow and process marijuana. There are over 700 licensed growing facilities, 135 licensed processing facilities and over 305 licensed provisioning facilities. There are over 30,000 workers in the industry. Workers in the marijuana industry may be exposed to several asthma-causing agents: marijuana plant dust, off-gassing of terpenes during the marijuana plant drying process, disinfectants, *i.e.* bleach and hydrogen peroxide/peracetic acid and mold, *i.e. Alternaria* and *Penicillium*. Nine cases of WRA have been reported among marijuana industry workers in Michigan. An additional five patients have been reported with acute bronchitis, pneumonitis and other respiratory symptoms from Michigan grow facilities: two workers from one incident after bleach and a cleaner with acid were mixed and generated chlorine gas, two workers from one incident after grinding used containers of fungicides and herbicides, and one worker from exposure to a sanitizer containing 75% ethanol. Respiratory irritant exposures in marijuana grow facilities include ozone, cleaning agents, fungicides, herbicides, and insecticides (https://oem.msu.edu/images/newsletter/Fall2023Vol34n4newsletter.pdf).

TABLE 9
Workplace Exposures Associated with Confirmed WRA Patients: 1988-2024

Exposure Agent	#	%
Cleaning Solutions	550	13.5
Isocyanates	479	11.8
Metal Working Fluids	338	8.3
Unknown (Mfg.)	314	7.7
Unknown (Office)	213	5.2
Exhaust/Smoke/Fumes	182	4.5
Welding Fume-Stainless & Other	168	4.1
Solvents	115	2.8
Paint Fumes	101	2.5
Fungus	95	2.3
Epoxy	92	2.3
Acids	74	1.8
Fire	74	1.8
Formaldehyde	68	1.7
Latex/Rubber	63	1.6
Construction Exposures	60	1.5
Plastic Fumes	58	1.4
Chlorine	55	1.4
Animal Dander	51	1.3
Fragrances	42	1.0
Acrylates	38	0.9
Wood Dust	35	0.9
Cobalt	34	0.8
Flour	29	0.7
Ammonia	28	0.7
Heat	23	0.6
Herbicide/Pesticide	23	0.6
Plants/Organic Matter	23	0.6
Cigarette Smoke	21	0.5
Fiberglass	21	0.5
Styrene	20	0.5
Aldehydes	18	0.4
Medication	18	0.4
Asphalt	16	0.4
Cement Dust	16	0.4
Chromium	16	0.4
Metal Dust	16	0.4
Amines	14	0.3
Caustics	14	0.3
Cosmetology Chemicals	14	0.3
Fire Extinguisher Powder	14	0.3
Grain Dust	13	0.3
Printing Inks	13	0.3
Rust Inhibitor	13	0.3
Anhydrides	12	0.3
Meat Wrapper's Asthma	10	0.2
Sewage	10	0.2
Insecticides	9	0.2
Other[a]	340	8.4
Total	**4,063**	

[a]There were 12 cases from exposure to: Exertion.

There were 9 cases from exposure to Cold Air.

There were 8 cases each with exposure to: Freon, Paper Dust, Pepper Gas and Polyurethane.

There were 7 cases each with exposure to: Azodicarbonamide, Cooking Oil, Drywall Dust, Enzymes, Sulfur Dioxide, Textile Lint.

There were 6 cases each with exposure to: Nitrogen, Ozone, Pickling Ingredients, Solder Fume.

There were 5 cases each with exposure to: 1,1,1 Trichloroethane, Coal Dust, Hydraulic Fluid, Lime Dust, Mold Release Spray, Photo Developing Fluids, Sand.

There were 4 cases each with exposure to: Asbestos, Coal Tar, Copier Toner, Natural Gas, Rose Hips, Sulfonate, Trichloroethylene, X-Ray Developing Fluids

There were 3 cases each with exposure to: Cadmium Solder, Colophony, Concrete Sealer, COVID-19, Explosion, Fertilizer, Flux, Isopropyl Alcohol, Kerosene, Nickel, Polyethylene, Sludge, Zinc, Zinc Oxide.

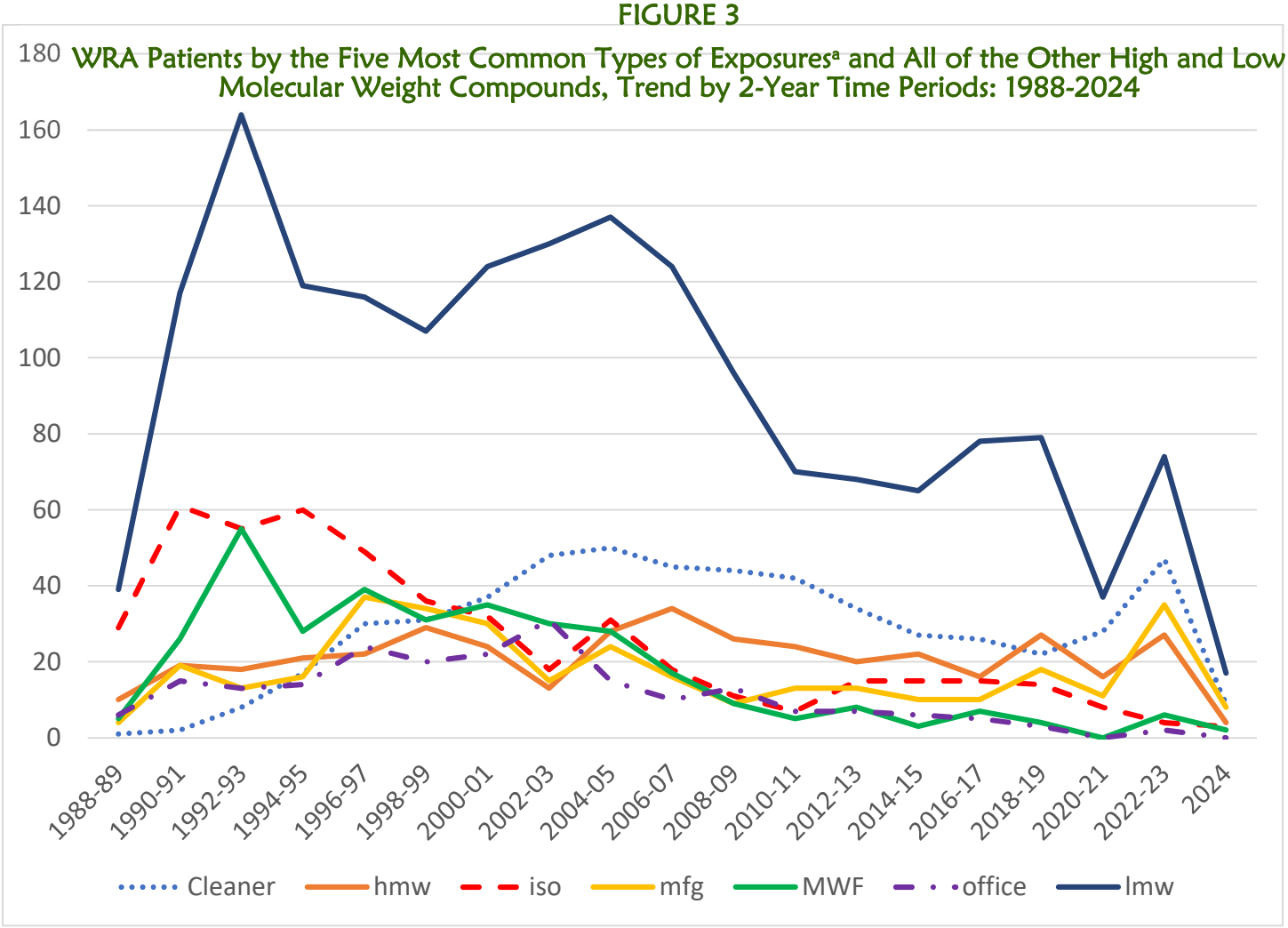
There were 2 cases each with exposure to: Barbeque Smoker, Bitrex, Calcium Chloride (used in Cherry Brine), Car Window Sealant, Carbon Dioxide, Cellulose, Copper Oxide, Fireproofing Chemicals, Gas and Oil Refinery Exposures, Glaze, Heated Polyvinyl Chloride, Methamphetamine Lab, Odor, Perchloroethylene, Phosgene, Plating Chemicals, 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-bromo-3-chloro-5 5-Dimethyl Hydantoin, Agent Orange, Ammonium Bifluoride, Ammonium Chloride, Antifreeze, Auto Body Shop Chemicals, Benzoate Esters, Blood, Blue Prints, Calcium Carbonate, Carbon Monoxide, Catheter Demonstration Chemical, Ceramic Powder, Cereal Dust from Food Manufacturing, Crude Oil, Cyanide, Deck Stain, Desert Storm, Dry Ice, Eggs, Ethylene Oxide, Face Mask, Flares, Gortex, Greenhouse Chemicals, Hydrogen Gas, Iodine, Laboratory Chemicals, Metal Finishing Chemicals, Methane, Methanol, Mica, Monoammonium Phosphate, Ninhydrin, Nonylphenol Polyethylene Glycol Ether, Nylon-polyhexamethylene Adipamide, Phenol, Pigment, Phosphate, Plasma Cutting, Platinum, Polyolefin, Potassium Aluminum Fluoride, Polybutadiene, Propane, Smoke from Burning Food, Soda Ash, Sodium Acetate, Sodium Chlorite, Soot, Spices, Stress, Swimming Pool Shock, Tetrahydrofuran, Titanium Tetrachloride, Tuberculosis Vaccine, Vaping Fumes, Vinegar, Wax, White Lithium, Wood Smoke, World Trade Center Exposure, Zinc Borate.

