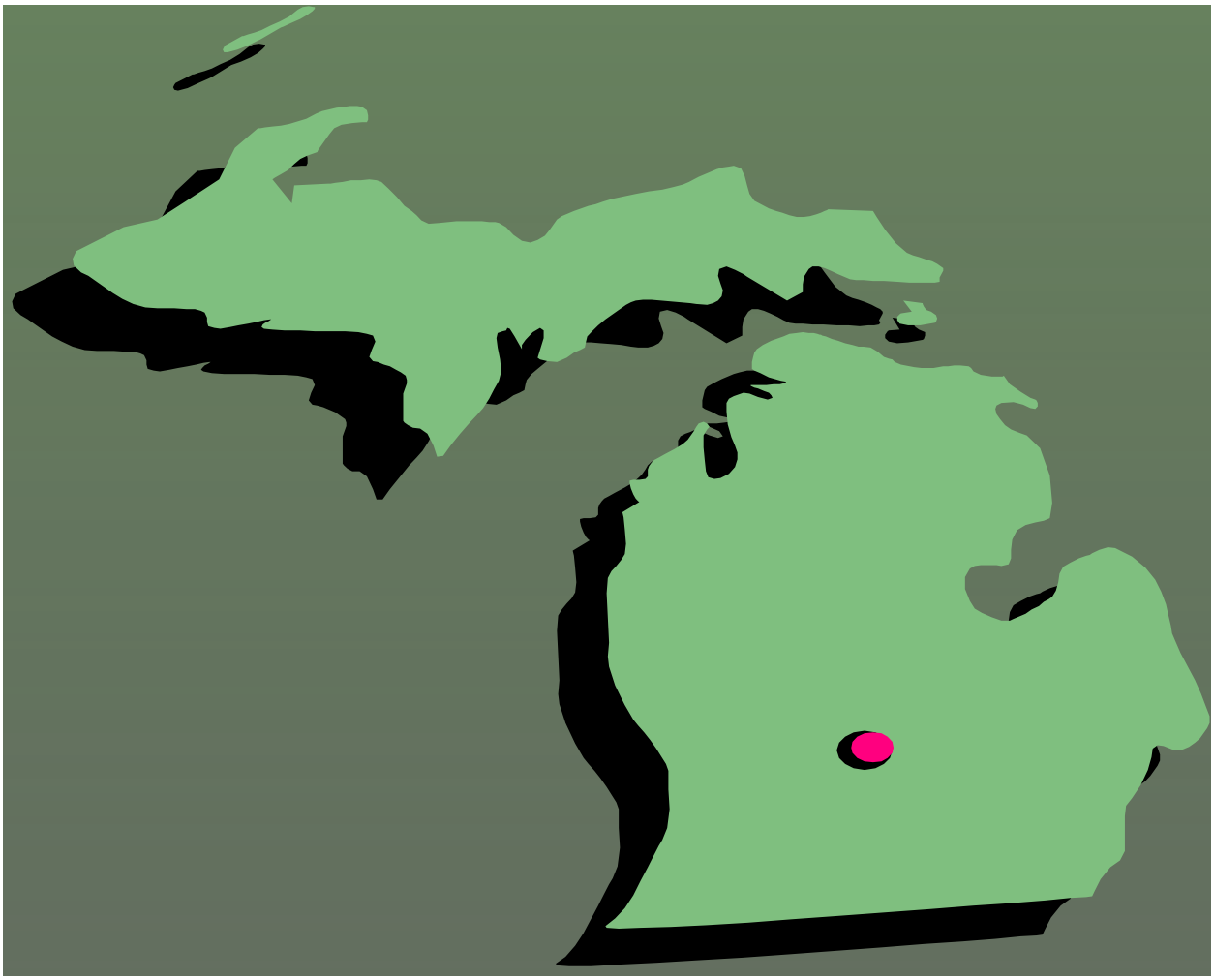
SEPTEMBER 23, 2026

2023
ANNUAL REPORT

TRACKING WORK-RELATED ASTHMA IN MICHIGAN



2023 Annual Report

Tracking Work-Related Asthma in Michigan
September 23, 2026

2023 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 33rd 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 1988-2023, 4,014 WRA cases have been identified with MI's tracking system.
- We estimate there are 62,000-97,000 adults in MI with WRA.
- 77% of the MI WRA patients have new-onset asthma; 23% 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 (11.9%), are the most commonly reported exposures causing WRA in MI.
- The average incidence rate of WRA among Black/African American workers is 3.4 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.

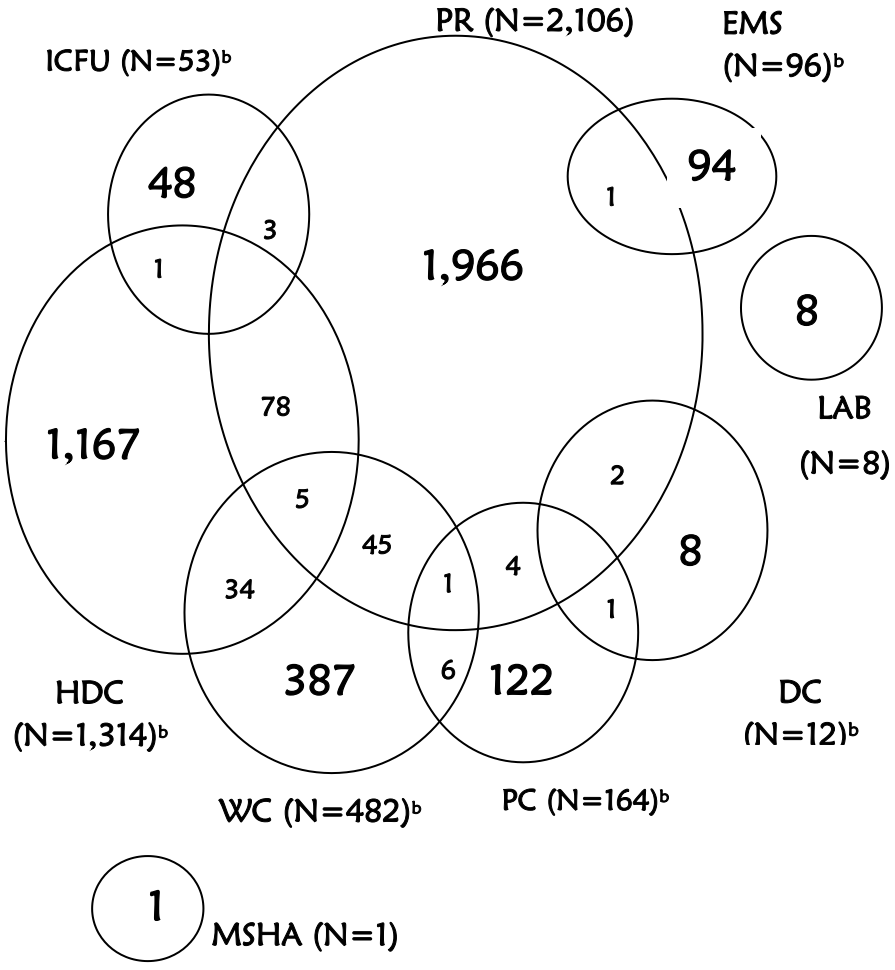
REPORTS

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
Total	1,256	1,370	956	432	4,014

Table 1 shows that 4,014 people were confirmed with WRA between 1988—2023. The reports are divided into: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA) and Reactive Airways Dysfunction Syndrome (RADS). Sixty additional patients have been confirmed since last year's report (all 60 for 2023). Figure 1 shows the overlap of the patients by reporting sources for 1988—2023.

FIGURE 1
Overlap of Reporting Sources for 4,014 Confirmed WRA Patients: 1988-2023[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 and WC-PR, and an overlap of WC-PC-HDC for two

Demographics – Trends

The analyses conducted for the annual report were divided into 1988-1997, 1998-2007, 2008-2017 and 2018-2023 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 422 reported from 2018-2023. 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 2018-2023 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 2018-2023 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 3.25 per 100,000 Michigan Black/African American workers compared to 0.97 per 100,000 Michigan White workers; this was a 3.4 times greater incidence (95% CI 1.95, 5.716). Historically, in our surveillance program, Hispanic ethnicity was not collected. To date, we have identified 92 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	2018-2023	Change in Percentage
Gender	# (%)	# (%)	# (%)	# (%)	# (%)	
Female	2,169 (54)	626 (49)	800 (55)	519 (61)	224 (53)	+8%
Male	1,845 (46)	648 (51)	661 (45)	338 (39)	198 (47)	- 8%

TABLE 3
Race of WRA Patients by Time Period

		Time Period				
	All years	1988-1997	1998-2007	2008-2017	2018-2023	Change in Percentage
Race	# (%)	# (%)	# (%)	# (%)		
White	2,918 (73)	997 (78)	1,093 (75)	602 (70)	226 (54)	-31%
Black/African American	796 (20)	239 (19)	272 (19)	162 (19)	123 (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	55 (1)	11 (1)	27 (1)	13 (2)	4 (1)	None
Unknown	195 (5)	13 (1)	49 (3)	69 (8)	64 (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 (8.7 cases per 100,000), Clare (6.9 cases per 100,000), Huron (4.9 cases per 100,000), Montmorency and Osceola (each with 4.5 cases per 100,000), Genesee (4.2 cases per 100,000), Saginaw (4.1 cases per 100,000) and Baraga (3.8 cases per 100,000).

