

JUNE 8, 2020

2018

ANNUAL REPORT

TRACKING WORK-RELATED

ASTHMA IN MICHIGAN



2018 ANNUAL REPORT

Work-Related Asthma Surveillance Program

TABLE OF CONTENTS

SUMMARY	1-2
BACKGROUND	2
PROCEDURES	2-3
RESULTS	4-27
DISCUSSION	28-31
REFERENCES	32
APPENDIX	33-42

Michigan State University Department of Medicine

West Fee Hall
909 Wilson Road, Room 117
East Lansing, MI 48824
517.353.1846

Kenneth D. Rosenman, MD
Mary Jo Reilly, MS

Michigan Department of Labor and Economic Opportunity (LEO)

PO Box 30649
Lansing, MI 48909
517.284.7777

Barton G. Pickelman
Director, MIOSHA

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



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

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.

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 28th 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 asthma¹. 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.

Summary, continued...

- ◆ Since 2007, the number of cases identified each year has been less than the overall yearly average of 124.
- ◆ From 1988-2018, 3,673 WRA cases have been identified with MI's tracking system.
- ◆ We estimate there are 62,000-97,000 adults in MI with WRA.
- ◆ 79% of the MI WRA patients have new-onset asthma; 21% have pre-existing asthma aggravated by an exposure at work.
- ◆ MIOSHA enforcement inspections at the facilities where individuals worked who were reported with WRA revealed that, on average, almost one out of every six of the fellow workers have asthma or respiratory symptoms compatible with asthma.
- ◆ Cleaning agents (12.7%) and isocyanates (11.9%), are the most commonly reported exposures causing WRA in MI.
- ◆ Approximately 45,458 individuals in the MI workforce are employed in manufacturing where isocyanates are used.
- ◆ The average incidence rate of WRA among African Americans is 2 times greater than that of Caucasians.

Background

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

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

Work-Related Asthma Tracking Procedures

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

SOURCES TO IDENTIFY PATIENTS

- ◆ **Health Care Providers** private practice, 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



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

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

WRA Tracking Procedures in Michigan

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

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

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

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

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

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

*SUBCATEGORIES OF WRA

New Onset

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

Exacerbation

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

Results

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

REPORTS

Table 1 shows that 3,673 people were confirmed with WRA between 1988—2018. The reports are divided into: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA) and Reactive Airways Dysfunction Syndrome (RADS). Eighty-one additional patients have been confirmed since last year's report (all 81 for 2018). Figure 1 shows the overlap of the patients by reporting sources for 1988—2018.

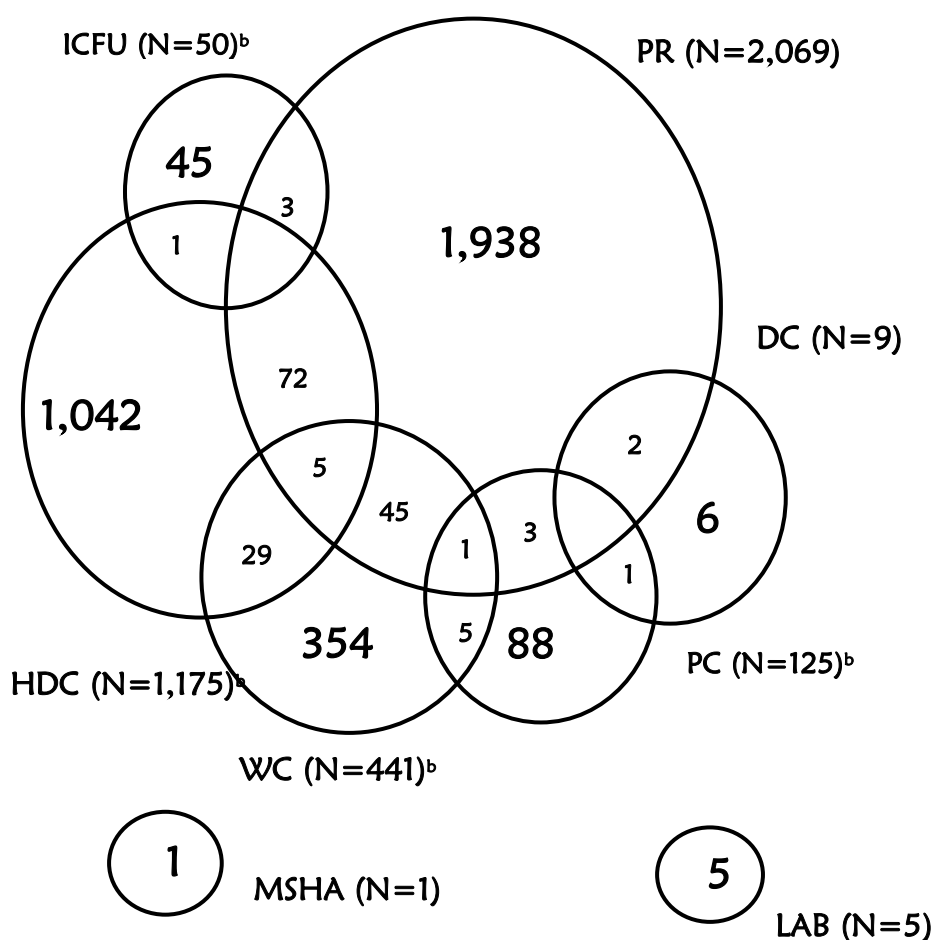
TABLE 1
Number of Confirmed Cases of Work-Related Asthma by Year and Type

	Disease Status				
YEAR	OA	POA	AA	RADS	TOTAL
1988	23	7	0	1	31
1989	43	12	3	5	63
1990	87	35	14	8	144
1991	55	30	14	16	115
1992	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 ^a
2018	15	19	44	3	81 ^a
Total	1,180	1,331	754	408	3,673

^aReports are still being processed for calendar years 2017 and 2018; an increase in these totals will be reflected in next year's annual report.

FIGURE 1

Overlap of Reporting Sources for 3,673 Confirmed Work-Related Asthma Patients: 1988-2018^a



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

^bThere was an overlap of PC-HDC for 24 individuals, an overlap of one individual for PC-ICFU, and an overlap of WC-PC-HDC for two individuals.

Demographics – Trends

The analyses conducted for the annual report were divided into 1988-1997, 1998-2007 and 2008-2018 to examine trends over time. There were 1,274 individuals reported with work-related asthma from 1988-1997, 1,461 individuals reported from 1998-2007 and 938 reported from 2008 to 2018. 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 2008-2018 time periods.

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

RACE: Table 3 shows there was an increase over time in the percentage of Hispanic cases of WRA, and a decrease in the percentage of Caucasian cases of WRA. The percentages of other races remained unchanged over time, although the numbers of cases of other races were quite low. The annual incidence rate for African Americans was 2.74 per 100,000 Michigan African American workers compared to 1.37 per 100,000 for Michigan Caucasian workers; this was a 2 times greater incidence (95% CI 1.210, 3.642).

TABLE 2 Gender of Work-Related Asthma Patients by Time Period					
	Time Period				
	All years	1988-1997	1998-2007	2008-2018	Change in Percentage
Gender	# (%)	# (%)	# (%)	# (%)	
Female	1,982 (54)	626 (49)	800 (55)	556 (59)	+ 20%
Male	1,691 (46)	648 (51)	661 (45)	382 (41)	- 20%

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.

TABLE 3 Race of Work-Related Asthma Patients by Time Period					
	Time Period				
	All years	1988-1997	1998-2007	2008-2018	Change in Percentage
Race	# (%)	# (%)	# (%)	# (%)	
Caucasian	2,669 (73)	973 (76)	1,074 (74)	622 (66)	-13%
African American	689 (19)	239 (19)	271 (19)	179 (19)	None
Hispanic	82 (2)	24 (2)	27 (2)	31 (3)	+ 50%
Alaskan/Am Indian	32 (1)	10 (1)	13 (1)	9 (0.8)	None
Asian	15 (<1)	4 (0.3)	7 (0.5)	4 (0.4)	+ 33%
Other	42 (1)	11 (1)	20 (1)	11 (1.2)	+20%
Unknown	144 (4)	13 (1)	49 (3)	82 (9)	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 (10.7 cases per 100,000), Clare (7.9 cases per 100,000), Genesee (4.8 cases per 100,000), Huron (4.6 cases per 100,000) and Osceola (4.6 cases per 100,000) and Saginaw (4.5 cases per 100,000).

TABLE 4

Average Annual Incidence Rates of Work-Related Asthma Among Michigan Workers by County of Exposure: 1989-2016^a

County	Avg Annual		Cases 1989-2016	County	Avg Annual		Cases 1989-2016
	# EE's ^b	Inc Rate ^c			# EE's ^b	Inc Rate ^c	
Alcona	3,701	1.0	1	Keweenaw	934	3.8	1
Alger	4,082	1.7	2	Lake	4,078	1.8	2
Allegan	51,890	3.5	51	Lapeer	41,930	2.9	34
Alpena	13,883	2.8	11	Leelanau	10,451	2.1	6
Antrim	10,773	1.0	3	Lenawee	47,409	2.5	33
Arenac	6,827	2.6	5	Livingston	86,477	1.6	38
Baraga	3,466	4.1	4	Luce	2,678	10.7	8
Barry	28,195	1.0	8	Mackinac	5,996	1.8	3
Bay	51,280	1.8	26	Macomb	396,836	2.7	302
Benzie	7,828	1.4	3	Manistee	11,000	1.3	4
Berrien	73,886	1.4	29	Marquette	31,306	2.4	21
Branch	21,410	3.8	23	Mason	13,628	1.0	4
Calhoun	65,736	2.4	44	Mecosta	17,904	1.6	8
Cass	24,866	0.7	5	Menominee	12,260	0.3	1
Charlevoix	12,704	2.8	10	Midland	39,455	2.8	31
Cheboygan	11,260	4.1	13	Missaukee	6,220	2.3	4
Chippewa	15,632	1.1	5	Monroe	72,714	1.5	31
Clare	11,718	7.9	26	Montcalm	27,030	2.2	17
Clinton	34,384	0.8	8	Montmorency	3,781	4.7	5
Crawford	6,164	3.5	6	Muskegon	78,772	1.2	27
Delta	18,237	2.4	12	Newaygo	20,992	2.9	17
Dickinson	13,230	3.5	13	Oakland	613,059	2.5	437
Eaton	55,075	0.8	13	Oceana	12,255	1.5	5
Emmet	17,085	1.3	6	Ogemaw	8,852	3.6	9
Genesee	194,623	4.8	260	Ontonagon	3,234	1.1	1
Gladwin	10,067	1.1	3	Osceola	10,174	4.6	13
Gogebic	7,230	1.0	2	Otsego	11,317	3.5	11
Grand Traverse	42,943	1.7	21	Ottawa	123,438	0.7	25
Gratiot	18,133	2.4	12	Roscommon	9,630	3.0	8
Hillsdale	21,637	2.1	13	Saginaw	90,666	4.5	115
Houghton	15,701	1.6	7	Sanilac	19,843	3.6	20
Huron	15,387	4.6	20	Schoolcraft	3,448	2.1	2
Ingham	144,855	3.3	135	Shiawassee	33,207	0.6	6
Ionia	27,764	1.4	11	St. Clair	78,702	2.7	59
Iosco	9,639	1.9	5	St. Joseph	28,518	1.5	12
Iron	5,278	2.7	4	Tuscola	26,543	3.1	23
Isabella	33,403	2.5	23	Van Buren	36,707	0.9	9
Jackson	72,768	2.5	51	Washtenaw	178,274	3.7	183
Kalamazoo	123,404	1.4	49	Wayne	851,213	3.4	812
Kalkaska	7,816	3.7	8	Wexford	13,447	1.6	6
Kent	294,931	1.2	95	All Michigan Counties^d	4,702,000	2.6	3,399

^a 1989 through 2016 represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2017 and 2018 is not yet complete. Therefore, 1988, 2017 and 2018 reports 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, 2002. Accessed 12-17-2015.

^c Rates are based on the average number of cases per year from 1989-2016 (28 years), per 100,000 Michigan workers.