TABLE 10
Top Workplace Exposures of WRA Patients by Time Period

		Time Period				
	All Years	1988-1997	1998-2007	2008-2017	2018-2024	Change in Percentage
Exposure Type	# (%)	# (%)	# (%)	# (%)	# (%)	
Cleaning Agents	550 (13.5)	59 (4.6)	214 (14.6)	183 (21.4)	94 (20.0)	+ 335%
Isocyanates	479 (11.8)	253 (19.9)	136 (9.3)	63 (7.4)	27 (5.7)	- 71%
Metalworking Fluids	338 (8.3)	153 (12.0)	144 (9.9)	32 (3.7)	9 (1.9)	- 84%
Welding Fume	168 (4.1)	62 (4.9)	62 (4.2)	31 (3.6)	13 (2.8)	- 43%
Solvents	115 (2.8)	50 (3.9)	49 (3.4)	9 (1.1)	7 (1.5)	- 62%
Paint	101 (2.5)	18 (1.4)	49 (3.4)	21 (2.5)	13 (2.8)	+ 100%
Epoxy	92 (2.3)	33 (2.6)	27 (1.8)	19 (2.2)	13 (2.8)	+ 8%
Fungus	95 (2.3)	0	41 (2.8)	38 (4.4)	16 (3.4)	+ 21%
Formaldehyde	68 (1.7)	33 (2.6)	17 (1.2)	15 (1.8)	3 (0.6)	- 77%
Acids	74 (1.8)	27 (2.1)	24 (1.6)	15 (1.8)	8 (1.7)	- 19%
Latex/Rubber	63 (1.6)	25 (2.0)	32 (2.2)	4 (0.5)	2 (0.4)	- 80%

FIGURE 3



[a]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.

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. The percentage of current smokers in the most recent time period is higher than the state average for 2024 (13.4%) (Michigan.gov/BRFS).

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

HEALTH CARE USAGE Sixty-seven percent of the WRA patients had at least one visit to the Emergency Department (ED) in their lifetime for their WRA, and 34% had at least one hospitalization for their WRA (Table 14). The average number of ED visits was 5.1 and the average number of hospitalizations was 3.6.

WORK-RELATED ASTHMA DEATHS Fortunately, a very small percent (0.01-0.02%) of asthma patients die from asthma. From 1998 to 2024, we have identified 13 work-related asthma deaths.

There were two WRA deaths in 2023: a 52-year-old male who worked for a plastic injection molding company died from exposure to welding fume, and a 44-year-old male died from exposure to welding fume at an auto parts manufacturing facility. There was one WRA death in 2022: a 31-year-old male who had just begun working at a cereal manufacturer died from exposure to cereal dust. There were no WRA deaths reported in 2020 or 2021. There was one WRA death in 2019: a 50-year-old female died from exposure to ingredients at a pickle manufacturing facility. There were no work-related asthma deaths identified in calendar years 2008-2012, 2014, or 2016-2018. There was one work-related asthma death each in 1998, 2003, 2005-2007, 2013, 2015, and two in 2004. We have published articles on some of the work-related asthma deaths[4,5,6].

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%, a decrease to 17% in 2021, a decrease to 15.2% in 2022, a decrease to 13.6% in 2023 and a decrease to 13.4% in 2024.

TABLE 11
Cigarette Smoking Status of 3,884[a] Confirmed WRA Patients: 1988-2024

	Smoking Status						
	Current		Ex-Smoker		Non-Smoker		TOTAL
	#	%	#	%	#	%	
OA	255	20.6	469	37.9	512	41.4	1,236
POA	205	15.3	536	40.0	600	44.7	1,341
AA	181	20.4	221	24.9	485	54.7	887
RADS	113	26.9	155	36.9	152	36.2	420
All	754	19.4	1,381	35.6	1,749	45.0	3,884

[a]Missing data on 179 patients.

TABLE 12
Cigarette Smoking Status of WRA Patients by Time Period

		Time Period				
	All Years	1988-1997	1998-2007	2008-2017	2018-2024	Change in Percentage
Smoking Status	# (%)	# (%)	# (%)	# (%)	# (%)	
Current	754 (19)	243 (20)	295 (21)	140 (17)	76 (18)	- 10%
Ex-Smoker	1,381 (36)	540 (43)	479 (34)	258 (32)	104 (24)	- 44%
Non-Smoker	1,749 (45)	463 (37)	632 (45)	409 (51)	245 (58)	+ 36%
Total	3,884[a]	1,246	1,406	807	425	

[a]Missing data on 179 patients.

TABLE 13
Personal History of Allergies or Asthma Among 3,663[a] Confirmed WRA Patients: 1988-2024

Personal History of:

	Allergies & Asthma		Asthma Only		Allergies Only		No Allergies or Asthma	
	#	%	#	%	#	%	#	%
OA	71	6.1	61	5.2	347	29.9	683	58.8
POA	97	7.8	66	5.3	422	34.1	651	52.7
AA	445	49.1	419	46.2	23	2.5	20	2.2
RADS	17	4.7	39	10.9	88	24.6	214	59.8
All	630	17.2	585	16.0	880	24.0	1,568	42.8

[a]Missing data on 400 patients.

TABLE 14
Health Care Usage Among Confirmed WRA Patients: 1988-2024

Lifetime History of Health Care Usage

ED Visit[a]		Hospitalized[b]	
Yes # (%)	No # (%)	Yes # (%)	No # (%)
2,575 (67)	1,241 (33)	1,204 (34)	2,374 (66)
Range 1-300 visits		Range 1-200 hospitalizations	
AVG 5.1 ±14.2		AVG 3.6±9.7	

[a]Missing data on 247 patients.
[b]Missing data on 485 patients.

SYMPTOMS

Three thousand sixty-eight (3,068) 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: Sixty-four to 72% of the cases were no longer exposed to the agent associated with their WRA. 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 still exposed with breathing problems still present, reported their symptoms were improving, compared to 50% among those no longer exposed; during 2018-2024, 18% of those still exposed reported an improvement in symptoms, compared to 29% among those no longer exposed. Also, among those still exposed, there was a decrease among those reporting the need for less asthma medication, with 21% reporting the need for less asthma medication during 1988-1997 compared to 30% among those no longer exposed, and 11% reporting the need for less asthma medication during 2018-2024, compared to 23% among those no longer exposed.

TABLE 15
Persistence of Symptoms and Medication Use in 3,551 Confirmed WRA Patients: 1988-2024

Still Exposed?	Total	Breathing Problems Still Present?				Still Taking Asthma Medications?			
		Yes		Less		Yes		Less	
		#	%	#	%	#	%	#	%
Yes	1,049	995	94.9	296	28.2	916	87.3	178	17.0
No	2,502	2,073	82.9	1,153	46.1	1,946	77.8	711	28.4
Total	3,551[a]	3,068		1,449		2,862		889	

[a]Information missing on 512 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.