TABLE 4

Average Annual Incidence Rates of WRA Among Michigan Workers by County of Exposure: 1989-2023[a]

County	Avg Annual # EE's[b]	Avg Annual Rate[c]	Cases 1989-2023	County	Avg Annual # EE's[b]	Avg Annual Rate[c]	Cases 1989-2023
Alcona	3,978	0.7	1	Keweenaw	964	3.0	1
Alger	4,114	2.1	3	Lake	3,769	1.5	2
Allegan	52,902	3.0	56	Lapeer	41,143	2.8	41
Alpena	13,799	2.3	11	Leelanau	10,985	2.1	8
Antrim	11,031	1.3	5	Lenawee	46,375	2.3	38
Arenac	7,095	3.2	8	Livingston	89,656	1.3	41
Baraga	3,771	3.8	5	Luce	2,635	8.7	8
Barry	29,443	1.1	11	Mackinac	5,898	2.4	5
Bay	51,775	1.7	30	Macomb	388,397	2.4	331
Benzie	8,447	1.7	5	Manistee	11,232	1.0	4
Berrien	73,214	1.2	32	Marquette	33,712	1.9	23
Branch	20,932	3.7	27	Mason	13,856	1.4	7
Calhoun	65,698	2.7	61	Mecosta	18,832	1.4	9
Cass	25,950	0.6	5	Menominee	12,279	0.2	1
Charlevoix	13,166	2.2	10	Midland	39,876	2.6	36
Cheboygan	11,581	3.2	13	Missaukee	6,182	2.3	5
Chippewa	16,095	1.2	7	Monroe	73,426	1.6	40
Clare	11,936	6.9	29	Montcalm	24,664	2.2	19
Clinton	35,981	0.8	10	Montmorency	3,818	4.5	6
Crawford	6,276	2.7	6	Muskegon	84,078	1.0	29
Delta	19,019	1.8	12	Newaygo	21,694	2.4	18
Dickinson	13,639	3.1	15	Oakland	587,558	2.3	474
Eaton	55,973	0.7	13	Oceana	13,473	1.7	8
Emmet	18,242	1.3	8	Ogemaw	9,015	3.5	11
Genesee	194,390	4.2	289	Ontonagon	3,244	0.9	1
Gladwin	9,853	0.9	3	Osceola	9,470	4.5	15
Gogebic	7,182	1.2	3	Otsego	11,552	3.0	12
Gd Traverse	46,122	1.5	24	Ottawa	129,733	1.0	47
Gratiot	18,546	2.2	14	Roscommon	9,910	2.6	9
Hillsdale	20,594	2.1	15	Saginaw	91,100	4.1	131
Houghton	16,560	1.4	8	Sanilac	20,628	3.2	23
Huron	15,887	4.9	27	Schoolcraft	3,634	1.6	2
Ingham	143,187	3.1	156	Shiawassee	33,709	0.6	7
Ionia	28,891	1.4	14	St. Clair	76,672	2.3	63
Iosco	10,137	1.7	6	St. Joseph	29,431	1.6	16
Iron	5,562	2.1	4	Tuscola	26,745	2.7	25
Isabella	36,135	2.4	30	Van Buren	38,392	0.8	11
Jackson	72,370	2.3	57	Washtenaw	181,088	3.3	212
Kalamazoo	126,692	1.5	65	Wayne	812,369	3.2	913
Kalkaska	8,175	3.1	9	Wexford	13,687	1.5	7
Kent	305,783	1.2	132	***All Counties[d]***	**4,684,000[e]**	**2.4**	**3,898**

[a] 1989 through 2023 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 1989-2023 (35 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 1989-2023 reporting period.

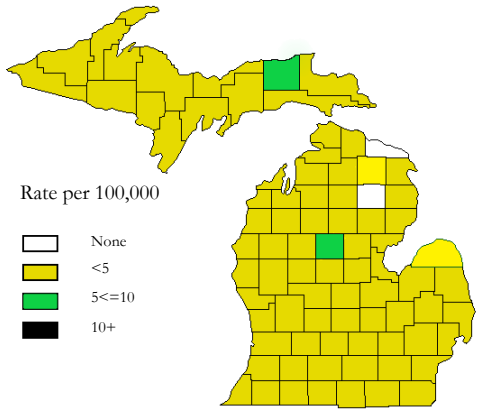
[e] Total is rounded up.

Type of Industry – Trends



TOP COUNTIES: Table 5 shows the top 11 counties with the highest overall rates of WRA that had more than one case during the 1989-2023 time period. Six of the top counties with the highest overall rates of WRA had a decrease of 10% or greater, while four counties, Huron, Montmorency, Osceola and Saginaw, had an increase in the rate of WRA over time. In four of the counties, the rates increased during the 2018-2023 time period and in four counties the rate decreased during the 2018-2023 time period.

FIGURE 2
Average Annual Incidence Rate of WRA by County of Exposure: 1989-2023[a]



[a] 1989 through 2023 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	2018-2023	
County	Rate	Rate	Rate	Rate	Rate	Change in Percentage
Branch	3.7	4.0	5.6	2.9	2.8	- 30%
Cheboygan	3.2	8.3	1.8	3.2	--	- 61%
Clare	6.9	8.8	9.4	7.5	4.8	- 45%
Genesee	4.2	4.6	6.8	3.1	2.5	- 46%
Huron	4.9	4.7	5.2	3.3	8.3	+ 77%
Kalkaska	3.1	6.5	5.1	--	2.4	- 63%
Luce	8.7	19.8	7.5	9.4	--	- 53%
Montmorency	4.5	--	5.3	11.0	6.4	+ 21%
Osceola	4.5	2.1	9.8	1.1	3.2	+ 52%
Saginaw	4.1	3.4	7.4	2.3	3.3	- 3%
Sanilac	3.2	2.8	6.0	1.7	2.9	+ 4%
All MI Counties	2.4	3.0	3.1	2.0	1.6	- 47%

[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 2018-2023 using 2020 data, accessed 5-29-2024.

Table 6 shows the Michigan industries by NAICS codes, with cases of work-related asthma from 1988 to 2023. 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 10.4 cases per 100,000 in manufacturing. Industries with the next highest average annual incidence rates were: mining with 7.3 cases per 100,000 workers and utilities with 3.3 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 41.2% in 2018-2023. There were also decreases in mining, wholesale trade and educational services. There were increases in all other industries from 1988-1997 to 2018-2023.

TABLE 6
Number of WRA Patients, 1988-2023 by Primary Industrial Exposure and Average Annual Incidence Rate per 100,000 Workers, 1989-2023

2002 N American Industry Classification System		WRA Cases 1988-2023		Number of Employees[a]	Average Ann. Incidence Rate[b]	
		#	%		Rate	# Cases
11	Agriculture, Forestry, Fishing, & Hunting	43	1.1	79,404	1.5	43
21	Mining	14	0.3	5,449	7.3	14
22	Utilities	23	0.6	20,098	3.3	23
23	Construction	117	2.9	154,728	2.1	116
31-33	Manufacturing	2,207	55.0	599,847	10.4	2,183
42	Wholesale Trade	45	1.1	171,650	0.7	44
44-45	Retail Trade	137	3.4	472,032	0.8	137
48-49	Transportation & Warehousing	88	2.2	114,359	2.2	88
51	Information	25	0.6	57,049	1.3	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	102	2.5	290,471	1.0	102
61	Educational Services	175	4.4	344,234	1.4	174
62	Health Care & Social Assistance	495	12.3	582,008	2.4	494
71	Arts, Entertainment & Recreation	34	0.8	51,504	1.9	34
72	Accommodation & Food Services	132	3.3	372,503	1.0	132
81	Other Services (except Public Admin)	100	2.5	136,541	2.1	99
92	Public Administration	157	3.9	172,227	2.6	155
00	Unknown	28	0.7	--	--	28
Total		4,014		4,242,534	2.7	3,983

[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 1989-2023 (35 years), per 100,000 Michigan workers.