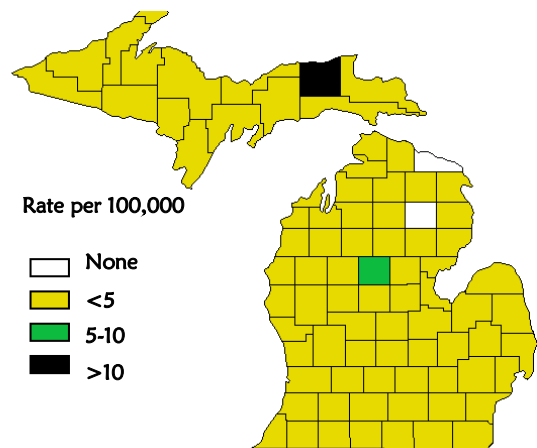
^d Fifty-eight cases had an out-of-state exposure and 22 had an unknown county of exposure, for the 1989-2016 reporting period.

Type of Industry – Trends



TOP 10 COUNTIES: Table 5 shows the top 10 counties with the highest overall rates of WRA that had more than one case during the 1989-2016 time period. All of the top 10 counties with the highest overall rates of WRA had a decrease greater than 10% in the rate of WRA over time. Many of the rates increased during the 1998-2007 time period but then decreased during the 2008-2018 time period.

FIGURE 2
Average Annual Incidence Rate of WRA by County of Exposure: 1989-2016^a



^a 1989 through 2016 represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2017 and 2018 is not yet complete. Therefore, 1988, 2017 and 2018 reports are not included in this figure.

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

	All years	1988-1997			1998-2007			2008-2018			
County	Rate	# Cases	# EE's ^a	Rate	# Cases	# EE's	Rate	# Cases	# EE's	Rate	Change in Percentage
Branch	3.9	7	17,699	4.0	12	21,340	5.6	7	17,032	3.7	- 8%
Cheboygan	3.7	8	9,658	8.3	2	11,422	1.8	3	9,277	2.9	- 65%
Clare	7.7	8	9,100	8.8	11	11,761	9.4	9	10,570	7.7	-13%
Genesee	4.5	83	179,394	4.6	132	191,377	6.9	54	163,453	3.0	- 35%
Huron	4.4	7	14,941	4.7	8	15,499	5.2	6	15,104	3.6	- 23%
Kalkaska	3.7	4	6,188	6.5	4	7,932	5.0	1	6,604	1.4	- 78%
Luce	9.7	4	2,021	19.8	2	2,660	7.5	2	2,112	8.6	- 57%
Osceola	4.5	2	9,343	2.1	10	9,938	10.1	2	8,996	2.0	- 5%
Saginaw	4.2	31	91,307	3.4	67	90,388	7.4	20	80,771	2.3	- 32%
Sanilac	3.5	5	17,992	2.8	12	19,452	6.2	4	17,315	2.1	- 25%
All MI Counties	2.5	1,274	4,258,000	3.0	1,461	4,702,000	3.1	938	4,198,000	2.0	-33%

^aEE's =employees. Source: MI Dept of Tech, Mgt, & Budget, Labor Market Information, Annual Unemployment Statistics (LAUS) by County, 2002.

Type of Industry – Trends

Table 6 shows the Michigan industries by NAICS codes, with cases of work-related asthma from 1988 to 2018. The main industries were in manufacturing (56%) and health care and social assistance (12%).

The incidence rate of WRA by industry ranges from <0.1 cases per 100,000 in management of companies to a high of 9.3 cases per 100,000 in manufacturing. Industries with the next highest average annual incidence rates were: mining with 5.4 cases per 100,000 workers and health care and social assistance with 3.0 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 36.8% in 2008-2018. Increases in the percentages of cases with WRA occurred in many industry sectors, including: retail trade, administrative and support and waste management, health care and social assistance, and accommodation and food services.

TABLE 6
Number of Work-Related Asthma Patients, 1988-2018 by Primary Industrial Exposure and Average Annual Incidence Rate per 100,000 Workers, 1989-2016 (Years of Complete Reporting)

2002 North American Industry Classification System		WRA Cases 1988-2018		Number of Employees ^a	Average Ann. Incidence Rate ^b	
		#	%		Rate	# Cases
11	Agriculture, Forestry, Fishing, & Hunting	27	0.7	81,664	1.0	24
21	Mining	13	0.4	8,600	5.4	13
22	Utilities	20	0.5	35,300	1.9	19
23	Construction	102	2.8	199,800	1.7	95
31-33	Manufacturing	2,064	56.2	761,400	9.3	1,982
42	Wholesale Trade	39	1.1	175,400	0.8	38
44-45	Retail Trade	118	3.2	530,700	0.7	109
48-49	Transportation & Warehousing	72	2.0	92,900	2.6	68
51	Information	24	0.7	70,400	1.2	24
52	Finance & Insurance	35	1.0	157,700	0.7	30
53	Real Estate & Rental & Leasing	19	0.5	55,700	1.1	17
54	Professional, Scientific & Technical Services	34	0.9	258,700	0.4	30
55	Management of Companies & Enterprises	2	0.1	73,600	<0.1	1
56	Administrative & Support & Waste Management	82	2.2	267,000	1.0	73
61	Educational Services	163	4.4	332,000	1.7	158
62	Health Care & Social Assistance	457	12.4	499,300	3.0	426
71	Arts, Entertainment & Recreation	32	0.9	53,500	2.0	30
72	Accommodation & Food Services	115	3.1	345,200	1.1	108
81	Other Services (except Public Administration)	86	2.3	256,100	1.1	79
92	Public Administration	147	4.0	390,400	1.3	137
00	Unknown	22	0.6	--	--	18
Total		3,673		4,568,564	2.7	3,479

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

^bReporting in 1988 was begun mid-year, and reporting for 2017 and 2018 is not yet complete. Therefore, 1988, 2017 and 2018 reports are not included in the calculation of the annual average incidence rate. Rates are based on the average number of cases by industry from 1989-2016 (28 years), per 100,000 Michigan workers.

TABLE 7
1,982 Work-Related Asthma Patients from Manufacturing Industries:
1989-2016^a

2002 North American Industry Classification System		# WRA Cases	Avg Ann Rate ^a	# Employees ^b
311	Food Mfg	66	7.4	31,900
323	Printing & Related Support Activities	19	3.4	20,200
325	Chemical Mfg	104	11.0	33,800
326	Plastics & Rubber Products Mfg	107	8.7	43,700
327	Nonmetallic Mineral Product Mfg	18	3.7	17,600
331	Primary Metal Mfg	68	8.9	28,300
332	Fabricated Metal Product Mfg	116	4.9	84,500
333	Machinery Mfg	153	6.9	79,700
334	Computer & Electronic Product Mfg	14	2.4	21,100
336	Transportation Equipment Mfg	1,143	13.7	296,900
337	Furniture & Related Product Mfg	14	1.6	31,000
	Miscellaneous Mfg (*includes NAICS: 312-16,321-322,324,335,339)	160	7.9	72,700

^aAverage annual incidence rate, based on cases from 1989-2016 (28 years) per 100,000 adult workers in Michigan in each industrial category, and represents years with complete reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2017 and 2018 is not yet complete. Therefore, 1988, 2017 and 2018 reports are not included in this table.

^bSource: Michigan Department of Technology, Management and Budget, Labor Market Information, Industry Employment (CES), 2002. Accessed 12-17-2015.

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

		Time Period						
		1988-1997		1998-2007		2008-2018		
NAICS	Industry	#	%	#	%	#	%	Change in Percentage
11	Agriculture, Forestry, Fishing, & Hunting	4	0.3	12	0.8	11	1.2	+ 300%
21	Mining	5	0.4	6	0.4	2	0.2	- 50%
22	Utilities	3	0.2	5	0.3	12	1.3	+ 550%
23	Construction	32	2.5	37	2.5	33	3.5	33
31-33	Manufacturing	912	71.6	809	55.4	345	36.8	- 49%
42	Wholesale Trade	23	1.8	14	1.0	3	0.3	- 83%
44-45	Retail Trade	15	1.2	48	3.3	53	5.7	+ 375%
	Transportation & Warehousing	14	1.1	35	2.4	23	2.5	+ 127%
51	Information	6	0.5	11	0.8	7	0.7	+ 40%
52	Finance & Insurance	2	0.2	17	1.2	16	1.7	+ 750%
53	Real Estate & Rental & Leasing	2	0.2	11	0.8	6	0.6	+ 200%
54	Professional, Scientific & Technical Services	9	0.7	16	1.1	9	1.0	+43%
55	Management of Companies & Enterprises	0	—	1	0.1	1	0.1	N/A
56	Administrative & Support & Waste Management	10	0.8	27	1.8	45	4.8	+ 500%
61	Educational Services	40	3.1	73	5.0	50	5.3	+ 71%
62	Health Care & Social Assistance	105	8.2	194	13.3	158	16.8	+ 105%
71	Arts, Entertainment & Recreation	5	0.4	11	0.8	16	1.7	+ 325%
72	Accommodation & Food Services	19	1.5	49	3.4	46	4.9	+ 227%
81	Other Services (except Public Administration)	22	1.7	31	2.1	33	3.5	+106%
92	Public Administration	44	3.5	46	3.1	57	6.1	+ 74%
00	Unknown	2	0.2	8	0.5	12	1.3	N/A

Type of Exposure – Trends

Table 9 shows the exposures associated with WRA among Michigan workers. The most frequent exposures reflect the importance of the automotive manufacturing industry in the State, and the widespread use of cleaning products across all industry sectors. Most frequently identified exposures include: cleaning products, associated with 465 (12.7%) of Michigan's WRA patients, and isocyanates (MDI, TDI, HDI and others) accounting for 436 (11.9%) of the WRA case exposures. Metal working fluids (coolants) accounted for 333 (9.1%) 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, such as services and manufacturing, can contain disinfectants, often in the form of quaternary amines, which have been repeatedly shown to cause asthma among workers who either use them or are in the area when they are being used. The Michigan WRA Tracking Program has developed a brochure on the hazards of cleaning agents. It is available at: www.oem.msu.edu, and can be found under the **Resources Section**.

Welding is the fifth most common cause of WRA in Michigan. Both welders themselves as well as individuals who work in the same area may be affected by welding fume. A 2011 publication highlights the morbidity and high health care costs from asthma associated with welding³.

TOP EXPOSURES OVER TIME: Table 10 shows the trends among the top exposures by time period. Isocyanates decreased from 19.3% of all the WRA exposures in 1988-1997 to 6.8% in 2008-2018. Cleaning agents increased from 4.6% of all the WRA exposures in 1988-1997 to 20.5% in 2008-2018. Metalworking fluids, solvents, latex rubber, welding fume, epoxy, formaldehyde and acids also decreased over time, while there was an increase in cases reported from exposure to 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 1988-2017 (years of most complete data). 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. Diisocyanates were decreasing until 2010-2011. Office, and animal or plant products with high molecular weights appear unchanged. Cleaning agents appear to be trending upward until 2006-2007 and then decreasing since that time. The manufacturing industry and associated exposures have been decreasing over time.



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

TABLE 9
Top Workplace Exposures Associated with Confirmed
WRA Patients: 1988-2018

Exposure Agent	#	%
Cleaning Solutions	465	12.7
Isocyanates	436	11.9
Metal Working Fluids	333	9.1
Unknown (Mfg.)	267	7.3
Unknown (Office)	209	5.7
Exhaust/Smoke/Fumes	174	4.7
Welding Fume-Stainless & Other	159	4.3
Solvents	113	3.1
Paint Fumes	92	2.5
Epoxy	82	2.2
Fungus	84	2.3
Formaldehyde	67	1.8
Acids	69	1.9
Latex/Rubber	62	1.7
Fire	61	1.7
Chlorine	53	1.4
Plastic Fumes	52	1.4
Chemicals Used in Construction	53	1.4
Animal Dander	43	1.2
Acrylates	39	1.1
Cobalt	33	0.9
Fragrances	34	0.9
Flour	29	0.8
Wood Dust	28	0.8
Ammonia	24	0.7
Styrene	23	0.6
Cigarette Smoke	23	0.6
Herbicide/Pesticide	21	0.6
Fiberglass	19	0.5
Aldehydes	19	0.5
Chromium	16	0.4
Amines	16	0.4
Cement Dust	15	0.4
Medication	16	0.4
Cosmetology Chemicals	14	0.4
Plants/Organic Matter	14	0.4
Asphalt	14	0.4
Caustics	13	0.4
Rust Inhibitor	13	0.4
Fire Extinguisher Powder	12	0.3
Grain Dust	13	0.4
Printing Inks	12	0.3
Anhydrides	11	0.3
Metal Dust	9	0.2
Insecticides	9	0.2
Meat Wrapper's Asthma	9	0.2
Freon	8	0.2
Heat	9	0.2
<u>Other^a</u>	<u>284</u>	<u>7.7</u>
Total	3,673	

^aThere were 7 cases with exposure to: Azodicarbonamide, Enzymes, Paper Dust, Polyurethane, Sewage.