TABLE 16
Persistence of Symptoms and Medication Use in Confirmed WRA 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	
2008-2017	Yes	210	194	92.4	51	24.3	193	91.9	30	14.3
	No	527	397	75.3	241	45.7	410	77.8	169	32.1
	Total	737	591		292		603		199	
2018-2024	Yes	111	99	89.2	20	18.0	99	89.2	12	10.8
	No	200	143	71.5	58	29.0	143	71.5	45	22.5
	Total	311	242		78		242		57	
Change in Percentage	Yes			-7%		-47%		+5%		-49%
	No			-14%		-41%		-4%		-24%

PULMONARY FUNCTION TESTING

The percentage of WRA patients who had different types of pulmonary function testing overall 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 WRA Patients by Time Period

		Time Period				
	All Years	1988-1997	1998-2007	2008-2017	2018-2024	Change in Percentage
Test Type	(%)	(%)	(%)	(%)	%	
Pre-post Bronchodilatation	49	54	54	44	18	- 67%
Methacholine Challenge	17	25	16	10	4	- 84%
Peak Flow at Work & Home	3	3	3	5	1	[a]
Pre-post Work-shift	3	2	4	3	1	[a]
Specific Antigen Challenge	<1	0.9	0.3	—	--	[a]

[a]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, 40% were awarded, 17% were denied and 43% were pending approval at the time they were interviewed.

WORKERS' COMPENSATION OVER TIME: The percentage of WRA patients who applied for workers' compensation benefits did not change across the time periods: 1988-1997, 1998-2007, 2008-2017 and 2018-2024. The first two periods showed 49% of patients applying for workers' compensation benefits, the third period had 50% apply, and the fourth period had 49% apply. However, there were differences in the outcomes of applying for benefits, with an increase in the percentage awarded benefits over the four time periods from 37% to 33% to 47% to 65%. The percentage of claims denied increased from 16% to 17% to 22% in the first three periods and decreased to 15% in the most recent time period. Accordingly, the percentage of claims pending approval decreased from 48% to 50% to 32% to 20% in the most recent time period.

INDUSTRIAL HYGIENE

A total of 826 workplace inspections associated with the 4,063 confirmed WRA cases have been conducted since 1988 (Table 18); 134 of those facilities have been inspected more than once. There was one inspection each in 2020 and 2021, two inspections in 2022, no inspections in 2023 and three inspections in 2024.

Air sampling was conducted during 594 inspections (Table 19); 31 of the 586 (5.3%) 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: 1988-2024

	# Patients	Companies	
Inspection Status	Represented	#	%
Inspected	1,295	826[a]	27.9
No Follow-up Planned	2,558	1,945	65.6
Scheduled for Inspection	0	0	--
Out of Business	80	72	2.4
No Longer Use Occupational Allergen	27	26[b]	0.9
Sent Company Letter to Check Exposures[d]	103	96	3.3
Total	4,063	2,965[c]	

[a]826 inspections were conducted in 692 different workplaces.
[b]Eight companies that no longer use the suspected causal agent were previously inspected.
[c]Represents 2,831 different facilities.
[d]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 826 Workplace Inspections: 1988-2024

Air Sampling – NIOSH Standard	#	%
Above NIOSH Standard	67	8.1
Below NIOSH Standard	494	59.8
No NIOSH Standard	33	4.0
Unknown (no report yet)	6	0.7
Did Not Sample for an Allergen	30	3.6
Did Not Sample	196	23.7
Total	826	
Air Sampling – MIOSHA Standard	#	%
Above MIOSHA Standard	31	3.8
Below MIOSHA Standard	555	67.2
No MIOSHA Standard	7	0.8
Unknown (no report yet)	6	0.7
Did Not Sample for an Allergen	31	3.8
Did Not Sample	196	23.7
Total	826	

AIR MONITORING

Table 20 shows the suspected causal agents that were above the NIOSH and/or MIOSHA 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

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

TABLE 20
Suspected Causal Agents Above the MIOSHA Permissible Exposure Limit (PEL) and/or NIOSH Recommended Exposure Limit (REL): Michigan 1988-2024

	Above NIOSH REL		Above MIOSHA PEL	
Asthma-Causing Agents	#	%	#	%
Formaldehyde	28	41.8	1	3.2
Cobalt	8	11.9	6	19.4
Styrene	6	9.0	4	12.9
Metal-Working Fluids	5	7.5	1	3.2
Glutaraldehyde	4	6.0	3	9.7
HDI	4	6.0	No PEL	--
MDI	3	4.5	0	--
Wood Dust	3	4.5	2	6.5
Chromic Acid	1	1.5	1	3.2
Ethylene Oxide	1	1.5	0	--
Phthalic Anhydride	1	1.5	1	3.2
Starch	1	1.5	0	--
Total Dust (Dry Plant Materials)	1	1.5	0	--
Total Dust (Grinding on Fiberglass)	1	1.5	1	3.2
Welding Fume (Total Particulate)	No REL	--	9	29.0
Flour Dust	No REL	--	2	6.5
TOTAL	67		31	

Co-Worker Interviews at Workplace Investigations – Trends

Co-workers were interviewed during 624 of the 826 inspections. Workers had daily or weekly breathing symptoms associated with work or new-onset asthma since beginning to work at 403 of the 624 (65%) companies. The average percentage of co-workers with symptoms in these 403 companies was 20.4%. All 1,708 co-workers from the remaining 221 companies reported no daily or weekly breathing symptoms associated with work. One thousand six hundred thirty-five (1,635) of the 10,565 (15.5%) co-workers interviewed had symptoms consistent with work-related asthma (Table 21). Over time, the percentage of co-workers with breathing problems decreased between the first two periods, but then increased during the third period and decreased in the fourth period.

The MIOSHA Injury and Illness Logs (Form 300) kept by employers listed 586 workers from 137 companies with asthma or asthma-like symptoms. Only 10 workers identified in the interviews with daily or weekly chest tightness, shortness of breath (SOB) or wheezing were also listed on the MIOSHA Log. Combining the information from the interviews and Injury and Illness Logs, a total of 2,221 symptomatic workers were identified during the 826 MIOSHA enforcement inspections.

TABLE 21
Daily or Weekly Breathing Symptoms at Work or New-Onset Asthma Among Co-Workers of the 4,063 Confirmed WRA Patients: 1988-2024 and by Time Period

	# Companies Inspected where Co-Workers were Interviewed	# Co-Workers with Daily or Weekly Breathing Symptoms at Work or New-Onset Asthma/# Co-Workers Interviewed	%
	624	1,635/10,565	15.5
BY TIME PERIOD:			
1988-1997	339	1,125/6,293	17.9
1998-2007	204	380/3,200	11.9
2008-2017	75	121/979	12.4
2018-2024	6	9/93	9.7
	# Companies with >=1 Co-Worker on OSHA Log with Asthma or Asthma Symptoms/# Companies Inspected	# Co-Workers on OSHA Log with Breathing Symptoms	
	137/823	586	
BY TIME PERIOD:			
1988-1997	76/437	400	
1998-2007	52/266	174	
2008-2017	8/108	11	
2018-2024	1/12	1	
Total Co-Workers with Symptoms from Interviews and OSHA Logs		2,221	

[a]Ten individuals were identified on both the co-worker questionnaire and the OSHA Log.



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.



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 undercounts non-manufacturing exposed employees such as at auto body paint shops because the EPA does not include non-manufacturing establishments. Conversely, our estimate overcounts 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 possible source to identify chemical exposures associated with WRA is the Michigan Department of Environment, Great Lakes, and Energy (EGLE, formerly the 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. ***As of 2021, overall EGLE data is no longer available due to a change in their FOIA procedures. Individuals, including community residents, health care providers, safety professionals and workers, can request individual company information on chemicals reported to EGLE.***

In the EPA TRI, 85 companies reported using isocyanates 2023 and in 2024, 84 companies in 2022; 79 companies in 2021, 95 companies in 2020, 104 companies in 2019, 106 companies in 2018, 112 companies in 2017, 111 companies in 2016 and 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 are listed in Table 22. In 2024, there were 27,217 workers potentially exposed to isocyanates in manufacturing, similar to the 27,416 workers potentially exposed to isocyanates in manufacturing in 2023, which is an approximate increase of 5,000 workers compared with 22,403 workers in 2022.