TABLE 7
2,183 WRA Patients from Manufacturing Industries: 1989-2023[a]

2002 North American Industry Classification System		# WRA Cases	Avg Ann Rate[a]	# Employees[b]
311	Food Mfg	87	6.8	36,408
323	Printing & Related Support Activities	20	4.0	14,304
325	Chemical Mfg	117	11.3	29,592
326	Plastics & Rubber Products Mfg	124	8.5	41,567
327	Nonmetallic Mineral Product Mfg	22	6.0	10,528
331	Primary Metal Mfg	74	9.6	21,913
332	Fabricated Metal Product Mfg	131	4.7	80,225
333	Machinery Mfg	164	6.5	72,028
334	Computer & Electronic Product Mfg	17	2.5	19,575
336	Transportation Equipment Mfg	1,240	19.7	180,153
337	Furniture & Related Product Mfg	19	2.5	22,002
	Miscellaneous Mfg (*includes NAICS: 312-16,324,339)	94	8.6	31,188

[a]Average annual incidence rate, based on cases from 1989-2023 (35 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		2018-2023		
NAICS	Industry	#	%	#	%	#	%	#	%	Change in Percentage
11	Agr, Forestry, Fishing, & Hunting	4	0.3	12	0.8	8	0.9	18	4.3	+ 1333%
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	0.7	+ 250%
23	Construction	32	2.5	37	2.5	30	3.5	18	4.3	+ 72%
31-33	Manufacturing	912	71.6	809	55.4	313	36.5	174	41.2	- 42%
42	Wholesale Trade	23	1.8	14	1.0	3	0.4	6	1.4	- 22%
44-45	Retail Trade	15	1.2	48	3.3	51	6.0	21	5.0	+ 317%
48-49	Transportation & Warehousing	14	1.1	35	2.4	21	2.5	18	4.3	+ 290%
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	0.5	+ 150%
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	0.9	+ 29%
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	27	6.4	+ 700%
61	Educational Services	40	3.1	73	5.0	50	5.8	12	2.8	- 10%
62	Health Care & Social Assistance	105	8.2	194	13.3	145	16.9	49	11.6	+ 41%
71	Arts, Entertainment & Recreation	5	0.4	11	0.8	15	1.8	3	0.7	+ 75%
72	Accommodation & Food Services	19	1.5	49	3.4	42	4.9	21	5.0	+ 233%
81	Other Svcs (except Public Admin)	22	1.7	31	2.1	29	3.4	19	4.5	+ 165%
92	Public Administration	44	3.5	46	3.1	51	6.0	17	4.0	+ 14%
00	Unknown	2	0.2	8	0.5	11	1.3	7	1.4	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 541 (13.5%) of Michigan's WRA patients, and isocyanates (MDI, TDI, HDI and others) accounting for 476 (11.9%) of the WRA case exposures. Metal working fluids (coolants) accounted for 336 (8.4%) 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 2018-2023. Cleaning agents increased from 4.6% of all the WRA exposures in 1988-1997 to 20.1% in 2018-2023. 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 1988-2023. 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*. Six 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: 1988-2023

Exposure Agent	#	%
Cleaning Solutions	541	13.5
Isocyanates	476	11.9
Metal Working Fluids	336	8.4
Unknown (Mfg.)	306	7.6
Unknown (Office)	213	5.3
Exhaust/Smoke/Fumes	182	4.5
Welding Fume-Stainless & Other	167	4.2
Solvents	112	2.8
Paint Fumes	101	2.5
Fungus	95	2.4
Epoxy	92	2.2
Acids	74	1.8
Fire	74	1.8
Formaldehyde	66	1.6
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	41	1.0
Acrylates	38	0.9
Cobalt	34	0.8
Wood Dust	33	0.8
Flour	29	0.7
Ammonia	26	0.6
Herbicide/Pesticide	22	0.5
Plants/Organic Matter	22	0.5
Cigarette Smoke	21	0.5
Fiberglass	21	0.5
Styrene	20	0.5
Heat	19	0.5
Aldehydes	18	0.4
Medication	18	0.4
Cement Dust	16	0.4
Chromium	16	0.4
Metal Dust	15	0.4
Amines	14	0.3
Cosmetology Chemicals	14	0.3
Asphalt	14	0.3
Caustics	14	0.3
Fire Extinguisher Powder	14	0.3
Rust Inhibitor	13	0.3
Printing Inks	13	0.3
Grain Dust	13	0.3
Anhydrides	11	0.3
Meat Wrapper's Asthma	10	0.2
Sewage	10	0.2
Insecticides	9	0.2
Other[a]	334	8.3
Total	**4,014**	

[a]There were 10 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, Enzymes and Sulfur Dioxide.

There were 6 cases each with exposure to: Drywall Dust, Nitrogen, Pickling Ingredients, Solder Fume, Textile Lint.

There were 5 cases each with exposure to: 1,1,1 Trichloroethane, Coal Dust, Hydraulic Fluid, Lime Dust, Mold Release Spray, Ozone, 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

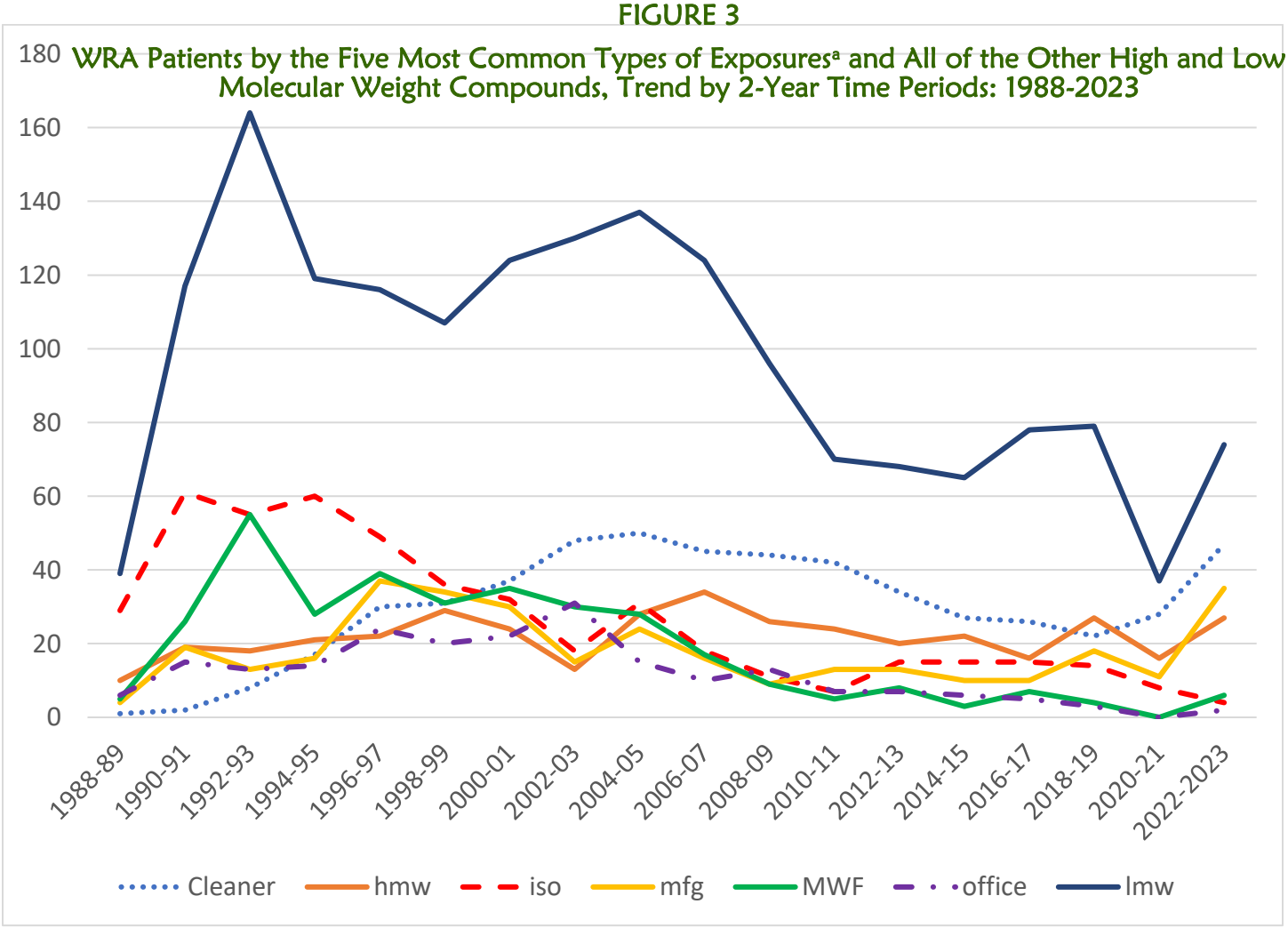
There were 3 cases each with exposure to: Cadmium Solder, Colophony, Concrete Sealer, COVID-19, Explosion, Fertilizer, Flux, Isopropyl Alcohol, Kerosene, Nickel, Polyethylene, Sludge, Zinc, Zinc Oxide.

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, 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	2018-2023	Change in Percentage
Exposure Type	# (%)	# (%)	# (%)	# (%)	# (%)	
Cleaning Agents	532 (13.5)	59 (4.6)	214 (14.6)	183 (21.4)	85 (20.1)	+ 337%
Isocyanates	476 (12.0)	253 (19.9)	136 (9.3)	63 (7.4)	24 (5.7)	- 71%
Metalworking Fluids	335 (8.5)	153 (12.0)	144 (9.9)	32 (3.7)	7 (1.7)	- 86%
Welding Fume	165 (4.2)	62 (4.9)	62 (4.2)	31 (3.6)	12 (2.8)	- 43%
Solvents	111 (2.8)	50 (3.9)	49 (3.4)	9 (1.1)	4 (0.9)	- 77%
Paint	97 (2.5)	18 (1.4)	49 (3.4)	21 (2.5)	13 (3.1)	+ 121%
Epoxy	92 (2.3)	33 (2.6)	27 (1.8)	19 (2.2)	13 (3.1)	+ 19%
Fungus	95 (2.4)	0	41 (2.8)	38 (4.4)	16 (3.8)	+ 36%
Formaldehyde	66 (1.7)	33 (2.6)	17 (1.2)	15 (1.8)	1 (0.2)	- 92%
Acids	73 (1.8)	27 (2.1)	24 (1.6)	15 (1.8)	8 (1.9)	- 10%
Latex/Rubber	63 (1.6)	25 (2.0)	32 (2.2)	4 (0.5)	2 (0.5)	- 75%

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 2023 (13.6%) (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 2023, 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, and a decrease to 13.6% in 2023.