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

There were 5 cases each with exposure to: 1,1,1 Trichloroethane, Coal Dust, Cold Air, Exercise, Mold Release Spray, Photo Developing Fluids.

There were 4 cases each with exposure to: Asbestos, Coal Tar, Cooking Oil, Copier Toner, Drywall Dust, Lime Dust, Natural Gas, Rose Hips, Sand, Sulfonate, Trichloroethylene, X-Ray Developing Fluids.

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

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

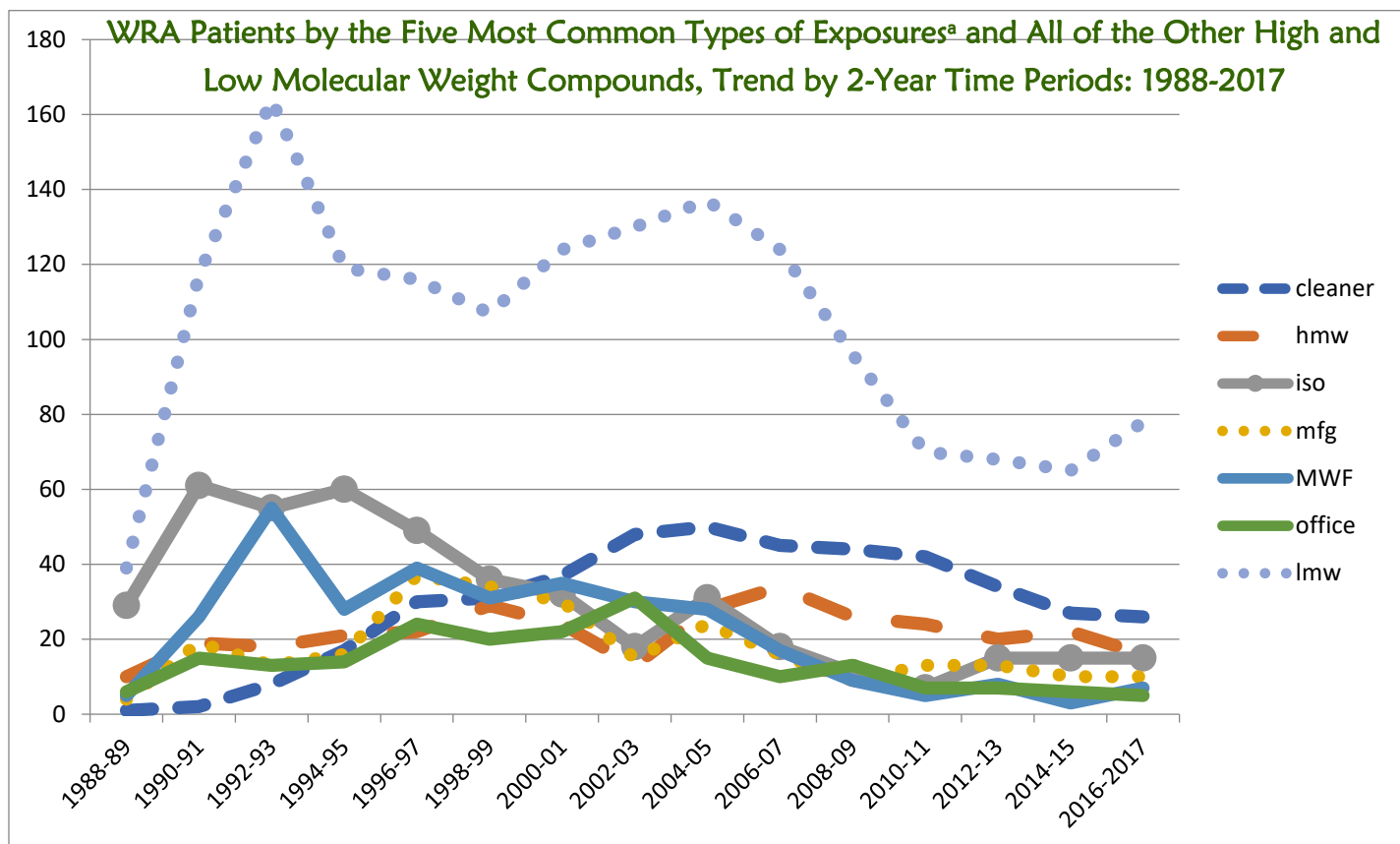
There was 1 case each with exposure to: 1,3-Dichloro-2-Propanol, 1,3 Dichloro 1-bromo-3-chloro-5 5-Dimethyl Hydantoin, Agent Orange, Ammonium Bifluoride, Antifreeze, Barbeque Smoker, Benzoate Esters, Bitrex, Blood, Blue Prints, Calcium Carbonate, Calcium Chloride (used in Cherry Brine), Car Window Sealant,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

^bPercentage does not add to 100 due to rounding.

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

	Time Period				
	All Years	1988-1997	1998-2007	2008-2018	Change in Percentage
Exposure Type	# (%)	# (%)	# (%)	# (%)	
Cleaning Agents	465 (12.7)	59 (4.6)	214 (14.6)	192 (20.5)	+ 346%
Isocyanates	436 (11.9)	246 (19.3)	126 (8.6)	64 (6.8)	- 65%
Metalworking Fluids	333 (9.1)	153 (12.0)	144 (9.9)	36 (3.8)	- 68%
Welding Fume	159 (4.3)	63 (4.9)	62 (4.2)	34 (3.6)	- 27%
Solvents	113 (3.1)	51 (4.0)	52 (3.6)	10 (1.1)	- 73%
Paint	92 (2.5)	18 (1.4)	49 (3.4)	25 (2.7)	+ 93%
Epoxy	82 (2.2)	33 (2.6)	28 (1.9)	21 (2.2)	- 15%
Fungus	84 (2.3)	0	41 (2.8)	43 (4.6)	+ 64%
Formaldehyde	67 (1.8)	33 (2.6)	19 (1.3)	15 (1.6)	- 38%
Acids	69 (1.9)	27 (2.1)	24 (1.6)	18 (1.9)	- 10%
Latex/Rubber	62 (1.7)	25 (2.0)	33 (2.3)	4 (0.4)	- 80%

FIGURE 3



^aCleaner=cleaning agents, hmw=high molecular weight agents, iso=diisocyanates, mfg=manufacturing agents, MWF=metal working fluids, office=office exposures, lmw=low molecular weight agents.

Medical Results – Trends

SMOKING STATUS Table 11 shows patients' cigarette smoking status. Slightly less than 20% of patients were smoking when their asthma developed. This is very similar to the state average for 2017 (19.3%) (source, CDC BRFSS results, www.cdc.gov). **SMOKING STATUS OVER TIME:** Table 12 shows the change in cigarette smoking status over time. There was an increase in the percentage of WRA patients who never smoked over time, corresponding with decreases among those who ever or currently smoked cigarettes.

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

HEALTH CARE USAGE Sixty-six percent of the WRA patients had at least one visit to the Emergency Department (ED) in their lifetime for their WRA, and 35% had at least one hospitalization for their WRA (Table 14). The average number of ED visits was 5.4 and the average number of hospitalizations was 3.7.

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

There was one WRA death in 2018; Case ID 4192 details the events associated with this death. There were no work-related asthma deaths identified in calendar years 2009 through 2014 and in 2016 or 2017. There was one work-related asthma death in 2015. Case ID OA3828 in the Case Narratives Section (page 33 of the 2015 Annual Report, Tracking WRA in Michigan www.oem.msu.edu) details the events of this WRA death. In addition, we have published articles on some of the work-related asthma deaths^{4,5}.

TABLE 11
Cigarette Smoking Status of 3,536^a
Confirmed WRA Patients: 1988-2018

	Smoking Status						
	Current		Ex-Smoker		Non-Smoker		TOTAL
	#	% ^a	#	%	#	%	
OA	245	20.9	450	38.3	479	40.8	1,174
POA	193	15.1	515	40.3	571	44.6	1,279
AA	147	21.3	183	26.5	361	52.2	691
RADS	106	27.0	146	37.2	140	35.7	392
All	691	19.5	1,294	36.6	1,551	43.9	3,536

^aMissing data on 137 patients.

^bPercents may not add to 100 due to rounding.

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

	Time Period				
	All Years	1988-1997	1998-2007	2008-2018	Change in Percentage
Smoking Status	# (%)	# (%)	# (%)	# (%)	
Current	691 (20)	243 (20)	295 (21)	153 (17)	- 15%
Ex-Smoker	1,294 (37)	540 (43)	479 (34)	275 (31)	- 28%
Non-Smoker	1,551 (44)	463 (37)	632 (45)	456 (52)	+ 41%
Total	3,536	1,246	1,406	884	

TABLE 13

Personal History of Allergies or Asthma Among 3,337^a Confirmed WRA Patients: 1988-2018

Personal History of...

	Allergies & Asthma		Asthma Only		Allergies Only		No Allergies or Asthma	
	#	%	#	%	#	%	#	%
OA	62	5.6	54	4.9	331	30.0	658	59.5
POA	91	7.7	55	4.6	411	34.6	631	53.1
AA	363	51.4	307	43.5	18	2.5	18	2.5
RADS	17	5.0	35	10.4	83	24.6	203	60.1
All	533	16.0	451	13.5	843	25.3	1,510	45.3

^aMissing data on 336 patients.

TABLE 14

Health Care Usage Among Confirmed WRA Patients: 1988-2018

Lifetime History of Health Care Usage

ED Visit ^a		Hospitalized ^b	
Yes # (%)	No # (%)	Yes # (%)	No # (%)
2,275 (66)	1,169 (34)	1,140 (35)	2,120 (65)
Range 1-300 visits		Range 1-200 hospitalizations	
AVG 5.4 ±14.7		AVG 3.7±9.8	

^aMissing data on 229 patients.

^bMissing data on 413 patients.

SYMPTOMS

Two thousand eight hundred sixty-three (2,863) of the patients with WRA had persistence of their asthma symptoms (Table 15). Higher percentages of those *still exposed* continued to have breathing problems and take asthma medicine compared to those *no longer exposed*. Higher percentages of those *no longer exposed* had improved breathing and were taking less medicine.

SYMPTOMS OVER TIME: Approximately 70% of the cases were no longer exposed to the agent associated with their WRA and this did not change over time. Among those still exposed to the agent associated with their WRA, there was a trend of less symptom improvement for those still experiencing breathing problems (Table 16). During 1988-1997, 34% of those with breathing problems reported their symptoms were improving, compared to 50% among those no longer exposed; during 2008-2018, 23% of those still exposed reported an improvement in symptoms, compared to 45% 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 14% reporting the need for less asthma medication during 2008-2018, compared to 33% among those no longer exposed.

TABLE 15

Persistence of Symptoms and Medication Use in 3,291 Confirmed WRA Patients: 1988-2018

Still Exposed?	Total	Breathing Problems Still Present?				Still Taking Asthma Medications?			
		Yes		Less		Yes		Less	
		#	%	#	%	#	%	#	%
Yes	950	905	95.3	277	29.2	827	87.1	167	17.6
No	2,341	1,958	83.6	1,110	47.4	1,831	78.2	682	29.1
Total	3,291 ^a	2,863		1,387		2,658		849	

^aInformation missing on 382 individuals.

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

Medical Results – Trends, continued...