TABLE 22 Michigan Workers Employed in Manufacturing Facilities in 2024 Where Isocyanates are Used, by County

County	Company Name[a]	# Workers Employed by Isocyanate Using Facilities[b]	Total # Workers in the County[c]	% Workers Potentially Exposed to Isocyanates
ALLEGAN	MOTUS INTEGRATED TECHNOLOGIES—MAPLEWOOD PARKER HANNAFIN HPD YAN FENG AUTOMOTIVE INTERIORS PMSC	378	35,863	**1.1**
BARRY	BRADFORD WHITE CORP	900	11,104	**8.1**
BAY	QUANTUM COMPOSITES INC	14	29,015	**<0.1**
BERRIEN	LECO CORP NILES STEEL TANK	542	52,289	**1.0**
BRANCH	GOKOH COLDWATER INC	15	12,605	**0.1**
CALHOUN	BREMBO HOMER FOUNDRY COMCAST URETHANE TRANSCONTINENTAL	98	43,502	**0.2**
CLARE	LEAR CORP. FARWELL PLANT	278	5,774	**4.8**

Table 22. County	Company Name[a]	# Workers Employed by Isocyanate Using Facilities[b]	Total # Workers in the County[c]	% Workers Potentially Exposed to Isocyanates
CRAWFORD	WEYERHAEUSER	59	3,273	**1.8**
DICKINSON	GREDE, LLC IRON MOUNTAIN LOUISIANA-PACIFIC-SAGOLA OSB	685	11,242	**6.1**
EATON	DETROIT AUTOMOTIVE TECHNOLOGIES SIKA CORP	278	38,496	**0.7**
GENESEE	KAIS-AIR	273	115,592	**0.2**
HILLSDALE	ESSEX SPECIALTY PRODUCTS	2	10,582	**<0.1**
HURON	VALLEY ENTERPRISES	121	9,592	**1.3**
INGHAM	HUNTSMAN ADVANCED MATERIALS SA AUTOMOTIVE	223	109,348	**0.2**
ISABELLA	ELECTROLUX PROFESSIONAL GROUP THE DELFIELD CO.	1,049	18,553	**5.7**
JACKSON	MILSCO MICHIGAN SEAT TAC MFG	377	48,053	**0.8**
KALAMAZOO	AZON USA FLOWSERVE CORP STRYKER INSTRUMENTS	1,204	107,950	**1.1**
KENT	FLEXIBLE STEEL LACING CO, DBA FLEXCO GRAND RAPIDS FOAM TECHNOLOGIES HB FULLER NORDIC SPAS LLC PURFORMS INC. RICHWOOD INDUSTRIES INC.	579	389,149	**0.1**
LENAWEE	ANDERSON DEVELOPMENT INTEVA PRODUCTS	415	21,433	**1.9**
LIVINGSTON	ANTOLIN-HOWELL	718	57,606	**1.2**
LUCE	LOUISIANA-PACIFIC CORP-NEWBERRY SIDING	14	976	**1.4**
MACOMB	AXALTA COATING SYSTEMS FCA US ASSEMBLY PLANT INTERNATIONAL CASTING CORP L & L PRODUCTS INC. MAYCO INTERNATIONAL ROMEO RIM INC SHELBY FOAM SYSTEM WOLVERINE BRONZE	2,263	300,890	**0.8**
MASON	GREAT LAKES CASTING	210	8,577	**2.4**
MIDLAND	DDP SPECIALTY ELECTRONIC PARTS LLC	349	35,249	**1.0**
MONROE	SUNRISE WINDOWS LTD	452	35,906	**1.3**
MONTCALM	KENT FOUNDRY	46	13,130	**0.4**
MUSKEGON	MUSKEGON COMPOSITES, INC STRUCTURAL CONCEPTS-PLANT 2	489	56,200	**0.9**
OAKLAND	ARMALY SPONGE EAGLE INDUSTRIES LYMTAL INTERNATIONAL INC TEMPERFORM CORP. WEBASTO ROOF SYSTEMS	409	676,947	**0.1**
OGEMAW	TAYLOR ENTRANCE SYSTEMS	170	5,272	**3.2**

Table 22. County	Company Name[a]	# Workers Employed by Isocyanate Using Facilities[b]	Total # Workers in the County[c]	% Workers Potentially Exposed to Isocyanates
OTTAWA	MAGNA ENGINEERED GLASS	20	115,798	**<0.1**
SAGINAW	GLASTENDER POREX TECHNOLOGIES SAGINAW METAL CASTING OPERATIONS	905	69,059	**1.3**
SANILAC	ASCO LP GRUPO ANTOLIN MIDWEST RUBBER CO	520	9,156	**5.7**
ST CLAIR	AURIA SOLUTIONS IAC PORT HURON MAGNA ELECTRIC VEHICLE STRUCTURES	197	35,950	**0.5**
VAN BUREN	SIKA MBCC US LLC SPECIAL-LITE INC	195	17,077	**1.1**
WASHTENAW	FAURECIA INTERIOR SYSTEMS-SALINE	1,510	133,688	**1.1**
WAYNE	BASF CORP—LIVONIA PLANT BASF CORP—WYANDOTTE PLANT CAPITAL RESIN CORP CYGNET AUTOMATED CLEANING DETROIT ASSEMBLY COMPLEX EQ DETROIT FCA US JEFFERSON NORTH ASSEMBLY PLANT NORTHFIELD MANUFACTURING PLASTOMER TOOLING EQUIPMENT INTERNATIONAL WEBASTO ROOF SYSTEMS WOODBRIDGE CORP	10,778	641,340	**1.7**
WEXFORD	REC BOAT HOLDINGS-CRUISER PLANT REC BOAT HOLDINGS-SPORT/ENGINEERING	480	10,904	**4.4**
TOTAL		**27,215**	**3,826,018**	**0.7**

[a]Source: U.S. Environmental Protection Agency. Toxics Release Inventory, Michigan Companies Using Isocyanates in 2024, data accessed 7/9/2026.

[b]Source: Manta.com and D&B Hoovers accessed 7/9/2026.

[c]Source: Michigan Labor Market Information, Data Explorer, 2024 Annual Employment (PRIVATE OWNERSHIP) by County, www.milmi.org accessed 10/28/2026.

Table 23 summarizes any company with one of the 400 TRI-covered 6-digit NAICS codes in the state, by county, that uses 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 US EPA TRI for the calendar year 2024. A listing of the 400 TRI-covered 6-digit NAICS codes can be found at: https://guideme.epa.gov/ords/guideme_ext/f?p=guideme:gd:::::gd:naics_codes.

Additional chemical exposures associated with WRA in Michigan can be found in the 2021 report at: oem.msu.edu, under the Resources Section for Work-Related Asthma, titled Michigan Workforce, 2021: Potential Exposure to Acrylic Acid, Chromium or Chromium Compounds, Diethanolamine and Ethylene Oxide.

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TABLE 23
Michigan Facilities by County, Reporting to the United States Environmental Protection Agency (EPA) Toxic Release Inventory (TRI) in 2024[a]

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, 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	EXPOSURES
ALGER	NEENAH PAPER MICHIGAN INC.	A
ALLEGAN	ADVANCED ARCHITECTURAL PRODUCTS	S
	JBS PLAINWELL	A
	LG ENERGY SOLUTION MICHIGAN INC.	CO
	OTSEGO PAPER INC.	A
	SEKISUI KYDEX LLC	S
	SUPERIOR STONE PRODUCTS	MMA, S
	TIARA YACHTS INC.	S
ALPENA	HOLCIM (US) INC.	A
BARRY	BRADFORD WHITE CORP.	CO
	HASTINGS FIBERGLASS PRODUCTS	S
BAY	MERSEN USA GS CORP - BAY CITY	CH
	MICHIGAN SUGAR CO - BAY CITY FACTORY.	A
	QUANTUM COMPOSITES INC.	MA, S
BERRIEN	NCP COATINGS LLC	CO
	SPECIAL-LITE INC.	S
BRANCH	ELMET TECHNOLOGIES	A, CO
	REAL ALLOY SPECIFICATION LLC	CH
	STAR OF THE WEST MILLING CO.	CH
CALHOUN	AVIENT COLORANTS USA LLC – ALBION FACILITY	CO
	BASF TODA AMERICA INC.	CO
	BLEISTAHL NA LLP	CO
	KNAUF INSULATION INC.	A
	MUSASHI AUTO PARTS-MI INC.	A
	ROSLER METAL FINISHING USA LLC	S
	THE ANDERSONS MARATHON HOLDINGS LLC - ALBION FACILITY	F
	WOODWORTH INC HOMER	A
CASS	MENNEL MILLING CO. OF MICHIGAN (109 S MILL AND 301 S MILL)	CH
CHARLEVOIX	ST MARYS CEMENT U.S. LLC	A
CLINTON	MWC LLC.	A
CRAWFORD	ARAUCO NA GRAYLING PARTICLEBOARD	F
	BAKELITE CHEMICALS LLC	A, F
	WEYERHAEUSER NR CO.	F
DELTA	BILLERUD ESCANABA LLC.	A, CH, F
DICKINSON	LOUISIANA-PACIFIC SAGOLA OSB	F
	BILLERUD QUINNESEC	A, CH, F
EATON	ETM ENTERPRISES INC.	S