TABLE 11
Cigarette Smoking Status of 3,843[a]
Confirmed WRA Patients: 1988-2023

	Smoking Status						
	Current		Ex-Smoker		Non-Smoker		TOTAL
	#	%	#	%	#	%	
OA	255	20.7	466	37.9	509	41.4	1,230
POA	203	15.3	533	40.0	595	44.7	1,331
AA	176	20.3	216	24.9	475	54.9	867
RADS	112	27.0	155	37.3	148	35.7	415
All	746	19.4	1,370	35.6	1,727	44.9	3,843

[a]Missing data on 171 patients.

TABLE 12
Cigarette Smoking Status of WRA Patients by Time Period

		Time Period				
	All Years	1988-1997	1998-2007	2008-2017	2018-2023	Change in Percentage
Smoking Status	# (%)	# (%)	# (%)	# (%)	# (%)	
Current	746 (19)	243 (20)	295 (21)	140 (17)	68 (18)	- 10%
Ex-Smoker	1,370 (36)	540 (43)	479 (34)	258 (32)	93 (24)	- 44%
Non-Smoker	1,727 (45)	463 (37)	632 (45)	409 (51)	223 (58)	+ 36%
Total	3,843[a]	1,246	1,406	807	384	

[a]Missing data on 171 patients.

TABLE 13
Personal History of Allergies or Asthma Among 3,630[a] Confirmed WRA Patients: 1988-2023

Personal History of:

	Allergies & Asthma		Asthma Only		Allergies Only		No Allergies or Asthma	
	#	%	#	%	#	%	#	%
OA	71	6.1	61	5.3	346	29.9	679	58.7
POA	94	7.6	66	5.4	423	34.4	67	52.6
AA	435	49.0	410	46.2	23	2.6	20	2.3
RADS	17	4.8	39	11.0	87	24.5	212	59.7
All	617	17.0	576	15.9	879	24.2	1,558	42.9

[a]Missing data on 384 patients.

TABLE 14
Health Care Usage Among Confirmed WRA Patients: 1988-2023

Lifetime History of Health Care Usage

ED Visit[a]		Hospitalized[b]	
Yes # (%)	No # (%)	Yes # (%)	No # (%)
2,536 (67)	1,234 (33)	1,195 (34)	2,344 (66)
Range 1-300 visits		Range 1-200 hospitalizations	
AVG 5.1 ±14.2		AVG 3.6±9.7	

[a]Missing data on 244 patients.
[b]Missing data on 475 patients.

SYMPTOMS

Three thousand forty-seven (3,047) 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-five 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 2018-2023, 17% 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 9% reporting the need for less asthma medication during 2018-2023, compared to 22% among those no longer exposed.

TABLE 15
Persistence of Symptoms and Medication Use in 3,519 Confirmed WRA Patients: 1988-2023

Still Exposed?	Total	Breathing Problems Still Present?				Still Taking Asthma Medications?			
		Yes		Less		Yes		Less	
		#	%	#	%	#	%	#	%
Yes	1,036	985	95.1	293	28.3	906	87.5	175	16.9
No	2,483	2,062	83.0	1,147	46.2	1,935	77.9	705	28.4
Total	3,519[a]	3,047		1,440		2,841		880	

[a]Information missing on 495 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	
2018-2023	Yes	98	89	90.8	17	17.3	89	90.8	9	9.2
	No	181	132	72.9	52	28.7	132	72.9	39	21.5
	Total	279	221		69		221		48	
Change in Percentage	Yes			-6%		-49%		+7%		-57%
	No			-12%		-42%		-2%		-27%

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	2018-2023	Change in Percentage
Test Type	(%)	(%)	(%)	(%)	%	
Pre-post Bronchodilatation	49	54	54	44	17	- 69%
Methacholine Challenge	17	25	16	10	3	- 88%
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 2018-2023. The first two time 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 823 workplace inspections associated with the 4,014 confirmed WRA cases have been conducted since 1988 (Table 18); 123 of those facilities have been inspected more than once. There was one inspection each in 2020 and 2021, two inspections in 2022, and no inspections in 2023.

Air sampling was conducted during 587 inspections (Table 19); 31 of the 582 (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: 1988-2023

	# Patients	Companies	
Inspection Status	Represented	#	%
Inspected	1,291	823[a]	28.2
No Follow-up Planned	2,513	1,902	65.2
Scheduled for Inspection	0	0	--
Out of Business	80	72	2.5
No Longer Use Occupational Allergen	27	26[b]	0.9
Sent Company Letter to Check Exposures[d]	103	96	3.3
Total	4,014	2,919[c]	

[a]823 inspections were conducted in 700 different workplaces.
[b]Eight companies that no longer use the suspected causal agent were previously inspected.
[c]Represents 2,796 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 823 Workplace Inspections: 1988-2023

Air Sampling – NIOSH Standard	#	%
Above NIOSH Standard	67	8.1
Below NIOSH Standard	490	59.5
No NIOSH Standard	33	4.0
Unknown (no report yet)	5	0.6
Did Not Sample for an Allergen	30	3.6
Did Not Sample	198	24.1
Total	823	
Air Sampling – MIOSHA Standard	#	%
Above MIOSHA Standard	31	3.8
Below MIOSHA Standard	551	67.0
No MIOSHA Standard	7	0.9
Unknown (no report yet)	5	0.6
Did Not Sample for an Allergen	31	3.8
Did Not Sample	198	24.1
Total	823	

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 1988-2023

	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 823 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 823 MIOSHA enforcement inspections.

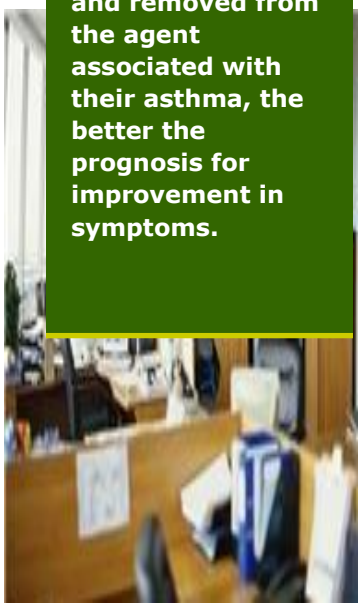
TABLE 21
Daily or Weekly Breathing Symptoms at Work or New-Onset Asthma Among Co-Workers of the 4,014 Confirmed WRA Patients: 1988-2023 and by Time Period

	# 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
2018-2023	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	
2018-2023	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 in 2023, 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 2023, there were 27,416 workers potentially exposed to isocyanates in manufacturing, which is an approximate increase of 5,000 workers compared with 22,403 workers in 2022. There were 24,020 workers in 2021, 29,894 workers in 2020 and 45,298 workers in 2019 potentially exposed to isocyanates.

TABLE 22 Michigan Workers Employed in Manufacturing Facilities in 2023 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	40,935	**0.9**
BARRY	BRADFORD WHITE CORP	900	11,185	**8.0**
BAY	QUANTUM COMPOSITES INC	14	33,933	**<0.1**
BERRIEN	LECO CORP NCP COATINGS NILES STEEL TANK	642	60,307	**1.1**
BRANCH	GOKOH COLDWATER INC	15	14,529	**0.1**
CALHOUN	BREMBO HOMER FOUNDRY COMCAST URETHANE TRANSCONTINENTAL	98	53,473	**0.2**
CLARE	LEAR CORP. FARWELL PLANT	278	7,060	**3.9**