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

Time Period	Still Exposed?	Total	Breathing Problems Still Present?				Still Taking Asthma Medications?			
			#	Yes %	#	Less %	#	Yes %	#	Less %
1988-1997	Yes	339	326	96.2	116	34.2	288	85.0	72	21.2
	No	852	705	82.7	422	49.5	633	74.3	251	29.5
	Total	1191	1031		538		921		323	
1998-2007	Yes	389	376	96.7	109	28.0	336	86.4	64	16.5
	No	923	828	89.7	432	46.8	760	82.3	246	26.7
	Total	1312	1204		541		1096		310	
2008-2018	Yes	222	203	91.4	52	23.4	203	91.4	31	14.0
	No	566	425	75.1	256	45.2	438	77.4	185	32.7
	Total	788	628		308		641		216	
Change in Percentage	Yes			-5%		-32%		+8%		-34%
	No			-9%		-9%		+4%		+11%

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 Work-Related Asthma Patients by Time Period

	Time Period				
	All Years	1988-1997	1998-2007	2008-2018	Change in Percentage
Test Type	(%)	(%)	(%)	(%)	
Pre-post Bronchodilatation	51	54	54	42	- 22%
Methacholine Challenge	18	25	16	10	- 60%
Peak Flow at Work & Home	4	3	3	5	^a
Pre-post Work-shift	3	2	4	2	^a
Specific Antigen Challenge	<1	0.9	0.3	—	^a

^aNot 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, 38% were awarded, 17% were denied and 45% were pending approval.

WORKERS' COMPENSATION OVER TIME: The percentage of WRA patients who applied for workers' compensation benefits did not change across the time periods: 1988-1997, 1998-2007 and 2008-2018. The first two time periods showed 49% of patients applying for workers' compensation benefits, and the third period had 51% apply. However, there were differences in the outcomes of applying for benefits, with an increase in the percentage awarded benefits over the three time periods from 37% to 33% to 49% in the most recent time period. The percentage of claims denied also increased over the time periods, from 16% to 17% to 21% in the most recent time period. Accordingly, the percentage of claims pending approval decreased from 48% to 50% to 31% in the most recent time period.

INDUSTRIAL HYGIENE

A total of 816 workplace inspections have been conducted since 1988 (Table 18); 123 of those facilities had been inspected more than once. Seven completed inspection reports have been received since last year's report.

Air sampling was conducted during 584 inspections (Table 19); 30 (5.2%) of the 577 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: 1988-2018

Inspection Status	# Patients Represented	Companies	
		#	%
Inspected	1,274	816 ^a	31.0
No Follow-up Planned	2,182	1,614	61.3
Scheduled for Inspection	9	9	0.3
Out of Business	78	70	2.7
No Longer Use Occupational Allergen	27	26 ^b	1.0
Sent Company Letter to Check Exposures ^d	103	96	3.6
Total	3,673	2,631 ^c	

^a816 inspections were conducted in 693 different workplaces.

^bEight companies that no longer use the suspected causal agent were previously inspected.

^cRepresents 2,508 different facilities.

^dThe 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 816
Workplace Inspections: 1988-2018

Air Sampling – NIOSH Standard	#	%
Above NIOSH Standard	69	8.5
Below NIOSH Standard	485	59.4
No NIOSH Standard	32	3.9
Unknown (no report yet)	4	0.5
Did Not Sample for an Allergen	29	3.6
Did Not Sample	197	24.1
Total	816	
Air Sampling – MIOSHA Standard	#	%
Above MIOSHA Standard	30	3.7
Below MIOSHA Standard	547	67.0
No MIOSHA Standard	7	0.9
Unknown (no report yet)	4	0.5
Did Not Sample for an Allergen	31	3.8
Did Not Sample	197	24.1
Total	816	

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

TABLE 20
Suspected Causal Agents Above the MIOSHA Permissible Exposure Limit (PEL)
and/or NIOSH Recommended Exposure Limit (REL): Michigan 1988-2018

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

^aPercentages do not add to 100 due to rounding.

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

Co-Worker Interviews at Workplace Investigations – Trends

Co-workers were interviewed during 621 of the 816 inspections. Workers had daily or weekly breathing symptoms associated with work or new onset asthma since beginning to work at 401 of the 621 (65%) companies. The average percentage of co-workers with symptoms in these 401 companies was 20.5%. All 1,701 co-workers from the remaining 220 companies reported no daily or weekly breathing symptoms associated with work. One thousand six hundred thirty-one (1,631) of the 10,526 (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.

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 2,217 symptomatic workers were identified during the 816 MIOSHA enforcement inspections.

TABLE 21
Breathing Symptoms Among Co-Workers of the 3,673
Confirmed WRA Patients:
1988-2018 and by Time Period

	# Workers Interviewed	Daily or Weekly SOB, Wheezing or Chest Tightness	%
	10,526	1,631	15.5
BY TIME PERIOD:			
1988-1997	6,293	1,125	17.9
1998-2007	3,200	380	11.9
2008-2018	1,033	126	12.2
Workers on OSHA Log		586	
	# Companies Inspected	# Companies w/Employee on Log	%
	816	137	16.8
BY TIME PERIOD:			
1988-1997	437	76	17.4
1998-2007	266	52	19.5
2008-2018	113	9	8.0
Total Workers with Symptoms ^a		2,217	

^aTen individuals were identified both on the co-worker questionnaire and the OSHA Log.



Michigan Workforce Exposed to Select Causes of WRA

The United States Environmental Protection Agency (EPA) requires reporting by manufacturers, mines or electrical utilities that have at least 10 employees and use any one of 650 different chemicals in amounts greater than 10,000 pounds per year. Queries of reportable chemicals can be generated to identify state-level statistics. We identified Michigan’s isocyanate-using companies in the EPA Toxic Release Inventory (TRI) to estimate the number of workers employed by manufacturers potentially exposed to isocyanates, one of the most commonly reported causes of WRA in Michigan (Table 22). Our estimate under-counts non-manufacturing-exposed employees such as at auto body paint shops because the EPA does not include non-manufacturing establishments. Conversely, our estimate over-counts manufacturing employees because we included the total number of employees at each facility that reported isocyanates, even though not all workers at these facilities would have worked with or around isocyanates.

Another source to identify chemical exposures associated with WRA comes from 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.

Between the two reporting sources, there were 106 companies that reported using isocyanates in 2018, which is slightly less than the 112 companies that reported using isocyanates in 2017. There were 111 companies in 2016 and 112 companies in 2015 reporting isocyanate use. The number of workers employed in companies that use isocyanates, the total number of workers in these counties, and the percentage of workers by county who work in facilities where isocyanates are used is listed in Table 22. The 45,458 workers potentially exposed to isocyanates in 2018 is up from 44,739 in 2017 and 40,490 potentially exposed in 2016.

TABLE 22
Michigan Workers Employed in Manufacturing Facilities in 2018
Where Isocyanates are Used, by County

County	Company Name ^{c,d}	# Workers Employed ^a by Isocyanate-Using Facilities	Total # Workers in the County ^b	% Workers Potentially Exposed to Isocyanates
ALLEGAN	HAWORTH INC MOTUS INTEGRATED TECHNOLOGIES—MAPLEWOOD YAN FENG AUTOMOTIVE INTERIORS PMSC	4,013	60,206	6.7
ARENAC	GLOBE FIRE SPRINKLER	222	5,549	4.0
BARRY	BRADFORD WHITE CORP	1,307	30,585	4.3
BAY	QUANTUM COMPOSITES INC	14	47,942	<0.1
BERRIEN	LECO CORP NILES STEEL TANK VAIL RUBBER WORKS INC	743	70,176	1.1
CALHOUN	BREMBO HOMER FOUNDRY COMCAST URETHANE TRANSCONTINENTAL	668	60,219	1.1
CHARLEVOIX	EAST JORDAN FOUNDRY	514	12,506	4.1
CLARE	LEAR CORP. FARWELL PLANT	184	11,122	1.7

Table 22. County	Company Name^{a,d}	# Workers Employed by Isocyanate-Using Facilities	Total # Workers in the County^e	% Workers Potentially Exposed to Isocyanates
CRAWFORD	WEYERHAEUSER	159	5,181	3.1
DICKINSON	GREDE, LLC IRON MOUNTAIN LOUISIANA-PACIFIC-SAGOLA OSB	456	11,970	3.9
EATON	ALLIANCE INTERIORSSIKAAXON US	165	55,009	0.3
GENESEE	ASI PACKAGING COMPANY CREATIVE FOAM LANDAAL PACKAGING SYSTEMS	139	172,887	0.1
HILLSDALE	ESSEX SPECIALTY PRODUCTS	14	19,904	0.1
HURON	VALLEY ENTERPRISES	121	15,097	0.8
INGHAM	HUNTSMAN ADVANCED MATERIALS SA AUTOMOTIVE WILLIAMSTON PRODUCTS INC	400	144,991	0.3
ISABELLA	THE DELFIELD CO. UNIFIED BRANDS	1,046	33,454	3.1
JACKSON	MILSCO MICHIGAN SEAT TAC MFG	1,193	71,351	1.7
KALAMAZOO	AZON USA PARKER HANNIFIN CORP-HYDRAULIC SYS STRYKER INSTRUMENTS	3,848	128,349	3.0
KENT	CLIPPER BELT LACING CO, DBA FLEXCO INC GRAND RAPIDS FOAM TECHNOLOGIES HB FULLER LACKS WHEEL TRIM SYSTEMS, BARDEN PLATER PLASAN CARBON COMPOSITES PURFORMS INC RICHWOOD INDUSTRIES INC	3,494	348,246	1.0
LENAWEE	ANDERSON DEVELOPMENT INSULSPAN INTEVA PRODUCTS	983	45,038	2.2
LIVINGSTON	ANTOLIN-HOWELL PACKAGE DESIGN MFG INC	787	99,402	0.8
LUCE	LOUISIANA-PACIFIC CORP-NEWBERRY SIDING	175	2,267	7.7
MACOMB	AXALTA COATING SYSTEMS FCA US ASSEMBLY PLANT INTERNATIONAL CASTING CORP MOON ROOF CORP OF MI NEXEO SOLUTIONS NJT ENTERPRISES ROMEO RIM INC SHELBY FOAM SYSTEM WOLVERINE BRONZE	1,977	427,445	0.5
MARQUETTE	ARGONICS—MI PLANT	60	30,839	0.2
MASON	GREAT LAKES CASTING	211	13,159	1.6
MECOSTA	ORIGINAL FOOTWEAR INC	600	17,642	3.4
MIDLAND	CENTRAL WAREHOUSE –MIDLAND DOW CHEMICAL CO– 1790 BLDG	2,175	38,993	5.6
MONTCALM	AGA MARVEL KENT FOUNDRY	215	26,753	1.0
MONTCALM	MARVEL REFRIGERATION KENT FOUNDRY	215	27,270	0.8

Table 22. County	Company Name^{c,d}	# Workers Employed^a by Isocyanate-Using Facilities	Total # Workers in the County^b	% Workers Potentially Exposed to Isocyanates
MUSKEGON	DIVERSIFIED MACHINE-MONTAGUE MUSKEGON COMPOSITES, INC	702	74,639	0.9
OAKLAND	ARMALY SPONGE EAGLE INDUSTRIES FANUC ROBOTICS—CORP HDQTRS GALE INSULATION LYMTAL INTERNATIONAL INC RECTICEL UREPP N AMERICA SERVICE PARTNERS SIKAAXSON US WEBASTO ROOF SYSTEMS	1,754	648,277	0.3
OCEANA	BARBER STEEL FOUNDRY CORP	64	11,696	0.5
OTTAWA	MAGNA ENGINEERED GLASS ROYAL TECH	1,050	155,593	0.7
SAGINAW	GLASTENDER NEXTEER AUTOMOTIVE CORP POREX TECHNOLOGIES SAGINAW METAL CASTING OPERATIONS	6,282	82,697	7.6
SANILAC	ASCO LP GRUPO ANTOLIN MIDWEST RUBBER CO TRELLEBORG YSH INC (VIBRACOUSTIC)	741	18,575	4.0
ST CLAIR	AURIA SOLUTIONS ST CLAIR (IAC) IAC PORT HURON	357	72,183	0.5
ST JOSEPH	IAC MENDON	589	27,213	2.2
VAN BUREN	BASF CORP SPECIAL-LITE INC	166	33,955	0.5
WASHTENAW	EXTANG CORP FAURECIA INTERIOR SYSTEMS	1,885	188,693	1.0
WAYNE	ALPHA RESINS BASF CORP—LIVONIA PLANT BASF CORP—WYANDOTTE PLANT BAY LOGISTICS CYGNET AUTOMATED CLEANING EFTEC EQ DETROIT FCA US JEFFERSON NORTH ASSEMBLY PLANT PLASTOMER CORP PROGRESSIVE DISTRIBUTIONS CENTERS WINDSOR MACHINE & STAMPING (US) LTD WOODBIDGE CORP	5,503	752,926	0.7
WEXFORD	REC BOAT HOLDINGS-CRUISER PLANT	473	14,078	3.4
TOTAL		45,458	4,705,000	1.0

^aSource: Manta.com, accessed 5-18-2020.