COUNTY	COMPANY NAME	EXPOSURES
GENESEE	WOODWORTH INC FLINT	A
HOUGHTON	CALUMET ELECTRONICS CORP.	A, F
	KOPPERS PERFORMANCE CHEMICALS	A
	WARM RAIN CORP.	S
HURON	CORTEVA AGRISCIENCE LLC - HARBOR BEACH OPERATIONS	A
	MICHIGAN SUGAR CO - SEBEWAING FACTORY	A
	THUMB TOOL & ENGINEERING	A
INGHAM	AURORA SPECIALTY CHEMISTRIES	E, M
	NITREX INC.	A
	SYMMETRY MEDICAL INC.	CO
IONIA	BELDING TANK TECHNOLOGIES	S
	ROBROY ENCLOSURES	S
JACKSON	CHEMETALL US INC.	MA
	INDUSTRIAL STEEL TREATING	A
KALAMAZOO	ALLNEX USA INC.	F
	HAVILAND PRODUCTS CO.	A
	PHARMACIA & UPJOHN CO LLC A SUBSIDIARY OF PFIZER INC.	A, CH, E, F
	RICHARD-ALLEN SCIENTIFIC	F
KENT	ARKEMA INC.	P, S
	GM COMPONENTS HOLDINGS LLC	A
	HYDRO-CHEM SYSTEMS	A
	LACKS TRIM SYSTEMS-AIRLANE	F
	MICHIGAN TURKEY PRODUCERS LLC-HALL ST SW	A
	MICHIGAN TURKEY PRODUCERS-CHICAGO DR SW	A
	PLASTIC PLATE INC. - KRAFT PLATER	F
	PROGRESSIVE SURFACE	CO
	SUPERIOR STONE PRODUCTS INC.	MMA, S
LAPEER	LAPEER PLATING & PLASTICS INC.	F
LENAWEE	ADRIAN STEEL CO.	CO
	ANDERSON DEVELOPMENT CO.	MA, MMA, S
	WACKER CHEMICAL CORP	A
LIVINGSTON	FORTECH PRODUCTS	A
	WYMAN-GORDON CO.	CO
LUCE	LOUISIANA PACIFIC CORPORATION-NEWBERRY	F
MACOMB	AXALTA COATING SYSTEMS USA LLC-MOUNT CLEMENS PLANT	M, MMA, S
	HENKEL US OPERATIONS CORP.	F
	METALLURGICAL PROCESSING CO.	A
	SPECIALTY STEEL TREATING INC..	A
MANISTEE	PACKAGING CORP OF AMERICA	F, S
MARQUETTE	DYNO NOBEL INC	A
	EAGLE MINE-MICHIGAMME	CO
	EAGLE MINE LLC-HUMBOLDT MILL	CO
MASON	OCCIDENTAL CHEMICAL CORP.	A
MECOSTA	AGCO INC.	S
MENOMINEE	FIBREK	A

COUNTY	COMPANY NAME	EXPOSURES
	L.E. JONES CO LLC	CO
MIDLAND	CABOT FUMED SILICA - MIDLAND PLANT	CH
	DDP SPECIALTY ELECTRONIC MATERIALS US LLC	S
	MIDLAND COGENERATION VENTURE	F
	THE DOW CHEMICAL CO.1790 BUILDING	A, CH, F, S
	TRINSEO LLC-MI OPERATIONS	MMA, S
	XALT ENERGY LLC	CO
MONROE	ADVANCED HEAT TREAT CORP.	A
	DTE ELECTRIC CO - MONROE POWER PLANT.	A
	GUARDIAN INDUSTRIES - CARLETON	A
MUSKEGON	CANNON-MUSKEGON	CO
	HOWMET CORP - PLANTS 1, 3 & 10	CO
	MUSKEGON COMPOSITES INC.	S
	TECHLINE PRODUCTS	S
	WEBB CHEMICAL SERVICE CORP.	F
OAKLAND	AKZO NOBEL COATINGS INC.	S
	ENGINEERED HEAT TREAT INC	A
	LYMTAL INTERNATIONAL, INC.	MA
	ND INDUSTRIES	F
	OERLIKON METCO (US) TROY	CO
	SPECIALTY STEEL TREATING INC.	A
	WOODWORTH INC.	A
OGEMAW	HYPERION MATERIALS & TECHNOLOGIES - WEST BRANCH	CO
OSCEOLA	ADVANCED FIBERMOLDING INC.	S
OTTAWA	AURORIUM LLC - ZEELAND	MA
	BOAR'S HEAD PROVISIONS CO INC.	A
	GENTEX CORP. AUTOMOTIVE DIVISION	M
	J H CAMPBELL GENERATING PLANT	A
	NPR OF MICHIGAN	CO
	REQUEST FOODS INC. (COLDQUEST, GREENLY ST, QUINCY ST, JOHN F DONNELLY DR)	A
	THE HILLSHIRE BRANDS CO.	A
SAGINAW	ADVANCED MICRONUTRIENT PRODUCTS INC	A
	STAR OF THE WEST MILLING CO.	CH
SANILAC	DGP INC.	S
	MICHIGAN SUGAR CO-CROSW ELL FACTORY	A
	MIDWEST RUBBER CO.	CH
ST. CLAIR	MARYSVILLE ETHANOL LLC	F
	MICHIGAN METAL COATINGS 1720 AND 2015 DOVE ST)	CO
	SUNSATION PRODUCTS INC.	MMA, S
	ZF AXLE DRIVES MARYSVILLE	A
ST. JOSEPH	AQUATIC CO.	S
TUSCOLA	MICHIGAN SUGAR CO - CARO FACTORY	A
	POET BIOREFINING-CARO LLC	F
VAN BUREN	ALLOY STEEL TREATING CO. INC.	A

COUNTY	COMPANY NAME	EXPOSURES
WASHTENAW	DAPCO INDUSTRIES	A
WAYNE	AIR PRODUCTS & CHEMICALS INC/DETROIT HYDROGEN FACILITY	A
	AJAX METAL PROCESSING INC.	CO
	BASF CORP.	A, M, MMA, S
	COOPER HEAT TREATING LLC.	A
	DIPSOL OF AMERICA	CO
	DYNAMIC SURFACE TECHNOLOGIES INT. INC.	A
	EES COKE BATTERY LLC.	A
	EQ DETROIT INC.	CO
	INLAND WATERS POLLUTION CONTROL DETROIT FACILITY	S
	JCI JONES CHEMICALS INC.	CH
	MARATHON PETROLEUM CO LP - MICHIGAN REFINING DIV.	A, CO
	MCGEAN-ROHCO INC.	CO
	NEW BOSTON RTM INC.	S
	OERLIKON (US) PLYMOUTH	CO
	POLYCHEMIE INC.	F
	PVS TECHNOLOGIES INC	CH
	WAYNE DISPOSAL INC.	CO
	Z TECHNOLOGIES CORP.	A
WEXFORD	REC BOAT HOLDINGS LLC-SPORT/ENGINEERING	MMA, S
	REC BOAT HOLDINGS-CRUISER PLANT	MMA, S

[a]Source: US Environmental Protection Agency. Toxics Release Inventory, Michigan. Companies Using Select Toxic Chemicals for Calendar Year 2024, accessed 7/9/2026.

Discussion

Ongoing surveillance for WRA has identified changes over time. The reports of WRA from exposure to cleaning agents increased while reports of WRA caused by isocyanates, metal working fluids, and welding decreased. In 2020, with the onset of the COVID-19 pandemic, following the adoption of recommendations for increased use of disinfectants, 30% (14/46) of the WRA reports were associated with exposures to cleaners and disinfectants, while previously cleaning agents constituted 13% of all the MI WRA cases. In 2021, 21% (13/62) of cases were identified with exposures to cleaners and disinfectants. In 2022, 32% (23/72) of cases were identified with exposures to cleaners and disinfectants, in 2023 15% (9/60) of cases were identified with exposure to cleaners and disinfectants, and in 2024 18% (9/49) of cases were identified with exposure to cleaners and disinfectants. Cleaners and disinfectants are used in many workplaces, and controlling exposures will depend on the substitution of less hazardous products and limiting use to only the recommended and necessary applications. The decrease over time in reporting WRA for exposures to isocyanates, metal-working fluid and welding fume, which are used in industrial settings, may be due to the ability of these industrial settings to apply engineering and industrial hygiene controls.