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	4,079	**1.4**
DICKINSON	GREDE, LLC IRON MOUNTAIN LOUISIANA-PACIFIC-SAGOLA OSB	685	13,929	**4.9**
EATON	ALLIANCE INTERIORSSIKAAXON US SIKA CORP	65	43,101	**0.2**
HILLSDALE	ESSEX SPECIALTY PRODUCTS	2	12,545	**<0.1**
HURON	VALLEY ENTERPRISES	121	11,248	**1.1**
INGHAM	HUNTSMAN ADVANCED MATERIALS SA AUTOMOTIVE	223	153,703	**0.1**
ISABELLA	ELECTROLUX PROFESSIONAL GROUP THE DELFIELD CO.	1,049	24,088	**4.4**
JACKSON	MILSCO MICHIGAN SEAT TAC MFG	377	56,667	**0.7**
KALAMAZOO	AZON USA FLOWSERVE CORP	1,162	119,944	**1.0**
KENT	FLEXIBLE STEEL LACING CO, DBA FLEXCO GRAND RAPIDS FOAM TECHNOLOGIES HB FULLER KENDRICK PLASTICS LACKS WHEEL TRIM SYSTEMS, BARDEN PLATER NORDIC SPAS LLC PURFORMS INC. RICHWOOD INDUSTRIES INC.	1,040	413,253	**0.3**
LENAWEE	ANDERSON DEVELOPMENT INTEVA PRODUCTS	415	25,788	**1.6**
LIVINGSTON	ANTOLIN-HOWELL	718	64,117	**1.1**
LUCE	LOUISIANA-PACIFIC CORP-NEWBERRY SIDING	14	1,773	**0.8**
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	339,319	**0.7**
MASON	GREAT LAKES CASTING	210	10,212	**2.1**
MIDLAND	DDP SPECIALTY ELECTRONIC PARTS LLC	349	37,088	**0.9**
MONROE	SUNRISE WINDOWS LTD	452	40,590	**1.1**
MONTCALM	KENT FOUNDRY MARVEL REFRIGERATION	84	15,603	**0.5**
MUSKEGON	MUSKEGON COMPOSITES, INC STRUCTURAL CONCEPTS-PLANT 2	489	62,236	**0.8**
OAKLAND	ARMALY SPONGE EAGLE INDUSTRIES LYMTAL INTERNATIONAL INC TEMPERFORM CORP. WEBASTO ROOF SYSTEMS	409	726,000	**0.1**
OGEMAW	TAYLOR ENTRANCE SYSTEMS	170	6,159	**2.8**

Table 22. County	Company Name[a]	# Workers Employed by Isocyanate Using Facilities[b]	Total # Workers in the County[c]	% Workers Potentially Exposed to Isocyanates
OTTAWA	MAGNA ENGINEERED GLASS ROYAL TECH	80	129,767	**0.1**
SAGINAW	GLASTENDER POREX TECHNOLOGIES SAGINAW METAL CASTING OPERATIONS	905	79,442	**1.1**
SANILAC	ASCO LP GRUPO ANTOLIN MIDWEST RUBBER CO	520	10,288	**5.1**
ST CLAIR	AURIA SOLUTIONS IAC PORT HURON	122	41,897	**0.3**
VAN BUREN	SIKA MBCC US LLC SPECIAL-LITE INC	195	21,773	**0.9**
WASHTENAW	FAURECIA INTERIOR SYSTEMS-SALINE	1,510	150,308	**1.0**
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 PLASTOMER TOOLING EQUIPMENT INTERNATIONAL WINDSOR MACHINE & STAMPING (US) LTD WOODBRIDGE CORP	10,523	719,706	**1.5**
WEXFORD	REC BOAT HOLDINGS-CRUISER PLANT REC BOAT HOLDINGS-SPORT/ENGINEERING	480	13,629	**3.5**
TOTAL		**27,416**	**4,380,572**	**0.6**

[a]Source: U.S. Environmental Protection Agency. Toxics Release Inventory, Michigan Companies Using Isocyanates in 2023, data accessed 7/8/2026.

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

[c]Source: Michigan Labor Market Information, Data Explorer, 2023 Annual Employment by County, www.milmi.org accessed 7/18/2026.

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 2023. 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 2023[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
	CLARIOS APS PRODUCTION INC.	CO
	JBS PLAINWELL	A
	LG ENERGY SOLUTION MICHIGAN INC.	CO
	OTSEGO PAPER INC.	A
	SEKISUI KYDEX LLC	S
	TIARA YACHTS INC.	S
ALPENA	DECORATIVE PANELS INTERNATIONAL	F
	HOLCIM (US) INC.	A
	LAFARGE MIDWEST INC.	A
BARRY	BRADFORD WHITE CORP.	CO
	HASTINGS FIBERGLASS PRODUCTS	S
BAY	DE KARN JC WEADOCK GENERATING PLANT	A
	MERSEN USA GS CORP - BAY CITY	CH
	MICHIGAN SUGAR CO - BAY CITY FACTORY.	A
	QUANTUM COMPOSITES INC.	MA, S
BERRIEN	BLUEWATER THERMAL SOLUTIONS	A
	NCP COATINGS LLC	CO, P
	SPECIAL-LITE INC.	S
BRANCH	HC STARCK INC.	A, CO
	REAL ALLOY RECYCLING LLC	CH
	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
	II STANLEY CO INC.	S
	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	CH
CHARLEVOIX	ST MARYS CEMENT U.S. LLC	A
CLINTON	MWC LLC.	A
CRAWFORD	ARAUCO NA GRAYLING PARTICLEBOARD	F

COUNTY	COMPANY NAME	EXPOSURES
	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
	SIKA ADVANCED RESINS US	S
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, F
	MICHIGAN SUGAR CO - SEBEWAING FACTORY	A
	THUMB TOOL & ENGINEERING	A
INGHAM	AURORA SPECIALTY CHEMISTRIES	E, M
	KENT NUTRITION GROUP INC./KENT FEEDS INC.	CO
	MOLDED PLASTIC INDUSTRIES INC.	S
	NITREX INC.	A
	SYMMETRY MEDICAL INC.	CO
IONIA	BELDING TANK TECHNOLOGIES	S
	ROBROY ENCLOSURES	S
	THK RHYTHM AUTOMOTIVE	A
JACKSON	CHEMETALL US INC.	MA
	INDUSTRIAL STEEL TREATING	A
KALAMAZOO	ALLNEX USA INC.	F
	HAVILAND PRODUCTS CO.	A, F
	PHARMACIA & UPJOHN CO LLC A SUBSIDIARY OF PFIZER INC.	A, CH, E, F
KENT	ARKEMA INC.	P, S
	CUTTING EDGE ABRASIVES	S
	DFA DAIRY BRANDS FLUID LLC, DBA COUNTRY FRESH	A
	GM COMPONENTS HOLDINGS LLC	A
	HYDRO-CHEM SYSTEMS	A
	KENDRICK PLASTICS	F, S
	LACKS TRIM SYSTEMS-AIRLANE	F
	LACKS WHEEL TRIM SYSTEMS BARDEN PLATER	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

COUNTY	COMPANY NAME	EXPOSURES
	PROGRESSIVE METAL FORMING INC.	CO
	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
	INVECAST CORP.	CO
	METALLURGICAL PROCESSING CO.	A
	SPECIALTY STEEL TREATING INC..	A
MANISTEE	PACKAGING CORP OF AMERICA	F
MARQUETTE	DYNO NOBEL INC	A
	EAGLE MINE-MICHIGAMME	CO
	EAGLE MINE LLC-HUMBOLDT MILL	CO
MASON	HOUSE OF FLAVORS	A
	OCCIDENTAL CHEMICAL CORP.	A
MECOSTA	AGCO INC.	S
MENOMINEE	FIBREK	A
	L.E. JONES CO LLC	CO
MIDLAND	CABOT FUMED SILICA - MIDLAND PLANT	CH
	CORTEVA AGRISCIENCE LLC - MIDLAND	A, CH
	DDP SPECIALTY ELECTRONIC MATERIALS US LLC	S
	MIDLAND COGENERATION VENTURE	F
	THE DOW CHEMICAL CO.1790 BUILDING	A, CH, F, MMA, S
	TRINSEO LLC-MI OPERATIONS	MMA, S
	XALT ENERGY LLC	CO
MONROE	ADVANCED HEAT TREAT CORP.	A
	DTE ELECTRIC CO - MONROE POWER PLANT.	A, CO
	GUARDIAN INDUSTRIES - CARLETON	A
MUSKEGON	AMERICAN CHEMICAL SOLUTIONS LLC	P
	CANNON-MUSKEGON	CO
	HOWMET CORP - PLANTS 1, 3 & 10	CO
	MUSKEGON COMPOSITES INC.	S
	TECHLINE PRODUCTS	S
	WEBB CHEMICAL SERVICE CORP.	F
OAKLAND	ENGINEERED HEAT TREAT INC	A
	GENERAL MOTORS LLC ORION ASSEMBLY CENTER	F
	K C JONES PLATING CO.	A
	LYMTAL INTERNATIONAL, INC.	MA
	MACDERMID INC.	A
	OERLIKON METCO (US) TROY	CO
	SPECIALTY STEEL TREATING INC.	A
	UNITED PAINT & CHEMICAL	E
	WOODWORTH INC.	A
OGEMAW	HYPERION MATERIALS & TECHNOLOGIES - WEST BRANCH	CO
OSCEOLA	ADVANCED FIBERMOLDING INC.	S

COUNTY	COMPANY NAME	EXPOSURES
	GENERAL MILLS REED CITY YOPLAIT PLANT	A
OTTAWA	AURORIUM LLC - ZEELAND	MA
	BOAR'S HEAD PROVISIONS CO INC.	A
	J H CAMPBELL GENERATING PLANT	A
	NPR OF MICHIGAN	CO
	REQUEST FOODS INC. (COLDQUEST, GREENLY ST, QUINCY ST)	A
	THE HILLSHIRE BRANDS CO.	A
	VERTELLUS ZEELAND LLC	MA
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
SHIAWASSEE	GREAT LAKES COMPOSITES LLC	S
ST. CLAIR	MARYSVILLE ETHANOL LLC	F
	MICHIGAN METAL COATINGS	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
WASHTENAW	DAPCO INDUSTRIES	A
WAYNE	AIR PRODUCTS & CHEMICALS INC/DETROIT HYDROGEN FACILITY	A
	AJAX METAL PROCESSING INC.	CO
	BASF CORP.	A, M, MMA, S
	BODYCOTE THERMAL PROCESSING INC. - CANTON HAGGERTY	A
	COOPER HEAT TREATING LLC.	A
	DYNAMIC SURFACE TECHNOLOGIES INT. INC.	A
	EES COKE BATTERY LLC.	A
	EQ DETROIT INC.	CO, S
	INLAND WATERS POLLUTION CONTROL DETROIT FACILITY	S
	JCI JONES CHEMICALS INC.	CH
	L & W INC..6771 HAGGERTY RD	CO
	L&W INC.6201 HAGGERTY RD	CO
	MARATHON PETROLEUM CO LP - MICHIGAN REFINING DIV.	A
	MCGEAN-ROHCO INC.	CO
	NEW BOSTON RTM INC.	S
	OAKLAND STAMPING LLC	CO
	OERLIKON (US) PLYMOUTH	CO
	POLYCHEMIE INC.	F
	PVS TECHNOLOGIES INC	CH
	SATURN ELECTRONICS CORP..	A
	WAYNE DISPOSAL INC.	CO
	Z TECHNOLOGIES CORP.	A

COUNTY	COMPANY NAME	EXPOSURES
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 2023, accessed 11/07/2024.