^bSource: Michigan Labor Market Information, Data Explorer, www.milmi.org accessed October 9, 2019.

^cSource: U.S. Environmental Protection Agency. Toxics Release Inventory, Michigan Companies Using Isocyanates in 2018, data accessed October 17, 2019.

^dSource: MI Dept of Environment, Great Lakes, and Energy (EGLE), FOIA Request for SARA Title III Emergency Planning & Release Reporting of isocyanates, for calendar year 2018, received October 14, 2019.

Michigan Workforce Exposed to Select Causes of WRA, continued

Table 23 summarizes the companies, by county, using other chemicals that are known to cause asthma and those that are irritants and capable of causing Reactive Airways Dysfunction Syndrome. Those that can cause asthma are: Bisphenol A, Cobalt, Epichlorohydrin, Formaldehyde, Methyl Acrylate, Methyl Methacrylate, Phthalic and Maleic Anhydride and Styrene. Ammonia and Chlorine are classified as irritants. These companies were identified through the MI EGLE SARA Title III Emergency Planning and Release Reporting for calendar year 2018.

Additional chemical exposures associated with WRA in Michigan can be found in a 2018 report at:
https://oem.msu.edu/images/resources/WRAsthma/2018_MI_Workforce_Exposed_to_Select_Asthma-Causing_Agents.pdf

TABLE 23

Michigan Facilities by County, Reporting Toxic Chemicals to the MI Dept. of Environment, Great Lakes, and Energy (EGLE) in 2018, Under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA)^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, B=Bisphenol A, CH=Chlorine, CO=Cobalt, E=Epichlorohydrin, F=Formaldehyde, MA=Maleic Anhydride, M=Methyl Acrylate, MMA=Methyl Methacrylate, P=Phthalic Anhydride, S=Styrene

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
ALLEGAN	ADVANCED ARCHITECTURAL PRODUCTS	S	BENZIE	GRACELAND FRUIT, INC.	A
	BIRDS EYE FOODS LLC	A, CH		PLATTE RIVER ST FISH HATCHERY	F
	CHS INC-HAMILTON FARM BUREAU	A		SMELTZER ORCHARD COMPANY	A
	CSD	A	BERRIEN	ADVANCE PRODUCTS CORP	A
	DOUGLAS MARINE CORP	S		BLUEWATER THERMAL SOLUTIONS	A
	HUDSONVILLE CREAMERY & ICE CREAM	A		BUCHANAN AGRON. & PETRO.	A
	JBS PLAINWELL, INC.	A		BUCHANAN WATER & WWTP	CH
	OTSEGO, CITY WELLS #3, #4, #5 & WWTP	CH		COLOMA FROZEN FOODS INC	A
	SHERWIN WILLIAMS CO- HOLLAND	A		FREEZER/REPACK CTR	A
	TIARA YACHTS INC	S		GREG ORCHARD	A
	WATER RENEWAL	CH		HANSON COLD STORAGE	A
ANTRIM	BFI ELK RAPIDS	A		LETIZ FARMS	A
	JORDAN RIVER NAT FISH HATCHERY	F		NCP COATINGS	A, P
ARENAC	WHITESTONE PUMPING STATION	CH		NILES, CITY - DECKER, FRONT WELLS & IRON REMOVAL	CH
BARRY	CALEDONIA FARMERS ELEVATOR	A	BRANCH	CLEMENS FOOD GROUP	A
BAY	BAY CARBON INC	CH		QUINCY	CH
	BAY CITY MUNICIPAL WATER TREAT.	CH		REAL ALLOY RECYCLING INC	CH
	MERSEN USA BN. CORP.	CH		REAL ALLOY SPECIFICATIONS INC	CH
	QUANTUM COMPOSITES, INC.	S, MA		WATER TREATMENT PLT/COLDWATER	CH
	WEST BAY CTY REGIONAL WW	CH	CALHOUN	ALBION PLANT	A

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
CALHOUN	ANATECH, LTD.	F	GENESEE	STOKES STEEL TREATING CO	A
	BATTLE CREEK WATER & WWTP	CH		WATER POLLUTION CONTROL FAC	CH
	BLEISTAHL	CO		WOODWORTH INC. FLINT	A
	HOMER	A	GRATIOT	ALMA WASTEWATER PLANT	CH
	MARSHALL CITY WATER	CH		CITY OF ST. LOUIS WWTP	CH
	MUSASHI AUTO PARTS-MICHIGAN INC	A	HILLSDALE	NH3 TANK	A
	POST FOODS - BATTLE CREEK	CH		BEF FOODS INC.	A
CASS	RBT J SWALWELL WWTP	CH		CONAGRA FOODS INC	A
	THE MENNEL MILLING CO. OF MI	CH		HILLSDALE WWTP	CH
CHEBOYGAN	UNION HIGH SCHOOL	F	HOUGHTON	PRATTVILLE FERTILIZER & GRAIN	A
	CHEBOYGAN WELLHOUSE #4,#7 & WWTP	CH		THE ANDERSONS LITCHFLD FARM	A
CHIPPEWA	PENDILLS CREEK NFH	F		KOPPERS PERFORMANCE CHEM	A
	SULLIVAN CREEK NFH	F		MICHIGAN-AMERICAN WATER CO	CH
CLINTON	MAHLE ENGINE COMPONENTS USA, INC.	A	HURON	WARM RAIN CORP	S
	MARTIN BROWER	A		BAD AXE WWTP	CH
	MICHIGAN MILK PRODUCERS ASSOC	A		DOW AGROSCIENCES LLC	A
	NUTRIEN AG SOLUTIONS 879	A		FARMERS CO-OP GRAIN CO.	A
	SAVE-A-LOT LTD	A	INGHAM	HARBOR BEACH WATER & WWTP	CH
	SCCMUA	CH		THUMB TOOL & ENGINEERING	A
CRAWFORD	ST JOHNS WWTP	CH		ALDI INC - WEBBERVILLE	A
	ARCTIC GLACIER INC	A		ARCTIC GLACIER—LANSING	A
DELTA	ESCANABA WATER & WWTP	CH		ATMOSPHERE ANNEALING LLC	A
	VERSO ESCANABA LLC	A, CH		AURORA SPECIALTY CHEMISTRIES	E
EATON	ETM ENTERPRISES INC.	S		CREMER FARM CENTER, INC.	A
	LANSING PLANT	A, CH		DYE WATER CONDITIONING PLANT	A
	MEIJER LANSING DISTRIBUTION	A		E LANSING-MERIDIAN WATER & SEWER	A
	SIKAAXSON US	S		JORGENSEN FARM ELEVATOR	A
EMMET	SP KISCH IND	A		MASON P.O.T.W. PLANT	CH
	ODEN STATE FISH HATCHERY	F		MICHIGAN STATE UNIVERSITY	A, CH
GD TRAVERSE	CENTRE ICE	A		NITREX INC - MICHIGAN OPERATION	A
	CENTURY SUN METAL TREATING	A	IONIA	TECOMET-LANSING	CO
	MICHIGAN PLANT	A		THE ANDERSONS WEBBERVILLE	A
	SARA LEE FROZEN BAKERY LLC	A		WISE WATER CONDITIONING PLANT	A
GENESEE	TCS TRAVERSE COLD STORAGE LLC	A		BELDING TANK TECHNOLOGIES, INC	S
	TRAVERSE CITY	CH		CARGILL KITCHEN SOLUTIONS	A
	A RAGNONE TREATMENT PLANT	CH		FARM DEPOT 3 LTD	S
	CENTER ROAD, N PUMP STATION	CH		GALLAGHERS	A
	HENDERSON ROAD PUMP STATION	CH		HERBRUCKS POULTRY & HENNERY	A
	KOEGEL MEATS INC.	A			

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
IONIA	ROBROY ENCLOSURES	S	KENT	LOWELL WWTP & WATER TREATMENT	CH
	THK RHYTHM AUTOMOTIVE	A		MICHIGAN NATURAL STORAGE CO	A
	TWIN CITY FOODS	A, CH		MICHIGAN TURKEY PRODUCERS	A
IOSCO	HURON SHORE REGIONAL UTILITY A	CH		MONROE, LLC	MMA
	ROSE ICE COMPANY	A		NBHX TRIM USA	S
	TAWAS UTILITY AUTHORITY WWTP	CH		NORTH RIDGE ORCHARD	A
	TIP-TOP SCREW MFG IN	A		PATTERSON ICE CENTER	A
JACKSON	CHEMETALL US INC	A		PLAINFIELD TWP WATER DEPT	CH
	CITY OF JACKSON WATER TREATMENT	CH		PLASTIC PLATE INC (KRAFT)	F
	INDUSTRIAL STEEL TREATING	A		REMICO STREET FACILITY	F
KALAMAZOO	BELL'S BREWERY INC	A		RIVERIDGE PACKING	A
	CITY OF KALAMAZOO- STATIONS #28,#39	CH		ROSKAM BAKING CO-S1 & S2	A
	KALAMAZOO	A, CH		SPARTA FACILITY	A
	KALAMAZOO WATER/STA #1-#5, #8,#9 #11, #12, #14, #17, #18, #22, #24, #25, #31	CH		SPARTAN NASH DISTRIBUTION	A
	KNAPPEN MILLING CO	CH		SUPERIOR SEAFOOD INC.	A
	PHARMACIA & UPJOHN LLC	A,CH, E, F		SUPERIOR STONE PRODUCTS INC	MMA, S
	PRECISION HEAT TREATING COMPANY	A		SYSCO GRAND RAPIDS, LLC	A
	RICHARD-ALLAN SCIENTIFIC	F		THE HOME CITY ICE CO	A
	WESTERN MICHIGAN UNIVERSITY	A		UNIVAR USA	B
	29th STREET WAREHOUSE	S		VILLAGE OF SPARTA WATER & WWTP	CH
KENT	ARKEMA INC.	B,P,S		WYOMING CLEAN WATER PLANT	CH
	BODYCOTE- GRAND RAPIDS	A	KEWEENAW	YOUNG'S FARMS	A
	BRENNTAG GREAT LAKES LLC	S	LAPEER	GENESEE COUNTY WATER	CH
	BRETON INDUST PARK WAREHOUSE	B,S		LAPEER PLATING & PLASTICS	F
	CHASE STORAGE & CHASE ORCHARDS	A	LENAWEE	ADC MAIN PLANT	MA,MMA,S
	COCA-COLA GRAND RAPIDS	A		AIRGAS USA LLC	A
	COUNTRY FRESH LLC	A		DAIRY FARMERS OF AMERICA	A
	DISTRIBUTION CENTER #1	A		NUTRIEN AG SOLUTIONS 634	A
	FINISHMASTER INC #990 DIST CR	S		WAR-AG FARMS HOME	A
	FORTY-FOURTH STREET FACILITY	F		WELLHOUSE #3 #8—#12 & #14	CH
	FRUIT RIDGE APPLE CO	A		WILBUR-ELLIS COMPANY - MUNSON	A
	GM COMPONENTS HOLDINGS, LLC	A	LIVINGSTON	ASAHI KASEI PLASTICS NA	MA
	GORDON FOOD SERVICE	A		BRIGHTON WWTP	CH
	GRANDVILLE	A, CH		CHEMCO PRODUCTS, INC.	F
	HEEREN LLC	A		COR-MET INC.	CO
	JACK BROWN PRODUCE INC	A		GORDON FOOD SERVICE	A
	KING MILLING COMPANY	CH		GREEN OAK DC	A
	LACKS TRIM SYSTEM - AIRLANE PLANT	F		HOWELL WATER PLANT & WWTP	CH
	LACKS WHEEL SYSTEMS	F		PEPSI HOWELL	A
				THIRD STREET PUMP STATION	CH