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) consensus statement estimates that for 15% of adults with asthma, the asthma is caused by work exposures.[7] A second ATS consensus statement estimated that 21.5% of adults with asthma have work-aggravated asthma.[8] The combined estimates from these consensus statements would indicate that 36.5% of all adult asthma is work-related. Based on responses from the 2005 Behavioral Risk Factor Surveillance System (BRFSS) random sample of Michigan residents,

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

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.[1] Table 24 shows how this percentage varied by age, gender, race, annual income and education. Among those individuals who responded that 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.[1] At minimum, the data suggest that providers are not addressing the concerns of their patients and are probably missing the identification of WRA triggers. Because of the frequency with 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."[10]

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 and to use more asthma medication.[11,12]



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
GENDER		
Male	54.7	46.3-62.8
Female	51.4	46.5-56.2
RACE		
White	50.5	45.7-55.2
Black/African American	58.9	46.7-70.1
ANNUAL INCOME		
<$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
EDUCATION		
< 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

In 2020, we reviewed the Michigan work-related asthma surveillance system from 1988 to 2018.[13] Highlights of the data collected over the 31 years:

- Overall, the confirmed cases of WRA in Michigan have decreased over the 31 years. The cumulative incidence rate of WRA decreased from 3.5 during 1988-1997 to 2.0 cases per 100,000 Michigan workers during 2008-2018. Surveillance systems in other countries have also reported a downward trend in WRA.
- There were decreases in cases from specific exposures to well-known causes of WRA such as isocyanates and metal working fluids and in the cumulative incidence rate in the overall manufacturing sector (11.6 to 5.6 cases per 100,000 workers). This decrease was consistent with improved workplace engineering and controls such as enclosure of work processes, product substitution and use of personal protective gear.
- However, for cleaning products, which are found across all industries, generally with less standardized work practices than those applied in a manufacturing setting there was an increase over time in the number of cases and percentage of cases associated with cleaning products from 5% to 20%, even before their increased use associated with the COVID-19 pandemic.
- Sixty-six percent of WRA cases had an emergency department visit, with a median of two and an average of five visits, and 35% were hospitalized for their WRA, with a median of one and an average of four hospitalizations.
- Despite the high morbidity and cost of WRA, only 49% had applied for workers' compensation.
- Nine individuals died from an asthma attack from a workplace exposure (the paper describes one of the deaths). The decedents ranged from 19 to 77 years old. Five were men. Five worked in manufacturing and one each worked in construction, agriculture, food services, and automotive repair. Four were exposed to isocyanates, and one case each was exposed to secondhand cigarette smoke, milk tank cleaning agents, construction chemicals, mold machine release spray, and welding fume.
- WRA cases are useful for targeting workplace enforcement inspections. The confirmed cases worked in 2,601 facilities. Michigan OSHA inspected 806 of those facilities. During the inspections, 10,493 co-workers of the index cases completed a confidential respiratory questionnaire; 1,622 (15%) reported being bothered at work by daily or weekly chest tightness, shortness of breath or wheezing, or having new-onset asthma since beginning to work at the facility. Symptomatic co-workers decreased over time from 18% to 12%.

Workers who were reported to the Michigan surveillance system are generally young to middle age White men and women, with the greatest number being reported from the Detroit metropolitan area. However, the rate of WRA among Black/African American workers is 3.3 times greater than among White workers. Based on an analysis conducted for previous annual reports, factors from the WRA surveillance data that would contribute to greater morbidity among Black/African American workers include a greater likelihood of continuing to be exposed to the workplace agent, having a longer time of exposure before leaving work, and being less likely to receive Workers' Compensation.

With changes in the economy, more temporary workers are being hired on an as-needed basis. The transient nature of temporary work underscores the potential for under counting 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 (13.5%), isocyanates (11.8%) and metal working fluids (8.3%). Until recently, metal working fluids

were the second most frequently reported exposure, and until 2014, 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 roven 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. The COVID-19 pandemic has increased the use of disinfectants across all industries. Disinfectants shown to cause sensitization and asthma are Bleach (Sodium Hypochlorite), Chloramine T, Chlorhexidine, Hexachlorophene, Quaternary Ammonium Chloride Compounds, Formaldehyde Glutaraldehyde, Mixture of Hydrogen Peroxide and Peracetic Acid. We published a paper assessing calls about disinfectants to the Michigan Poison Center (MiPC) in the first part of 2020. The number of disinfectant calls from 2019 to 2020 increased by 42.8%, and the number of calls with symptoms increased by 57.3%. The average number of calls per day doubled after the first Michigan COVID-19 case, from 4.8 to 9.0, and the proportion of calls about disinfectants among all exposure calls to the MiPC increased from 3.5% to 5.0% ($P < .001$). [14] Previously, in conjunction with four other states that conduct surveillance for work-related asthma, we published a summary of work-related asthma associated with cleaning agents.[15] Work-related asthma was associated with 12.4% of the cases across all five states. 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).

We updated Table 22, first presented in the 2002 Work-Related Asthma Annual Report, on the number of manufacturing workers in companies that use isocyanates. The counties with the highest percentages of workers potentially exposed to isocyanates are: Barry (8.1%), Dickinson (6.1%), Sanilac and Isabella (each with 5.7%), Clare (4.8%), and Wexford (4.4%). Health care providers can use this information to heighten their awareness 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. Additional information on the chemicals used at a patient's company may be obtained by using the state's online portal for the EGLE FOIA Request Center at https://www.michigan.gov/egle/contact/foia.

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.[10] Among the 2,502 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 government and only 3% by the employer.[16] 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 a personal or family history of allergies do not predict who will develop WRA. About 41% of the WRA patients identified through the Michigan Tracking System have no personal history of allergies, and 81% 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.

There was one WRA inspection each in 2020 and 2021, and two inspections in 2022. There were no inspections in 2023. In 2024, there were three inspections. The number of inspections has decreased since the COVID-19 pandemic. In previous years, we identified 1,635 fellow workers with symptoms compatible with WRA (Table 21). Five hundred eighty-six individuals were listed on the MIOSHA Log of Work-Related Injuries and Illnesses (Form 300) as having WRA or symptoms compatible with WRA. There was only an overlap of 10 individuals reporting symptoms on co-worker interviews who were also reported on the MIOSHA Log. Part of the reason for the lack of overlap is that half of the symptomatic individuals indicated they had 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.[10] A review of companies using isocyanates showed that only 32% were providing periodic medical surveillance.[17]

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.[10] 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 instructing 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 timeliest workplace interventions, compared to receiving reports from hospitals.

Reporting can be done online at oem.msu.edu, via email at ODREPORT@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. Reporting forms can be found online at oem.msu.edu or by calling 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.

Since July 2020, we have initiated use of the Michigan Emergency Medical Services Information System (MI-EMSIS) as a new source to identify work-related asthma. MI-EMSIS compiles the data from all ambulance runs in the state, which averages about 83,000 monthly. An algorithm was developed to select ambulance runs that involve patients with respiratory symptoms from non-residential locations. The narratives from these runs are reviewed to identify potential asthma patients whose asthma is caused by a work exposure. The addition of this data source continues our effort to expand our multiple source surveillance system to minimize the number of cases not being reported.

The potential that 54% of Michigan adults with asthma report that 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

2024 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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AGRICULTURE

Exposure to Cannabis Products

OA4604. A male in his 20s developed WRA from exposure to marijuana dust after eight weeks of working at a marijuana grow facility. He developed a worsening cough and shortness of breath and was treated at the ED where he was prescribed DuoNeb and prednisone; he was discharged home with strict instructions to avoid dust exposure and discuss changing his job with his employer. He formerly smoked cigarettes.

Exposure to Cleaning Agents

POA4660. A male in his 20s developed WRA from exposure to ammonia and chlorine gas while using the cleaners to power wash at a farm. He developed wheezing and was prescribed albuterol and prednisone at the ED. He was a former cigarette smoker.

Exposure to Miscellaneous Chemicals

AA4642. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to zerotol, a fungicide used to treat plants where she worked as a marijuana trimmer at an indoor marijuana grow facility. She developed a cough, shortness of breath, wheezing and chest tightness and was treated in the ED with solumedrol and albuterol.