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, and in 2023 15% (9/60) 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]

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 3.4 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 (11.9%) and metal working fluids (8.4%). 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 proven more difficult to control (Figure 3), as well as increased workers in service industries.

Cleaning agents are one of the major exposures associated with work-related asthma. 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).

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

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 (8.0%), Sanilac (5.1%), Dickinson (4.9%), Isabella (4.4%), Clare (3.9%), and Wexford (3.5%). 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 2,483 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 43% of the WRA patients identified through the Michigan Tracking System have no personal or family 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. 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

2023 Patient Narratives by Type of Industry & Exposure



Abbreviations:

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

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

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MANUFACTURING

Exposure to Epoxies and Glues

AA4555. A male in his 30s, who worked at a furniture manufacturer had an exacerbation of his pre-existing asthma from the heat in the facility and exposure to glue being used to make the furniture. He had recently used FMLA due to multiple work-related asthma flare ups. EMS found him to be tachypneic, but no wheezing. He initially refused transport to hospital as he stated that he was feeling better, but then he started feeling short of breath so was transported to the ED. Enroute he received a breathing treatment. He was discharged from the ED with a rescue inhaler with instructions to follow up with his PCP to be given long term asthma medication. He had a history of asthma before working at this company and was a current smoker.

Exposure to Welding Fume

OA4620. A male in his 40s died from an asthma attack from exposure to welding fume where he worked as a welding technician at an auto parts manufacturer. He experienced wheezing. He was prescribed an inhaler, an albuterol nebulizer and ipratropium. He did seek care in the ED at least one time. He was a current cigarette smoker at the time of his death.

Exposure to Plastic Dust and Fumes

AA4594. A female in her 50s experienced an exacerbation of her pre-existing asthma from exposure to plastic injection mold dust where she worked at an auto parts manufacturer. She experienced cough and shortness of breath. She was treated in the ED. She was a lifelong non-smoker.

AA4585. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to smoke from a fire at the plastic injection molding manufacturing facility where she worked. The smoke from the fire aggravated her symptoms immediately. In the ED she was treated with albuterol. She was a life-long non-smoker.

OA4624. A male in his 50s died from an asthma attack at the auto parts manufacturer where he worked doing plastic injection molding

where he was exposed to polyurethane. His primary care doctor prescribed him albuterol the month before he died. He also used Flovent and Ventolin. He reported to his primary care doctor that he experienced chronic shortness of breath. He died at the hospital. He formerly smoked cigarettes for two years during his mid-teens.

Exposure to Cleaners and Cleaning Agents

AA4541. A female in her 30s worked at an auto manufacturer building engines. She experienced an exacerbation of her pre-existing asthma. She had worked at this company for three years as an operator on the line but was not doing her regular job on the day she had an asthma attack; she had picked up an extra shift. She was rebuilding an engine and had sprayed the engine with a chemical cleaner, which caused her to become short of breath. EMS arrived and found her short of breath and gave her a breathing treatment enroute to the hospital. At the hospital wheezing was noted in the left lower lung field, and she received another breathing treatment, which resolved her wheezing and shortness of breath. She was discharged that same day with steroids and an inhaler. She had a history of asthma since she was 10.

AA4583. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to cleaning agents used to clean car parts at an automotive parts manufacturing facility. He was a production worker assigned to clean the car parts. He experienced worsening cough and shortness of breath and was prescribed prednisone in the ED. He was a life-long non-smoker.

AA4648. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to chemicals used to manufacture paper products at her workplace. Although she had an office job at the factory, isopropyl alcohol and solvents triggered her asthma when she walked through the production area. She described the ventilation as poor, with open drums of the chemicals. Since beginning to work at the factory, she was hospitalized twice and had multiple trips to the ED. In addition to taking albuterol as needed since her childhood, the ED prescribed Spiriva. She was a life-long non-smoker.

AA4577. A male in his 20s experienced an exacerbation of his pre-existing asthma while working for a company that restored antique boats. After using a degreasing agent, he removed his respirator and began rinsing the boat with water. At that time, he experienced chest tightness, shortness of breath, cough, lightheadedness, numbness in his extremities and his face, and nausea. He was taken to the ED where he was treated with DuoNeb and IV steroids, which resolved his symptoms. He was discharged home with prednisone and a Ventolin inhaler. He formerly smoked for six years.

AA4588. A female in her 60s experienced an exacerbation of her pre-existing asthma after the automotive parts supplier where she worked began using a new detergent to clean metal components. She was brought to the ED by ambulance, where she was given DuoNeb and prednisone, and discharged home with albuterol.

Exposure to Heat, Humidity and Exertion

POA4682. A female in her 30s developed work-related asthma due to high heat and dust while working as a line operator at an automotive assembly plant. She had worked at the facility for five years when she was moved to a different work area. Shortly after being in her new work location, she developed a cough and shortness of breath. She sought treatment in the ED and was prescribed albuterol. She continues to work in this new area, and her asthma has worsened, and she requires more asthma medication. She formerly smoked a half a pack of cigarettes for 17 years from her teens to her mid-30s.

AA4552. A male in his 40s with a past medical history of COPD and asthma overworked himself in the heat while working in an assembly line at an auto manufacturer. He experienced shortness of breath. EMS arrived and noted decreased breath sounds in all fields and some tachycardia. He received a DuoNeb treatment enroute to the ED, which improved his lung sounds. At the ED he was discharged with a prescription for antibiotics. He was a current cigarette smoker.

AA4584. A female in her 30s experienced an exacerbation of her pre-existing childhood asthma from working in a hot and dusty environment while working on the assembly line at a car seat manufacturer. She experienced worsening wheezing, cough, chest tightness and shortness of breath. She was treated in the ED with albuterol, Atrovent and DuoNeb. She was a life-long non-smoker.

AA4564. A female in her 30s experienced an acute exacerbation of her pre-existing asthma while working at an automotive interior components manufacturer. Her workstation was located near a heater, and the hot air caused her to experience extreme shortness of breath. She called 911. She declined EMS transport to the hospital, but paramedics administered multiple DuoNeb treatments and a dose of steroids. It is unknown if she ever smoked cigarettes.

OA4570. A male in his 40s developed work-related asthma after working for five years at a sugar manufacturer. His job as a silo

attendant/silo operator/maintenance man was physically exerting. He developed shortness of breath and was prescribed albuterol and Trelegy. His exertion was mainly from climbing stairs throughout the day. He continued to work at the facility even though his symptoms worsened and he required a greater amount of asthma medication. He was a current smoker since his mid-teens. He formerly had asthma as a child, but it had resolved years before this job.

Exposure to Miscellaneous Chemicals, Fumes and Dusts

POA4658. A female in her 20s developed WRA from exposure to metal dust, metalworking fluids and welding fume while working on the line at an automotive parts manufacturer. About one year after beginning to work at the facility, she developed chest tightness, shortness of breath and wheezing. She had two trips to the ED where she was prescribed asthma medication. Her asthma worsened throughout her shift and as the work week progressed; when off work on weekends or vacations, her asthma improved. She continued to work this job and over time her asthma worsened, and she required a great amount of asthma medication. She was a current two cigarettes per day smoker.

POA4517. A female in her late 20s had wheezing and shortness of breath after reporting to work at an auto parts manufacturer. She was diagnosed with asthma in the preceding year which coincided with her starting her current job. She described her job as having to work around a lot of "dust". She had used a rescue inhaler which did not relieve her symptoms. She was transported to the hospital and treated for an asthma exacerbation. She was a current 1/2 pack a day cigarette smoker.

AA4534. A female in her 50s had chest pain, inspiratory and expiratory wheezing, and shortness of breath while at work at an auto manufacturer. She was given a breathing treatment which relieved most of her wheezing. An EKG showed sinus tachycardia with no signs of a myocardial infarction. She had a history of asthma since childhood. She believed her asthma exacerbation at work was due to the diesel/exhaust fumes in the location where she was working.