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
LUCE	NEWBERRY WWTP	CH	MONROE	MAYBEE FARMERS INC	A
MACKINAC	ST IGNACE WATER PLANT	CH		MEIJER NEWPORT DISTRIBUTION	A
MACOMB	AXALTA COATING SYSTEMS	B,M,MMA,S		OTTAWA LAKE CO-OP ELEVATOR	A
	BOSCOS PIZZA	A	MUSKEGON	BASF AGRICULTURAL SOLUTIONS LLC	A
	CARBIDE TECHNOLOGIES	A		COLE'S QUALITY FOODS, INC.	A
	DEPOR SHELBY	B, F		HOWMET CORP - PLT 10	B
	EVERFRESH / LA CROIX BEVERAGES	A		L-3 COMBAT PROPULSION SYSTEMS	A
	FORMSPRAG LLC	A		MUSKEGON COMPOSITES INC	S
	GM WARREN LLC TECHNICAL CENTER	A		PARAMELT (M. ARGUESO)	B
	METALLURGICAL PROCESSING CO	A		SNAPPY APPLE FARMS INC	A
	NEXEO SOLUTIONS	S, B		SUN CHEMICAL CORPORATION	A
	NITRO-VAC HEAT TREATING	A		WEBB CHEMICAL SERVICE CORP	F
	NORBROOK PLATING	A	NEWAYGO	GERBER PRODUCTS COMPANY	A
	REINHART FOODSERVICE LLC	A		RICE LAKE FARMS PACKAGING LLC	A
	RIVIERA BUILDING 2	A	OAKLAND	CHEMICAL BLENDING	MMA
	SPECIALTY STEEL TREATING, INC.	A		CHOR INDUSTRIES	A
	TURRI'S ITALIAN FOODS, INC	A		COMMERCIAL STEEL TREATING	A
MARQUETTE	KI SAWYER WWTP	CH		DEPOR INDUSTRIES	B,F
MASON	HOUSE OF FLAVORS INC	A		DETROIT STEEL TREATING CO.	A
	LUDINGTON WASTEWATER PLANT	CH		ENGINEERED HEAT TREAT INC	A
	MICHIGAN FOOD PROCESSORS	A		FARMINGTON HILLS ICE ARENA	A
	NORON COMPOSITE TECHNOLOGIES	MMA,S		GENERAL MOTORS - PROVING GD	CH
MECOSTA	ICE MTN NATURAL SPRING WATER	A		HAZEL PARK VIKING ARENA	A
	LEPRINO FOODS COMPANY REMUS	A		LAKELAND ARENA	A
	USM ACQUISITION LLC	S		MACDERMID INCORPORATED	F
MENOMINEE	L.E. JONES COMPANY	CO		MAHLE BEHR AMERICA INC	A
	MENOMINEE WATER & WWTP	CH		MATHESON WIXOM	A
	RULEAU BROTHERS INC	A		NOVI ICE ARENA	A
MIDLAND	CITY OF MIDLAND - WATER & WWTP	CH		OERLIKON	A
	CPI FLUID ENGINEERING	F		ONYX-ROCHESTER ICE ARENA	A
	DOW- MICHIGAN OPERATIONS	A, CH, S		SPECIALTY STEEL TREATING INC	A
	DOW CORNING SILICONE CORP- MIDLAND PLT	A, CH		STONE SOAP COMPANY INC	F
	MIDLAND STORE	A		SULZER METCO (US) INC	CO
	SK SARAN	A		SUN STEEL TREATING INC	A
	TRINSEO, LLC MICHIGAN OPERATIONS	MMA,S		US FOODS INC.	A
MONROE	ADVANCED HEAT TREAT CORP	A		VILLAGE ACRES TREATMENT PLANT	CH
	DTE ELECTRIC - MONROE POWER	A		VILLAGE OF HOLLY WWTP	CH
	HOME CITY ICE COMPANY- Toledo	A		VILLAGE OF MILFORD-IRON REMOVAL PLANT	CH
	INDEPENDENT DAIRY INC	A			

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
OAKLAND	WATERFORD IRON REMOVAL 5-1, 12-1, 14-1, 16-1 & 2, MS-1, 19-1, 24-1, 25-1 & 2, 28-1,31-1	CH	SAGINAW	FRANKENMUTH CITY OF WATER & WWTP	CH
	WOODWORTH INC PONTIAC	A		HI-TECH STEEL TREATING, INC.	A
OCEANA	2ND STREET STORAGE	A		NEXTEER AUTOMOTIVE	A
	ARBRE FARMS CORPORATION	A		SAGINAW TWP RETENTION BASIN	CH
	HART DIVISION	A		WATER, WWTP & RETENTION BASIN, SAGINAW CHARTER TWP	CH
	MICHIGAN FREEZE PACK	A	SANILAC	CROSWELL WATER PLANT	CH
	OCEANA CTY FREEZER STORAGE	A		DGP INCORPORATED	S
	PETERSON FARMS MAIN CAMPUS	A		MIDWEST RUBBER CO.	CH
OGEMAW	SANDVIK HARD MATERIALS	CO	SHIAWASSEE	AIRGAS SPECIALTY PRODUCTS - OWOSSO	A
OSCEOLA	ADVANCED FIBERMOLDING	S		CIE NEWCOR MFG-PLANT 1	A
	VENTRA EVART, LLC	F		HARVEST MILLS	A
	YOPLAIT REED CITY	A	ST CLAIR	DUNN PAPER, INC.	CH
OTSEGO	ALBIE'S FOODS	A		LK HURON WATER TREATMENT	CH
	GAYLORD	CH		PORT HURON	A
OTTAWA	ALLENDALDE PLANT	A		Z F MARYSVILLE AXLE DRIVES LLC	A
	BOAR'S HEAD PROVISIONS CO INC	A	ST JOSEPH	ABBOTT NUTRITION - STURGIS	A
	BODYCOTE-HOLLAND	A		AQUATIC CO.	S
	COUNTRYSIDE GREENHOUSES	CH		MICHIGAN MILK PRODUCERS ASSOC	A
	CREME CURLS BAKERY, INC.	A		NUTRIEN AG SOLUTIONS 635 & 641	A
	DIETRICH ORCHARDS	A		STURGIS WWTP	CH
	GOOD FRUIT STORAGE	A		THREE RIVERS WWTP	CH
	HUDSONVILLE PLANT	A	TUSCOLA	CARO WWTP	CH
	J.B.SIMS GENERATING STATION	CH		CASS CITY WWTP	CH
	JOHN F. DONNELLY PLANT	A		FARM DEPOT	S
	MEAD JOHNSON AND CO LLC	CH	VAN BUREN	ALLOY STEEL TREATING CO INC	A
	MICHIGAN NATURAL STORAGE	A		CITY OF SOUTH HAVEN, WWTP	CH
	MIEDEMA PRODUCE INC.	A		COCA COLA NORTH AMERICA	A
	POLYPLY COMPOSITES LLC.	S		DECATUR	A
	QUINCY STREET, INC	A		FRUIT BELT CANNING CO INC	A
	SUPERIOR SALES INC	A		GRAND JUNCTION FACILITY	A
	VERTELLUS ZEELAND LLC	MA		HARTFORD WAREHOUSE	A
	ZEELAND FACILITY	A		IQF FACILITY	A
	ZEELAND FARM SERVICES, INC	A		KNOUSE FOODS COOP-PAW-PAW	A
SAGINAW	ADVANCED MICRONUTRIENT PRODUCTS	A		LAWRENCE FREEZER CORP.	A
	BRIDGEPORT WWTP	CH		PAW PAW RIVER PRODUCE	A
	BUENA VISTA WWTP	CH		RYDER PAW PAW LOGISTIC CTR	A
	DOW CORNING CORPORATION - HEALTHCARE IND MFG	A		SHAFFER LAKE FRUIT, INC	A
				SILL FARMS MARKET, INC	A

Table 23, continued...

COUNTY	COMPANY NAME	EXPOSURE	COUNTY	COMPANY NAME	EXPOSURE
VAN BUREN	ST. JULIAN WINE COMPANY INC	A	WAYNE	JCI JONES CHEMICALS INC.	CH
	WELCH FOODS, INC.	A		KENNEDY RECREATION CENTER	A
WASHTENAW	ANN ARBOR, CITY OF WTP	A	WAYNE	LINCOLN DISTRIBUTING	S
	ANN ARBOR ICE CUBE	A		MASTRONARDI PRODUCE	A
	ARBOR HILLS ENERGY LLC	A		MCLANE FOOD SERVICE - PLYMOUTH	A
	CHELSEA MILLING CO	CH		MICHIGAN DAIRY	A
	DAPCO INDUSTRIES	A		NORTHEAST WATER PLANT	CH
	PHOTO SYSTEMS INC	F		PENSKE LOGISTICS, LLC.	A
	UNIVERSITY OF MICHIGAN	A		PEPSI BOTTLING GROUP	A
WAYNE	3M DETROIT ABRASIVES	F		PLYMOUTH	MMA
	A&R PACKING CO INC	A		POLYCHEMIE INC	F
	ARCTIC EDGE ICE ARENA	A		PRAXAIR DISTRIBUTION INC	A, CH
	ARCTIC LOGISTICS LLC	A		PROGRESSIVE DISTRIBUTION CENTERS INC	F
	BASF CORPORATION	MMA, S		PVS TECHNOLOGIES, INC.	CH, F
	BODYCOTE THERMAL PROCESSING	A		SMW MANUFACTURING	A
	CANTON	A		SOUTHWEST WATER PLANT	CH
	CANTON RENEWABLES	A		SPRINGWELLS WATER TREATMENT PLT	CH
	CARDINAL HEALTH	F		SYSCO DETROIT, LLC	A
	CHAMPION FOODS	A		TRENTON CHANNEL POWER PLANT	A
	CLASSIC PLATING	A		TRENTON, CITY OF WWTP	CH
	COOPER HEAT TREATING LLC	A		UNIVAR USA—ROMULUS	MA
	COSTCO WHOLESALE	A		USA HOCKEY ARENA	A
	COUNTRY FRESH, LLC - LIVONIA	A		WATER RESOURCE RECOVERY FACILITY	CH
	CREST INDUSTRIES INC	S		WATER WORKS PARK PLANT	CH
	DEARBORN ICE SKATING CENTER	A		WESTLAND MANUFACTURING	MMA, S
	DETROIT PRODUCTION CENTER	A		WOLVERINE PACKING CO DIST/LAMB/VEAL	A
	DBA ALDOA COMPANY	E, F	WEXFORD	YACK ARENA	A
	DRDC	M		AAR MOBILITY SYSTEMS	F
	DYNAMIC SURFACE TECH INT'L	A		FOUR WINNS-CRUISER DIVISION	MMA, S
	EDDIE EDGAR ARENA	A		FOUR WINNS-SPORT DIVISION	S
	FAYGO BEVERAGES INC.	A		HARING TOWNSHIP WATER SUPPLY	CH
	FCA US LLC-JEFFERSON PLANT	E, F			
	FREEZER SERVICES OF MI LLC	A			
	FRITZ PRODUCTS	CH			
	HOME CITY ICE CO - DETROIT	A			
	INTRASTATE EXETER	A			

*Source: Michigan Department of Environment, Great Lakes, and Energy (EGLE). Michigan Facilities' Guide to SARA Title III, Emergency Planning and Release Reporting, December 2007, 6th edition. The chemicals listed in this table are subject to reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) section 313, which is triggered by threshold amounts of 25,000 pounds manufactured or processed or 10,000 pounds otherwise used at facilities in Michigan. The companies listed in this table were current as of calendar year 2018 from a report generated by the Michigan EGLE on 10/14/2019.