AA4663. A male in his 40s experienced an exacerbation of his pre-existing asthma while working in post-harvest production trimming buds and preparing cannabis for packaging at an indoor cannabis grow facility. He was exposed to ozone and particles from humidifiers; he described the ozone machine and humidifier running at the same time, which was not supposed to happen. These exposures triggered wheezing, a cough, shortness of breath and chest tightness. His asthma worsened throughout his shift. He found a new job; since then, his asthma improved and he required less asthma medication. He formerly smoked a couple cigarettes per day in his teens for about six years.

CONSTRUCTION

Exposure to Multiple Construction-related Substances

RADS4662. A male in his 60s developed RADS from an acute exposure to smoke and fumes from an asphalt mix while laying pavement for a road construction company. His job was to drive the paving machine. He was provided a paper mask but the fumes from the asphalt permeated the cab of the paving machine. He developed wheezing, a cough, chest tightness and shortness of breath and, after a full day of this exposure, he was driven to the hospital for an overnight stay where he was treated with Spiriva, Fluticasone and albuterol. Five years after his acute exposure, he was placed on medical leave. Since then, his asthma improved and he discontinued his asthma medication. He was a life-long non-smoker.

MANUFACTURING

Exposure to Isocyanates

OA4641. A male in his 30s developed WRA from exposure to isocyanates where he worked as a production assistant at a polyurethane manufacturing plant. Shortly after he began working at the plant, he developed wheezing, a cough and shortness of breath. About a year after his asthma developed, he was reassigned to a new location and his asthma improved. He formerly smoked cigarettes.

AA4636. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to isocyanate foam dust and air fresheners where she worked as an office assistant at a mold pattern and tool factory with poor ventilation. She experienced wheezing, chest tightness, a cough and shortness of breath. Her asthma worsened on her first day back to work, during her shift and throughout the work week. Her asthma improved on weekends and during vacations. She was treated in the ED. She was fired after her asthma attack due to "budget cuts." Her asthma improved and she required less asthma medication after leaving this job. She had not found new employment at the time of interview. She was a life-long non-smoker.

AA4622. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to isocyanates and mold-covered parts at the automotive interior manufacturer where she worked as an inspector of the auto parts. She was provided with a paper mask. She experienced wheezing, a cough, shortness of breath and chest tightness, which worsened throughout the workday and work week. Her asthma improved when away from work on weekends or vacations. Within one week of starting that job, she had six trips to the ED. She was treated with an albuterol inhaler and nebulizer, and DuoNeb in the ED. She found a different job and since then her asthma improved and she required less asthma medication. She was a life-long non-smoker.

Exposure to Metal Working Fluids

POA4656. A female in her early 20s developed WRA from exposure to metal working fluids and metal fume emitted from the CNC machines she operated at an automotive parts manufacturer. She developed wheezing, cough, shortness of breath and chest tightness not long after beginning this job. These symptoms got worse during her work shift, were worse on her first day back to week after weekends or vacations and improved when she was away from work. She also noted that the floor stripper used in the area would trigger these breathing symptoms. After a visit to the ED, she was prescribed a steroid taper and albuterol. She ultimately left this job because of her asthma, and since then found new employment. She was a life-long non-smoker.

AA4630. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to metal working fluids and factory dust where she worked as a machine operator at a battery manufacturer. She experienced wheezing, a cough, chest tightness and shortness of breath. She was treated with steroids, and an inhaler in the ED; she had eight visits to the ED from these exposures. She was a life-long non-smoker.

Exposure to Metal Dust

AA4654. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to aluminum dust in a factory. He experienced a cough and shortness of breath and was treated with albuterol and Solu-Medrol in the ED. He smoked a half pack of cigarettes per day.

Exposure to Welding Fume

AA4610. A male in his 30s experienced an exacerbation of his pre-existing asthma when he was exposed to metal dust and welding fume in the production area of an automotive parts manufacturing facility. He normally worked in shipping and receiving but was asked to temporarily work in production when he experienced his asthma attack. He subsequently left this job and since then his asthma improved and he did not require asthma medication. He was a life-long non-smoker.

Exposure to Plastic Dust and Fumes

POA4599. A female in her 50s developed WRA from exposure to smoke and formaldehyde from plastic mold machines at an automotive parts factory. She developed shortness of breath not long after she began working at the facility. Her asthma worsened throughout the workday, was worse on Mondays, and improved on weekends and vacations. She was prescribed prednisone and albuterol during an ED visit. Since her asthma developed, her symptoms remained unchanged and she required less asthma medication. She was a life-long non-smoker.

Exposure to Solvents

AA4650. A female in her 50s experienced an exacerbation of her pre-existing asthma from exposure to solvents used to clean out plastic injection mold machines after the plastic was purged from the machines. Her job was to clean, load the hoppers and help purge the machines. She wore some protective equipment but not respiratory protection. She experienced shortness of breath and treated in the ED with albuterol, steroids and Breo; her ED visit turned into a hospitalization. She formerly smoked a half pack of cigarettes per day from her mid-teens to her mid-50s.

RADS4619. A female in her 30s developed RADS from exposure to paint thinner at an automotive assembly plant where she worked as a repair technician, touching up paint defects before the vehicles were finalized in production. She used paint thinner regularly to clean the touch up paint guns. She experienced chest tightness and was prescribed albuterol in the ED. She continued to work at this facility. She was a life-long non-smoker.

Exposure to Cleaning Agents

POA4637. A female in her 40s developed WRA while working at an automotive assembly plant. Her job included loading, assembling, installing and cleaning. She was exposed to factory dust and cleaning agents. Two years after beginning work at this facility, she developed a cough, chest tightness and shortness of breath. She had two visits to the ED, and was prescribed an albuterol nebulizer, an albuterol MDI and Symbicort. Subsequently she was reassigned to a new work area. Since that time her asthma improved, and she required less asthma medication. She formerly smoked a quarter pack of cigarettes per day for 19 years from her mid-20s to mid-40s.

Exposure to Wood Dust

OA4626. A male in his 30s developed WRA from exposure to wood dust while working as a production operator at a sawmill. The wood dust caused a cough, which improved on weekends and vacations. He was prescribed prednisone at the ED. He found a new job and since then his asthma improved. He was a life-long non-smoker.

OA4669. A male in his 50s developed WRA as a woodworker exposed to red cedar wood dust. He developed shortness of breath and was prescribed albuterol. He was a life-long non-smoker.

Exposure to Formaldehyde

POA4600. A female in her 60s developed WRA from exposure to formaldehyde shortly after she began to work as an assembler at an automotive plastic parts manufacturer. She developed chest tightness and shortness of breath which worsened throughout her shift and throughout the work week. Her asthma improved on weekends. She was prescribed prednisone in the ED. She was fired from this job; since then, her asthma remained unchanged and she discontinued her asthma medication. She was a current cigarette smoker.

Exposure to Heat, Humidity, Cold and Exertion

AA4627. A male in his early 30s experienced an exacerbation of his pre-existing asthma from exposure to heat and humidity at his job at an auto manufacturer where he worked on the line. These conditions triggered chest tightness and shortness of breath. During a visit to the ED, he was prescribed albuterol, DuoNeb and a steroid. He was a life-ling non-smoker.

AA4661. A female in her 50s experienced an exacerbation of her pre-existing asthma from exertion and cold air while working as a machine operator at a radiator manufacturing plant. She currently smoked a pack of cigarettes a day since her early 20s.

POA4634. A female in her 30s developed WRA about one year after beginning employment as a line worker at an automotive seat manufacturer where she worked in hot/humid conditions and was exposed to factory dust. She developed wheezing, a cough, chest tightness and shortness of breath and was treated in the ED with albuterol, DuoNeb and prednisone. Her asthma worsened throughout her shift, was worse on Mondays or first day back to work and worsened throughout the work week. She left this employment for a new job; since then, her asthma improved and she required less asthma medication. She was a life-long non-smoker.

Exposure to Miscellaneous Chemicals, Fumes and Dusts

POA4612. A male in his 50s developed WRA after working for 15 years at a chemical manufacturing company that makes silicone. His job as a warehouse chemical operator involved being a floor truck operator as well as working in shipping and receiving, hauling, putting away chemicals and operating a chemical mixer. He experienced a cough and shortness of breath. He was prescribed Wixela and Albuterol. He wore a full-face shield and an N95 mask. He continued to do this job, and his symptoms remained unchanged. He required a greater amount of asthma medication. Since his diagnosis he sought treatment at the emergency department more than 11 times and was hospitalized once. He was a life-long non-smoker.