AA4551. A male in his 50s had a severe exacerbation of his pre-existing asthma while at work at an auto supply manufacturer. He had been having trouble breathing the night before his asthma attack at work, but his breathing became much worse when he arrived for his work shift. He was taken to the hospital where he continued to deteriorate into acute respiratory distress syndrome. He required four days of Bipap treatment. He had a past history of COPD, hypertension and asthma. He was a former smoker with 37.5 pack years, who had quit 8 years prior to this hospitalization.

AA4553. A male in his 40s worked in a battery manufacturing plant and had shortness of breath after being exposed to carbon powder and PAS-C3B (Lithium/nickel/cobalt/manganese oxide graphite). He was wearing a mask but believed it wasn't fitting properly that day. The first day EMS arrived they treated him with DuoNeb and his shortness of breath improved; he was discharged from the ED that day. The next day while working in the same area as his previous exposure but not directly with the same chemicals, he again developed shortness of breath, a cough and felt dizzy; he again went via EMS to the ED. He received DuoNeb and a prednisone treatment which improved his shortness of breath. He had been diagnosed with asthma before these events but had not been taking any asthma medication.

POA4548. A female in her 40's with a past medical history of asthma since her 20s had an asthma exacerbation while working near hood sprayers on an auto assembly line. She was first diagnosed with asthma at a different auto plant in her 20s when she was exposed to diesel fumes. She had worked at her current location for 26 years, with no issues until recently. When EMS arrived, she had audible wheezing and was given two liters of oxygen. She was given one treatment of albuterol during transport to hospital, which improved her symptoms. At the ED she was evaluated, given a breathing treatment which resolved all her asthma symptoms, and she was discharged.

AA4543. A female in her 30s worked as a machinist for an automotive component supplier. She had an exacerbation of her pre-existing asthma after being exposed to steel dust. EMS arrived and found her with shortness of breath, dizziness and chest pain for the past three hours. She was given a breathing treatment which improved her breathing, but she still felt dizzy and was then transported to the ED. At the ED she was given steroids, prescribed another albuterol inhaler to have at work, and then discharged. She was a current smoker, smoking a quarter pack of cigarettes per day.

AA4581. A female in her 50s experienced an exacerbation of her pre-existing asthma from exposure to airborne dust and oils where she worked as an assembler at a car parts manufacturer. She described being barely able to walk to her workstation each time she went to work. She experienced worsening cough, chest tightness, wheezing and shortness of breath. She was treated in the ED. She formerly smoked five cigarettes a day in her late teens.

AA4559. A male in his 30s with pre-existing asthma was working at a powder coating manufacturer. He was powder coating various products and vacuuming the excess powder when done. He believed that vacuuming the excess powder was the primary exposure that caused his asthma exacerbation. He did not wear a face mask, only a face shield at the time of the exposure and had only been working at the company for two days prior to his exacerbation. When EMS arrived they were told that he had taken two puffs of his inhaler without relief; EMS noted wheezing in his left lower lung and gave him a breathing treatment which improved his symptoms. In the ED he had a repeat breathing treatment and steroids, which stabilized his symptoms. He had a past history of obesity, with a BMI >60. He had been diagnosed with

asthma about five years prior to this job but had not experienced any exacerbations before this event.

AA4569. A female in her 40s experienced an acute exacerbation of her pre-existing asthma while working as a machine operator at a large auto assembly plant where she had been employed for seventeen years. She experienced shortness of breath, chest tightness, and cough. The factory nurse placed her on oxygen and called an ambulance. She was taken to the hospital and given a DuoNeb treatment. For the prior six years, she experienced asthma symptoms every time she went to work, but she didn't know what substance triggered her symptoms. She never smoked cigarettes.

OA4533. A male in his 50s was diagnosed with occupational asthma after twenty years of exposure to leather dust, dyes, and paint at an automotive interiors manufacturer, where he worked as a labor team leader. Due to wheezing and shortness of breath, he was placed on a Breztri inhaler, Singulair, and given a home albuterol nebulizer by an occupational medicine physician. In 2023 he was on sick leave or disability from work and still had severe obstructive findings on pulmonary function testing. He never smoked cigarettes.

AA4568. A female in her teens experienced an acute exacerbation of her pre-existing asthma while working in a plant that manufactured water heaters. While installing fiberglass insulation into the product, she began experiencing shortness of breath. She was transported to the ED where she was given a prescription for an albuterol MDI. She reported that other coworkers had acquired breathing problems since beginning work at the same factory. She had never smoked cigarettes.

AA4589. A female in her 30s experienced an acute exacerbation of her pre-existing asthma after working at an automotive assembly plant for one year, where she was exposed to forklift exhaust and airbag components. She was taken to the ED and hospitalized overnight with cough, chest tightness, and shortness of breath. She was treated with IV steroids, oral steroids, a Dulera inhaler, and albuterol. She previously smoked half a pack of cigarettes per day for four years and was a current marijuana smoker.

AA4593. A male in his 30s experienced an exacerbation of his pre-existing asthma while working as a maintenance technician at an aluminum auto parts foundry. He had worked there for four years. One day, after inhaling excessive aluminum and concrete dust, he experienced difficulty breathing and developed a dry cough. Over the following three days, he visited urgent care and an ED and was given an antibiotic, albuterol MDI, Flonase, Claritin, and Zofran. He was a current cigarette and marijuana smoker.

AA4563. A female in her 50s experienced an exacerbation of her pre-existing asthma and COPD while working in the paint building at a large automotive assembly plant. She developed wheezing, cough, and shortness of breath before being placed on oxygen by the factory's nurse. She was then transported to the ED where she was given a DuoNeb treatment, IV steroids, and a referral to a pulmonologist. At that time, she smoked one pack of cigarettes per day.

Exposure in the Food Industry

AA4542. A female in her 40s worked at a condiment manufacturer as a machine operator; she had an exacerbation of her pre-existing asthma while packaging a new flavor of hot sauce that had a strong smell. When EMS arrived, they found the woman in a tri-pod position in a wheelchair, she had already used her rescue inhaler with no improvement. EMS reported wheezing in all lung fields and marked conversational dyspnea. She received a breathing treatment enroute to the hospital which improved her symptoms. Upon evaluation in the ED they noted the same findings as EMS, and treated her with another breathing treatment. Her symptoms resolved, and she was discharged with a short course of steroids. She had worked at the company for under a year. Three other workers had previously been treated at the ED for respiratory symptoms. She had a history of asthma since she was diagnosed at age three.

AA4558. A female in her 60s with pre-existing asthma was brought to the ED after she couldn't stop coughing at her work in a commercial bakery. She had been having intermittent asthma attacks for the six days prior to her visit to the ED. She worked in Human Resources. She had been working at this company for two years and this was the first time she had difficulty breathing at work. She worked in an old building; her office was in a renovated kitchen that she thought still had flour and dust. Even though she had a history of asthma, she did not use any asthma medication. She was treated with DuoNeb by EMS which improved her symptoms. At the ED, she was worked up for possible pulmonary embolism, which was negative and discharged with asthma medication. She also stated that five other co-workers were brought to the ED that summer.

AGRICULTURE

Exposure to Cannabis Products

AA4544. A male in his 20s had a severe exacerbation of his pre-existing asthma while working at a cannabis manufacturer, when he stepped outside into the cold air. When EMS arrived, he was in a tri-pod position and reported that he had already used his rescue inhaler four to five times without any improvement. He was transported to the ED where he was given a DuoNeb treatment as well as Solu-Medrol. His symptoms greatly improved, and he was discharged with a short course of steroids and an inhaler. He had a history of asthma before working at this job and had previously experienced asthma attacks from being in cold air. He reported that he had been hospitalized "many times" in the past for asthma but never intubated.

AA4645. A male in his 20s experienced an exacerbation of his childhood asthma while working as a flower room manager at a cannabis grow facility. He was exposed to the disinfectant, zerotol, that was being improperly used in a humidifier. The exposure triggered a cough, chest tightness and shortness of breath.

RADS4565. A female in her 50s developed RADS after an ozone leak at a marijuana processing facility where she had worked as a machine operator/bud sorter for three months. She developed cough, fatigue, sore throat, congestion, body aches, and a headache. She was treated at the ED with DuoNeb and given prednisone and albuterol for use at home. Three other people at work developed similar symptoms from this acute exposure. She was a current cigarette and marijuana smoker.

AA4737. A female in her 50s experienced an exacerbation of her pre-existing asthma from exposure to a very high level of ozone that was being used to disinfect surfaces at an indoor cannabis grow facility. She experienced shortness of breath, was transported to the ED and treated with Pulmicort. She formerly smoked two cigarettes a day.

Exposure to Miscellaneous Chemicals

AA4578. A female in her 20s experienced an exacerbation of her childhood asthma from exposure to nitric acid and phosphoric acid at a dairy farm where she worked maintenance. Her job included cleaning out the pipes used to transfer milk. She was prescribed albuterol in the ED. She was a life-long non-smoker.