Discussion

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

For the years 2008-2010, 52.5% (95% CI 48.2-56.8%) of Michigan adults who were ever employed and currently have asthma reported that a health care provider told them or they told a health provider their asthma was caused or made worse by exposures at work.¹ Table 24 shows how this percentage varied by age, gender, race, annual income and education. Among those individuals who responded their asthma was caused or made worse by work, only 22% had a discussion about work's effect on their asthma with their health care provider.¹ At minimum, the data suggest that providers are not addressing concerns of their patients and probably missing the identification of WRA triggers. Because of the frequency in which work exposures are a factor in adults with asthma, the American College of Chest Physicians Consensus Statement concluded that: "The substantial prevalence of WRA supports consideration of the diagnosis in all who present with new-onset or worsening asthma, followed by appropriate investigations and intervention including consideration of other exposed workers."⁸

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.⁹

In 2020, we reviewed the Michigan work-related asthma surveillance system from 1988 -2018.¹⁰ 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%.
- 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 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. 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%.

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 their 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.¹¹ Table 24 shows the characteristics of Michigan adults with asthma attributable to work, based on a telephone survey. These characteristics are similar to that found in the cases of WRA identified through our surveillance system.

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

As companies trim costs, more temporary workers are being hired on an as-needed basis. The transient nature of temporary work underscores the potential for 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 (12.7%), isocyanates (11.9%) and metal working fluids (9.1%). 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

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	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

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. 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.¹² 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). In a move that will provide even greater information about the ingredients of cleaning agents, New York State has promulgated a rule that covers all soaps and detergents sold in New York that contain a surfactant as a wetting or dirt emulsifying agent and are used primarily for domestic or commercial cleaning purposes, including but not limited to the cleansing of fabrics, dishes, food utensils and household and commercial premises. The rule required manufacturers to list ingredients intentionally added to cleaning products on their web page, that are present above trace quantities, by July 1, 2019. Fragrance and nonfunctional ingredients, such as byproducts and contaminants, must be disclosed by July 1, 2020.

We updated the table first presented in the 2002 Work-Related Asthma Annual Report (Table 22) on the number of manufacturing workers in companies that use isocyanates. In Luce county 7.7% of the workforce is potentially exposed to isocyanates, and in Saginaw county approximately 7.6% of the workforce is exposed. In Allegan, 6.7% and in Midland, 5.6% of the workforce is employed in facilities where isocyanates are used. 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.

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.⁸ On the average, among the 2,341 individuals who are no longer exposed to the causal agent, almost three years elapse from onset of respiratory symptoms at work to date last exposed. We do not have data on how much of this delay is secondary to the individual not seeking medical care and how much is related to the physician not recommending that the individual leave the exposure.

Data from the United Kingdom estimated that when medical care and lost time are factored in, the work-related asthma costs were 100 million dollars per year with 49% of the cost borne by the patient, 48% by the State and only 3% by the employer.¹³ We do not have cost estimates for Michigan, but given the fact that only 49% of individuals applied for Workers' Compensation benefits and we do not have universal health insurance as in the United Kingdom, we suspect that the individual patients in Michigan bear a high percentage of the costs associated with work-related asthma.

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

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

We identified 1,631 fellow workers with symptoms compatible with WRA (Table 21). Five hundred eighty-six

individuals were listed on the MIOSHA Injury and Illness Log (Form 300) as having WRA or symptoms compatible with WRA. There was only an overlap of 10 individuals 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 indicate they have never seen a doctor for their respiratory symptoms.

Medical monitoring is particularly relevant to reducing the burden of work-related causes of asthma. The longer a person with asthma remains exposed, the more likely their asthma will become a chronic problem.⁸ A review of companies using isocyanates showed that only 32% were providing periodic medical surveillance.¹⁴

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.⁸ 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 most timely 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 48909-8149.

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.

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

References

1. Lutzker LA, Rafferty AP, Brunner WM et al. Prevalence of Work-Related Asthma in Michigan, Minnesota, and Oregon. *J Asthma* 2010; 47:156-161.
2. Brooks SM, Weiss MA, Bernstein IL. Reactive Airways Dysfunction Syndrome (RADS)*: Persistent Asthma Syndrome After High Level Irritant Exposures. *Chest* 1985; 83:376-384.
3. Banga A, Reilly MJ, Rosenman KD. A Study of Characteristics of Michigan Workers with Work-Related Asthma Exposed to Welding. *J Occup Environ Med* 2011; 53(4):415-419.
4. Stanbury M, Chester D, Hanna EA, Rosenman KD. How Many Deaths Will it Take? A Death from Asthma Associated with Work-Related Environmental Tobacco Smoke. *Am J Ind Med* 2008; 51(2):111-116.
5. Chester DA, Hanna EA, Pickelman BG, Rosenman KD. Asthma Death after Spraying Polyurethane Truck Bedliner. *Am J Ind Med* 2005; 48:78-84.
6. American Thoracic Society. Occupational Contribution to the Burden of Airway Disease. *Am J Resp Crit Care Med* 2003; 167:787-797.
7. Henneberger PK, Redlich CA, Callahan DB, Harber P, Lemiere C, Martin J, Tarlo SM, Vandenplas O. An Official American Thoracic Society Statement: Work-Exacerbated Asthma. *Am J Resp Crit Care Med* 2011; 184:368-378.
8. Tarlo SM et al. Diagnosis and Management of Work-Related Asthma. ACCP Consensus Statement. *Chest* 2008; 134:1S-41S.
9. Knoeller GE, Mazurek JM, Moorman JE. Asthma Symptoms among Adults with Work-Related Asthma. *J Asthma* 2012; 1532-4303 online DOI:10.3109/02770903.2012.754029.
10. Reilly MJ, Wang L, Rosenman KD. The Burden of Work-Related Asthma in Michigan, 1988-2018. *Annals Am Thoracic Soc* 2020; 17: 284-292.
11. Henneberger PK, Kreiss K, Rosenman KD, Reilly MJ, Chang YF, Geidenberger CA. An Evaluation of the Incidence of Work-Related Asthma in the United States. *Int J Occup Environ Health* 1999; 5:1-8.
12. Rosenman KD, Reilly MJ, Pechter E, Fitzsimmons K, Flattery J, Weinberg J, Cummings K, Borjan M, Lumia M, Harrison RJ, Dodd K, Schleiff P. Cleaning Products and Work-Related Asthma, 10 Year Update. *J Occup Environ Med* 2020; 62: 130-137.
13. Ayres JG, Boyd R, Cowie H, Hurley JF. Costs of Occupational Asthma in the UK. *Thorax* 2011; 66:128-133.
14. Rosenman KD, Reilly MJ. Are U.S. Companies that Use Isocyanates Providing Medical Surveillance? Presentation and poster at Isocyanates and Health Conference April 3-4, 2013, Bethesda Maryland.

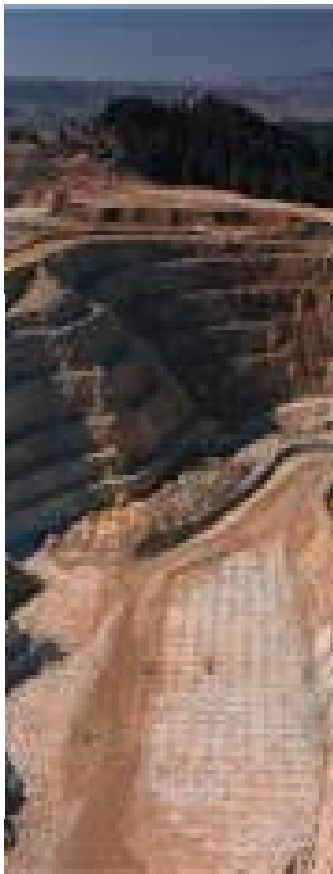
APPENDIX

2018 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.

TABLE OF CONTENTS	Pages
Manufacturing	33-37
Educational Services	37
Health Care Services	37-39
Wholesale & Retail Services	39
Office	39
Construction	39-40
Food Services	40
Public Services	40-41
Miscellaneous Services	41-42



MANUFACTURING

Exposure to Isocyanates

OA4081. A male in his 60s developed work-related asthma from exposure to isocyanate (naphthalenetetracarboxylic dianhydride (NDI)) while working as a technician for a chemical production company. He worked at this company for 23 years before symptoms began. He developed a cough, wheezing, and shortness of breath and sought medical treatment. He was prescribed Albuterol and Advair. He went on leave from work. He was a lifelong non-smoker.

OA4102. A male in his 20s experienced an exacerbation of his pre-existing asthma after being exposed to isocyanates while working for an automobile parts manufacturer. He developed wheezing. On his spirometry, FVC was 102% predicted, FEV1 was 79% predicted, and FEV1/FVC was 77% predicted. He was a former smoker.

OA4146. A male in his 20s developed work-related asthma from exposure to isocyanates while working as a machine operator at a fabricated products manufacturer. He developed chest tightness and wheezing and sought out medical treatment in the emergency department. He was prescribed Albuterol. He continued to work at this job but was reassigned to a new work area. He formerly smoked about 3 cigarettes per day for 4 years.

OA4143. A male in his 60s developed work-related asthma from exposure to isocyanates while working as an engineer at a door manufacturing company. He developed wheezing and sought medical treatment at the emergency department. He continued to work at the company but was reassigned to a new job. He was a lifelong non-smoker.

Exposure to Metal Working Fluids

OA4084. A male in his 40s developed work-related asthma after being exposed to coolant while working for an automotive manufacturing company. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Prednisone, Albuterol, and Tessalon Perles. On his spirometry, FVC was 110% of predicted, FEV1 was 97% of predicted, and FEV1/FVC was 81% of predicted. He formerly smoked a pack of cigarettes per day for 11 years.

OA4104. A male in his 40s developed work-related asthma after being exposed to oil mist, grinding dust, and metal dust while working as a machinist at a machining manufacturer. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He was prescribed ProAir, Qvar, and Singulair. On his spirometry, FVC was 87% predicted, FEV1 was 83% predicted, and FEV1/FVC was 91% predicted. He quit working at this company. He was a lifelong non-smoker.

OA4192: An African-American male in his 30's died from an acute asthma attack. He was at home after work when he stopped breathing. CPR was started at home and continued in the Emergency Department. Because of ST elevation he was taken to the catheter lab. No coronary obstructions were found. He never regained consciousness and died two days later. He worked at an auto parts manufacturing facility with exposure to metal working fluids. Two other individuals who work this facility had been reported with work-related asthma. The company had been cited in 2018 for violation of the respiratory protection standard, inadequate ventilation, errors in recording injuries and illnesses, and lack of a hearing conservation program. In 2017, the company was cited for lack of personal protection equipment, inadequate medical services, errors in recording injuries and illnesses, and inadequate ventilation control. In 2016, the company was cited for slip hazards, inadequate hazard communication plan and errors in recording injuries and illnesses.

AA4213. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to lithium while working for a battery manufacturer. He developed a cough and sought medical treatment from the emergency department. He was prescribed Albuterol and Prednisone. He was a lifelong non-smoker.

Exposure to Welding Fume

OA4080. A male in his 50s developed work-related asthma while working as a welder for an automotive manufacturing company where he worked for the past two years. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the hospital. He was prescribed Albuterol and Advair. He was still working. He was a lifelong non-smoker.

OA4085. A male in his 60s developed work-related asthma while working as a welder for a commercial kitchen supply manufacturing company. He developed a cough and sought medical treatment. He was prescribed ProAir and Qvar. On his spirometry, FVC was 123% of predicted, FEV1 was 125% of predicted, and FEV1/FVC was 77% of predicted. He was a lifelong non-smoker.

OA4103. A male in his 20s developed work-related asthma after exposure to welding machine fumes while working as a frame pusher for an automotive manufacturer. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment at an urgent care. He was prescribed Albuterol. He was no longer working at this job. He was a current smoker, having smoked an average of 3 cigarettes per day for the past four years.

AA4220. A female in her 50s experienced an exacerbation of her pre-existing asthma from exposure to welding fumes and other chemicals while working for a car manufacturer. She developed wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Albuterol and Prednisone. She was a lifelong non-smoker.

Exposure to Heated Plastic Fumes

AA4076. A female in her 40s experienced exacerbation of her pre-existing asthma after being exposed to fumes from burning PVC plastic while working as an operator for a plastic manufacturing company. She

worked here for four years before the exposure occurred. She developed wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Albuterol and Prednisone. She was a former smoker, having smoked an average of a pack per day for 17 years.