POA4617. A male in his 50s developed WRA from exposure to drywall dust at his job at a furniture manufacturer. He developed a cough and shortness of breath. During a visit to the ED, he was prescribed albuterol and prednisone. He continued to work at the facility after his ED visit. He currently smoked approximately half a pack of cigarettes a day.

POA4657. A female in her early 50s developed WRA from exposure to an unknown chemical during a thermal event. She worked as a material operator at an automotive parts assembly plant. She was prescribed an inhaler.

AA4618. A male in his 30s experienced an exacerbation of his pre-existing asthma from exposure to fumes at the auto manufacturing plant where he worked. He experienced wheezing and shortness of breath, which worsened throughout the work week. He sought treatment in the ED where he was prescribed albuterol, trelegy and methylprednisolone. Over time his asthma worsened, and he required a greater amount of asthma medication. He was a current cigarette smoker.

POA4665. A male in his 40s developed WRA from exposure to waxes, fumes and hydrocarbon resin at a chemical manufacturing plant where he worked as a production/chemical operator. He developed shortness of breath and was prescribed an inhaler and a steroid when he was hospitalized. He formerly smoked a pack and a half of cigarettes from his 20s to his 30s.

AA4644. A male in his 50s experienced an exacerbation of his pre-existing asthma from exposure to warehouse dust at a plating and plastics factory. He experienced chest tightness and was treated with albuterol in the ED. He smoked cigarettes.

AA4638. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to a leaking ammonia pipe at a fruit processing facility where she worked as a safety manager. She immediately experienced wheezing, a cough, chest tightness and shortness of breath. She was treated in the ED. The leaking pipe was repaired and since then her asthma improved and she required less asthma medication. She briefly smoked cigarettes for a year in her late teens.

AA4655. A male in his 40s experienced an exacerbation of his pre-existing asthma from exposure to fumes at an automotive stamping plant. He experienced wheezing and a cough. He was treated with albuterol, solumedrol and Advair in the ED; he was hospitalized at least once.

AA4623. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to a leaking magnesium bisulfite solution in the production area where she worked in the medical team at a metal plating plant. She experienced wheezing, a cough, chest tightness and shortness of breath. Her asthma worsened throughout her shift and throughout the work week; it improved on weekends and vacations. She was treated with albuterol in the ED. She was a life-long non-smoker.

Exposure in the Food Industry

AA4668. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to a malfunctioning line pipe containing a disinfectant where she was being trained at a food processing manufacturer. She saw her doctor the next day because she was experiencing chest tightness and shortness of breath. Her doctor prescribed albuterol and her breathing improved. She was awarded workers' compensation due to this incident.

WHOLESALE & RETAIL TRADE

Exposure to Cleaning Agents

RADS4674. A female in her 60s developed RADS from an acute exposure to undiluted bleach used for cleaning where she worked at a grocery store. She immediately developed wheezing, a cough and shortness of breath. She was prescribed albuterol and prednisone in the ED and hospitalized. She smoked a pack of cigarettes a day since her early 60s.

TRANSPORTATION & WAREHOUSING

Exposure to Heat and Humidity

AA4629. A female in her 30s experienced an exacerbation of her pre-existing asthma while working as a logistics coordinator in a hot, non-air-conditioned warehouse. She experienced wheezing and shortness of breath and was treated with an albuterol inhaler in the ED. She was a life-long non-smoker.

POA4632. A female in her 20s developed WRA while working as a package handler at a large shipping and receiving warehouse. She described conditions at the warehouse as being overheated while working to move heavy boxes without breaks. She experienced wheezing, a cough, shortness of breath and chest tightness that worsened throughout the workday and work week. She had one trip to the ED. She found a new job upon her doctor's advice. Since then, her asthma improved and she discontinued using asthma medications. She was a life-long non-smoker.

ADMINISTRATIVE & SUPPORT & WASTE MANAGEMENT

Exposure to Cleaning Agents

OA4616. A male in his 30s developed WRA from exposure to disinfectants while working for a commercial building janitorial company. Soon after beginning to work at this company, he developed a cough, shortness of breath, chest tightness and wheezing. He sought treatment from his primary care provider and was prescribed Advair. After his WRA diagnosis, he was reassigned to new work duties. Since then, his asthma improved although his asthma medication remained unchanged. He was a life-long non-smoker.

Exposure to Pesticides

AA4643. A male in his 40s experienced an exacerbation of his pre-existing asthma from exposure to pesticides he sprayed on homes for pest control. He worked for about a month when he experienced chest tightness which worsened throughout his work shift. He was prescribed albuterol, prednisone and a Proventil inhaler at an urgent care facility.

EDUCATIONAL SERVICES

Exposure to Cleaning Agents

AA4675. A male in his late teens experienced an exacerbation of his pre-existing asthma when he was exposed to bleach from cleaning activities at the daycare where he was a teaching assistant. He was using bleach to disinfect the daycare surfaces at the end of the day. He developed wheezing and shortness of breath within 30 minutes of this activity; EMS was called, he was treated with albuterol, and he was transported to the ED. At the ED he was treated with prednisone and Spiriva. He was a life-long non-smoker.

HEALTH CARE & SOCIAL ASSISTANCE

Exposure to Cleaning Agents

OA4659. A female in her 50s developed WRA after working 15 years at a hospital where she was exposed to bleach used for cleaning and disinfecting. Her duties were mainly office related in the laboratory. She developed wheezing, a cough, shortness of breath and chest tightness and was prescribed albuterol. She was treated over 10 times in the ED. Since her diagnosis, she was mostly able to avoid exposure to bleach; her asthma improved and she required less asthma medication. She formerly smoked a half pack of cigarettes from her early teens to her early 30s.

AA4635. A female in her 20s experienced an exacerbation of her pre-existing asthma from exposure to a disinfectant containing Quaternary ammonium compounds and bleach. She worked at a residential facility where she cooked, cleaned,

transported patients, and charted medical records. She experienced wheezing, a cough, chest tightness and shortness of breath soon after beginning to work at the facility. She was fired for missing work because of her asthma. She was prescribed albuterol, Flovent and montelukast in the ED. She formerly smoked a pack of cigarettes per day from her teens to her 20s.

AA4628. A female in her 40s experienced an exacerbation of her pre-existing asthma while working as a home health aide. She was exposed to an ammonia-based cleaning agent and bleach, which she improperly mixed at a client's home and produced chloramine gas. The fumes from this mixture caused wheezing and shortness of breath. She consulted with the Michigan Poison Center, who advised her to monitor her symptoms, use her inhaler and use steam from a shower to help alleviate her symptoms.

ARTS, ENTERTAINMENT & RECREATION

Exposure to Miscellaneous Dusts and Fibers

AA4652. A male in his 20s experienced an exacerbation of his pre-existing asthma from lint dust while cleaning dryer vents at a recreation facility. He developed a cough and shortness of breath, and was treated with albuterol in the ED. He was a life-long non-smoker.

ACCOMODATION & FOOD SERVICES

Exposure to Cleaning Agents

AA4646. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to fumes generated when bleach and another cleaning agent were mixed, producing chlorine gas. He worked at a full-service restaurant. Within 24 hours of this exposure, he developed wheezing and a cough; he was prescribed albuterol at the ED after this event. He was a life-long non-smoker.

AA4651. A male in his 40s experienced an exacerbation of his pre-existing asthma from exposure to degreaser being used to clean where he worked at a fast-food restaurant. He treated in the ED with albuterol and prescribed an epi pen. He currently smoked cigarettes.

OTHER SERVICES (Except Public Administration)

Exposure to Fragrances

AA4639. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to air fresheners where she worked at a mail processing center. The air freshener triggered wheezing, a cough, chest tightness and shortness of breath. She was treated in the ED with albuterol, trelegy and prednisone, and also hospitalized. She formerly smoked cigarettes.

PUBLIC ADMINISTRATION

Exposure to Heat, Humidity and Exertion

AA4633. A male in his 20s experienced an exacerbation of his pre-existing asthma while taking a running fitness test for the military. He experienced wheezing and shortness of breath. He was treated in the ED with DuoNeb and solumedrol.

MISCELLANEOUS INDUSTRIES

Exposure to Miscellaneous Chemicals

RADS4649. A male in his 40s developed RADS from an acute exposure to smoke from burning roofing sealant that was being applied to the roof at his workplace. The HVAC system carried the smoke into his workplace. He experienced shortness of breath and was prescribed Advair and albuterol in the ED. Ultimately the HVAC system was repaired. Five years after this exposure his asthma persisted, and he still required asthma medication. He was a life-long non-smoker.