WHOLESALE AND RETAIL TRADE

Exposure to Cleaning Agents

POA4681. A female in her 20s developed work-related asthma shortly after starting to work at a retail store where she used cleaners and paint thinner to clean products for decorating items in the store. She developed a cough, shortness of breath, wheezing and chest tightness which came on suddenly after doing this job. She had two ED visits and was hospitalized once. She was prescribed steroids. After these medical encounters she quit this job because of her asthma. Since then, her asthma symptoms are unchanged but she requires less asthma medication. She was a life-long non-smoker.

Exposure to Miscellaneous Dusts and Fibers

AA4561. A female in her 50s with pre-existing asthma was pushing large bins of clothes around a warehouse when she became short of breath. She took two puffs of her rescue inhaler and sat down outside the building. EMS arrived and assessed her and found that her vitals were stable and her lungs were free of wheezing, but she still felt she was not 100% and asked to be taken to the hospital. At the hospital she was evaluated, and it was recommended that she continue to use her steroid inhaler daily. Of note, wildfires in Canada were affecting air quality in Michigan in June, when this took place.

Meat Wrappers' Asthma

OA4640. A male in his 60s developed work-related asthma while working for a grocery store as a meat cutter. He worked for the store for over 30 years and was a meat cutter for his most recent eight years of work there before he developed "meat-wrappers asthma" from exposure to fumes from packaging the meat. He experienced a cough and shortness of breath from exposure to heated polyvinyl chloride from the plastic films and thermoactivated price labels. He also described mold in his work area. He sought medical treatment and was prescribed

albuterol and Duloxetine. He retired from this job after he was diagnosed with work-related asthma. He was a life-long non-smoker.

CONSTRUCTION

Exposure to Multiple Construction-related Substances

AA4536. A male in his 50s with pre-existing asthma was exposed to concrete sealant for two hours and immediately afterwards started to experience shortness of breath and dizziness. He waited a few hours to see if his asthma symptoms would resolve; his symptoms did not resolve so he sought treatment at the ED. At the ED, he received DuoNeb. Even though he was previously diagnosed with asthma, he was not taking any asthma medication. He occasionally smoked marijuana.

POA4653. A male construction worker in his 40s developed work-related asthma from exposure to wood dust, paint, tile grout and primer while cutting and laying tile for residential homes. He developed a cough and shortness of breath and was prescribed albuterol and Symbicort. He formerly smoked a pack of cigarettes a day for 20 years.

AA4575. A male in his 30s experienced an exacerbation of his pre-existing asthma while working outside as a machine operator on a construction site. He believed the poor air quality due to wildfire smoke and construction dust triggered his asthma. He experienced chest tightness and shortness of breath before being taken to the hospital by ambulance. He prescribed Trelegy and a daily allergy medication for his asthma. He had never smoked cigarettes.

HEALTH CARE AND SOCIAL ASSISTANCE

Exposure to Cleaning Agents

AA4673. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to oxycide, a disinfectant being used to clean in her area of the hospital where she worked as a respiratory therapist. She immediately experienced short breathing, which worsened as the workday progressed. She was prescribed albuterol and fluticasone furoate. She continues to work at the hospital. She was a life-long non-smoker.

AA4574. A female in her 20s experienced an exacerbation of her childhood asthma from exposure to a disinfectant at a dentist office where she worked as a dental hygienist. She had worked there for three years when a new disinfectant was being used improperly and spilled, causing immediate asthma symptoms. She developed wheezing and chest tightness. She sought treatment at an urgent care facility. Since the spill, her asthma symptoms resolved and she required the same amount of asthma medication as she did prior to the spill. She was a current half pack of cigarettes a day smoker.

Exposure to Scented Products

AA4614. A female in her 50s, a registered nurse, was working in a patient's home when she began experiencing an exacerbation of her pre-existing asthma. The patient's family member brought a cinnamon oil diffuser into the home, and the nurse immediately began to experience wheezing, cough, chest tightness, and shortness of breath. Because of this incident, the patient was started on albuterol, Singulair, Trelegy, and a QVAR inhaler by her doctor. This was paid for by workers' compensation. She had never smoked cigarettes.

Exposure to Pollen and Mold

AA4613. A female in her 50s experienced an exacerbation of her pre-existing asthma while working as a nursing manager of a long-term care facility. Her employer's Occupational Medicine Department inspected her work area and found an air conditioning unit filled with pollen, mold, and debris. Due to her cough and shortness of breath, her physician assistant prescribed albuterol and a daily allergy medication. She previously smoked half a pack of cigarettes per day for twenty years.

MISCELLANEOUS INDUSTRIES

Exposure to Cleaning Agents

AA4550. A female in her 30s with a past medical history of Rheumatoid Arthritis and asthma experienced wheezing when exposed to chemical cleaners while at work. She took prednisone as well as Benadryl and used her rescue inhaler three times. She was directed to go to the ED by her primary care physician. Her vitals were stable with no symptoms. The ED discharged her with no treatment and recommended she avoid further exposure to irritants.

Exposure to Paint Fumes

AA4586. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to paint fumes. She experienced worsening wheeze and shortness of breath. In the emergency department she was prescribed albuterol, Atrovent and prednisone. She formerly smoked cigarettes.

TRANSPORTATION AND WAREHOUSING

Exposure to Miscellaneous Agents

AA4683. A male in his 30s experienced an exacerbation of his pre-existing asthma from exposure to dust at a shipping warehouse. The dust triggered wheezing. He was prescribed Asmanex and albuterol. He had at least one trip to the ED. He was a life-long non-smoker.

AA4591. A female in her 20s experienced an exacerbation of her pre-existing asthma while working as a delivery driver. She was exposed to diesel fumes from other vehicles when she loaded and unloaded her truck at the warehouse and sorting facility. One day, she became so short of breath at work that an ambulance was called to take her to the ED. She was given a DuoNeb treatment, prednisone, pain medication, and a refill of her home albuterol MDI. She continued to work as a driver at the same facility. She had never smoked cigarettes.

UTILITIES

Exposure to Miscellaneous Agents

AA4579. A male in his 60s experienced an exacerbation of his pre-existing childhood asthma from exposure to the fumes from superheated coal that was off gassing as well as lead and welding fumes. He worked for an electric utilities company. He was a life-long non-smoker.

ACCOMODATION AND FOOD SERVICES

Exposure to Miscellaneous Agents Including Dusts, Exertion/Heat and Cleaning Agents

AA4580. A female in her 20s experienced an exacerbation of her childhood asthma from exposure to dust at the fast-food restaurant where she worked. She experienced worsening cough, chest tightness and shortness of breath. She was prescribed prednisone and albuterol in the ED. She was a life-long non-smoker.

AA4554. A male in his 20s with a past history of asthma had an acute asthma exacerbation while he was exerting himself in a restaurant. He had inspiratory and expiratory wheezing and difficulty breathing. EMS treated him with albuterol, which improved his wheezing. At the ED he received DuoNeb with prednisone and his asthma symptoms resolved.

POA4603. A male in his 50s who worked as a dishwasher at a restaurant developed work-related asthma from exposure to cleaning agents and steam. He developed wheezing, cough, chest tightness and shortness of breath. He was prescribed steroids during a visit to the ED. He had two visits to the ED and was hospitalized once. He was a lifelong nonsmoker.

ADMINISTRATIVE AND SUPPORT AND WASTE SERVICES

Exposure to Plant Material and Animal Dander

AA4572. A male in his teens experienced an acute exacerbation of his pre-existing asthma and allergies from exposure to grass and farm animals. On his first day of work for a lawn care company, he was mowing grass on a farm for several hours and gradually experienced wheezing and chest tightness. He did not have his rescue inhaler but continued working until he vomited. His coworkers called an ambulance, which took him to the hospital. He received a DuoNeb treatment and a refill of his home nebulizer solution. He quit working at the lawncare company on doctor's advice. He had never smoked cigarettes.

AA4679. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to pollen while performing landscaping duties. Laying mulch, mowing lawns and exertion caused him to experience wheezing, chest tightness and shortness of breath. He was treated in the ED. His job was seasonal; since that time his asthma improved and he did not require asthma medication. He formerly smoked two cigarettes per day from his late teens to his early 20s.

POA4702. A female in her 50s developed work-related asthma from exertion from jogging conditioning training as a security guard. She had worked for the security company for a year before her asthma developed. She was prescribed trelegy. She left that job and since then her asthma and medication use was unchanged. She was a life-long non-smoker.

OTHER SERVICES (Except Public Administration)

RADS4582. A male in his 60s working as a manager at an automotive repair shop developed RADS from an acute exposure to concentrated liquid weed killer. He was applying the product and not using any protective masks or clothing. He was exposed for about half an hour. He developed shortness of breath, cough, wheezing and chest tightness. He was treated in the ED with DuoNeb, Trelegy and Prednisone. He has had persistent difficulty breathing six months after this exposure. He formerly smoked two packs of cigarettes per day from his late 20s to his early 60s.

RADS4611. A male in his 30s developed RADS from an acute exposure to sulfur dioxide. He was self-employed doing industrial repairs. He developed wheezing, a cough and shortness of breath. He was prescribed Symbicort, Trelegy and Ventolin. Since the exposure his asthma worsened, and he required a greater amount of asthma medication. He was a lifelong non-smoker.