Exposure to Cleaning Agents

AA4063. A male in his 20s experienced an exacerbation of his pre-existing asthma after being exposed to bleach while working as a cleaner for a food production company. He had been working this job for five months. He experienced a cough, wheezing, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Albuterol. He stopped working this job a month later. He was a lifelong non-smoker.

AA4051. A male in his 20s experienced an exacerbation of his pre-existing asthma after being exposed to a cleaning solution while working for a wood chipping manufacturing company. He developed a cough, wheezing, chest tightness, and shortness of breath. He sought medical treatment in the emergency department and was prescribed Albuterol and Prednisone. He no longer works for this company. He was a lifelong non-smoker.

AA4079. A female in her 40s experienced an exacerbation of her pre-existing asthma after being exposed to industrial alcohol wipes while working as a paint production manager in an automobile assembly plant. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone, Albuterol, ProAir, and Nystatin. She was still working this job, but was no longer exposed to the alcohol wipes that caused her symptoms. She was a lifelong non-smoker.

Exposure to Miscellaneous Chemicals and Dusts

AA4059. A male in his 60s experienced an exacerbation of his pre-existing asthma while working in maintenance at a water heater manufacturing company where he worked for the past three years. He developed wheezing, chest tightness, and shortness of breath and sought medical treatment. He was a former smoker, having smoked an average of a pack and a half per day for 19 years.

AA4098. A male in his 40s developed work-related asthma after being exposed to an unknown irritant(s) while working as a machine operator at an automotive leather manufacturing company where he worked for five years. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment. He was prescribed a "rescue inhaler", Singulair, and Prednisone. On his spirometry, FVC was 103% of predicted, FEV1 was 100% of predicted, and FEV1/FVC was 97% of predicted. He was a lifelong non-smoker.

POA4037. A female in her 40s developed work-related asthma after being exposed leaks of cooled brine and potential other irritants while working as a production crop tender for a food production company. She had worked this job for six years before symptoms began. She developed a cough, wheezing, chest tightness, and shortness of breath. She sought medical treatment in the emergency department and was prescribed Albuterol. On her spirometry, FVC was 85% of predicted, FEV1 was 51% of predicted, and FEV1/FVC was 60% of predicted. She was away from work on leave. She was a current smoker and smoked an average of a half of a pack of cigarettes per day for the past 22 years.

POA4069. A female in her 40s developed work-related asthma while working in a chemical plant. She worked this job for two years before symptoms began. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Albuterol and Prednisone. She was a lifelong non-smoker.

AA4094. A male in his 50s experienced an exacerbation of his pre-existing asthma after being exposed to spills of transmission fluid while working as a programmer for a robotics manufacturing company. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment. He was prescribed Prednisone, Albuterol, and Advair. He had been moved and was no longer exposed to the transmission fluid. He was a lifelong non-smoker.

POA4109. A female in her 40s developed work-related asthma after being exposed to fumes from paint while working at an automobile assembly company. She developed shortness of breath and sought medical treatment. She was prescribed Symbicort. On her spirometry, FVC was 80% predicted, FEV1 was 56% predicted, and FEV1/FVC was 70% predicted. She was a current smoker and smoked an average of 10 cigarettes per day for an unknown number of years.

POA4093. A male in his 50s developed work-related asthma after being exposed to a new agent added to cutting fluids while working for an automobile and aerospace parts manufacturer. He developed a cough, chest tightness, wheezing, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Albuterol. He was a current smoker.

AA4112. A male in his 40s experienced an exacerbation of his pre-existing asthma after being exposed to a spill of hydrochloric acid while working as a journeyman electrician for a company that manufactured printing inks and pigments. He developed a cough, wheezing, chest tightness, and shortness of breath. He sought medical treatment in the emergency department and was prescribed a nebulizer, Symbicort, and Singulair. On his spirometry, FVC was 97% predicted, FEV1 was 83% predicted, and FEV1/FVC was 73% predicted. His assignment in that building was over and he was no longer exposed to hydrochloric acid. He was a lifelong non-smoker.

AA4072. A male in his 30s experienced an exacerbation of his pre-existing asthma after being exposed to smoke from ovens while working in an automobile manufacturing plant. He developed chest tightness and sought medical treatment from the company physician. He was prescribed Albuterol. On his spirometry, FVC was 100% predicted, FEV1 was 91% predicted, and FEV1/FVC was 90% predicted. He was a former smoker, having smoked an average of 10 cigarettes per day for five years.

OA4050. A male in his 20s developed work-related asthma after being exposed to chlorine in pool cleaning tablets while working on an assembly line for a stone supply company. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Prednisone and Albuterol. He was no longer working this job and no longer exposed to chlorine. He was a lifelong non-smoker.

AA4164. A male in his 20s experienced an exacerbation of his pre-existing asthma after being exposed to a large amount of saw dust without a mask while working in a sawmill. He developed a cough, wheezing, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Singulair, Albuterol and Prednisone. He smoked an average of 3 cigarettes per day for 1 year.

AA4185. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to environmental agents while working at a mirror manufacturer. He developed wheezing and sought medical treatment in the emergency department. He was prescribed Qvar and Ventolin.

AA4212. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to antifreeze while working for an auto parts manufacturer. He developed a cough, wheezing, chest tightness, and shortness of breath and sought treatment in the emergency department. He was prescribed Albuterol and Prednisone. He was a lifelong non-smoker.

POA4178. A male in his 30s developed work related asthma from exposure to cleaning chemicals while cleaning tanks for a chemical manufacturer. He developed a cough and wheezing. He quit this job because of health reasons. He was a lifelong non-smoker.

Exposure to Indoor Air Contaminants

AA4124. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to spray paint fumes while working at a metal finisher company. She developed a cough, wheezing, and shortness of breath and sought medical treatment in the emergency department. She quit this job on doctor's advice. She has continued to smoked a pack of cigarettes a day since she was 18.

AA4159. A female in her 40s experienced an exacerbation of her pre-existing asthma after being exposed to paint fumes while working as a machine operator in an automobile manufacturing plant. She developed a cough, wheezing, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Symbicort and Xopenex. She quit this job on doctor's advice. She formerly smoked an average of 5 cigarettes a day for 14 years.

AA4221. A male in his 50s experienced an exacerbation of his pre-existing asthma from exposure to diesel fumes while working for an auto company. He developed shortness of breath and sought medical treatment in the emergency department. He was a lifelong non-smoker.

EDUCATIONAL SERVICES

Exposure to Indoor Air Contaminants

AA4139. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to vape fumes while working as a school bus driver. She developed a cough and shortness of breath and sought medical treatment in the emergency department where she was prescribed ProAir. She was a lifelong non-smoker. She quit this job.

HEALTH CARE SERVICES

Exposure to Disinfectants

AA4071. A female in her 20s experienced an exacerbation of her pre-existing asthma after being exposed to ammonium chloride vapors while working at a hospital. She developed wheezing and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone. She was a current smoker.

AA4044. A female in her 20s experienced an exacerbation of her pre-existing asthma after being exposed to fumes from bleach mixed with toilet bowl cleaner while working as a direct care worker for a home health care service. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone and Albuterol. She was still working this job. She was a lifelong non-smoker.

AA4120. A female in her 50s developed work-related asthma from exposure to disinfectants and cleaners while working as a housekeeper in a hospital. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Symbicort, Albuterol, and Montelukast. She quit this job on doctor's advice. She formerly smoked an average of 8 cigarettes a day for 29 years.

Exposure to Indoor Air Contaminants and Miscellaneous Chemicals and Dusts

AA4107. A female in her 20s experienced an exacerbation of her pre-existing asthma after being exposed to unknown irritants while working in an assisted living home. She developed a cough and wheezing and sought medical treatment in the emergency department. She was prescribed Prednisone and DuoNeb. She was a lifelong non-smoker.

POA4045. A female in her 20s experienced an exacerbation of her pre-existing asthma after being exposed to unknown irritants while working as a registered nurse in a medical center. She worked at the medical facility for two years before symptoms began. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Symbicort, Singulair, and Spiriva. On her spirometry, FVC was 119% of predicted, FEV1 was 124% of predicted, and FEV1/FVC was 105% of predicted. She no longer worked at this job. She was a lifelong non-smoker.

AA4046. A female in her 50s experienced an exacerbation of her pre-existing asthma after being exposed to unknown irritants while working as a certified medical assistant at a hospital. She developed a cough, wheezing, chest tightness, and shortness of breath. She sought medical treatment in the emergency department and was prescribed Prednisone, Symbicort, Albuterol, and Qvar. On her spirometry, her FVC was 71% predicted, FEV1 was 75% predicted, and FEV1/FVC was 104% predicted. She was no longer working this job. She was a lifelong non-smoker.

POA4075. A female in her 50s developed work-related asthma while working at a nursing home. She developed a cough and sought medical treatment in the emergency department. She was a lifelong non-smoker.

AA4054. A male in his 50s experienced an exacerbation of her pre-existing asthma after being exposed to unknown irritants while working as an inpatient unit clerk at a hospital. He was bothered worse at work by a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Spiriva, Combivent, and Singulair. On his spirometry, FVC was 76% predicted, FEV1 was 68% predicted, and FEV1/FVC was 66% predicted. He continued to work at this job. He was a former smoker, having smoked one pack of cigarettes every few months for two years.

AA4118. A female in her 50s experienced an exacerbation of her pre-existing asthma from exposure to glue fumes during an office remodel while working as a medical assistant for a family doctor practice. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Albuterol. She formerly smoked an average of 10 cigarettes per day for 5 years.

AA4140. A female in her 40s experienced an exacerbation of her pre-existing asthma from an unknown exposure at the hospital where she worked. She developed a cough and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone, Albuterol, ProAir, Symbicort, and Singulair. She was a lifelong non-smoker.

OA4172. A female in her 50s developed work-related asthma from exposure to industrial strength toner while working in a medical clinic as a medical assistant. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone and Albuterol. She had smoked an average of 5 cigarettes a day for 19 years.

AA4214. A female in her 30s experienced an exacerbation of her pre-existing asthma after exposure to mold while working in a medical laboratory. She developed a cough and sought medical treatment in the emergency department. She was prescribed Prednisone and DuoNeb. She was a lifelong non-smoker.

Exposure to Animal Dander

OA4157. A male in his 70s developed work-related asthma after exposure to animal dander while working for a research lab in a hospital. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Albuterol, Breo, Singulair, and Loratadine. He retired from this job. He was a lifelong non-smoker.

Exposure to Construction Dust

AA4048. A female in her 50s experienced an exacerbation of her pre-existing asthma after being exposed to construction dust and paint fumes while working as a patient registrar in a hospital. She developed a cough, wheezing, chest tightness, and shortness of breath. She sought treatment in the emergency department and was prescribed Advair and Albuterol. Construction had concluded. She was a lifelong non-smoker.

WHOLESALE & RETAIL SERVICES

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

OA4105. A female in her 40s experienced an exacerbation of her pre-existing asthma after being exposed to diesel exhaust while working as an office manager for a building materials supplier where she had worked for the past six years. She developed a cough, wheezing, chest tightness, and shortness of breath. She sought medical treatment in the emergency department. She was prescribed Qvar, Albuterol, and an EpiPen. On her spirometry, FVC was 81% of predicted, FEV1 was 79% of predicted, and FEV1/FVC was 96% of predicted. She was no longer working at this job. She was a lifelong non-smoker.

AA4055. A female in her teens experienced an exacerbation of her pre-existing asthma after being exposed to pepper spray while working at a grocery store. She developed a cough and sought treatment in the emergency department. She was a lifelong non-smoker.

AA4136. A male in his 20s experienced an exacerbation of his pre-existing asthma after being exposed to an unknown chemical while working at a textile rental company. He formerly smoked an average of 8 cigarettes per day for 10 years.

AA4114. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to molds and dusts while working at a drug store. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed ProAir, Qvar, and Flonase. She was a lifelong non-smoker.

OFFICE/INDOOR AIR

Exposure to Indoor Air Contaminants

AA4082. A female in her 50s experienced an exacerbation of her pre-existing asthma after being exposed to unknown irritants while working as a nurse utilization analyst for an insurance company. She worked this job for two months before symptoms began. She experienced a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone and Medrol Dosepak. On her spirometry, FVC was 87% of predicted, FEV1 was 94% of predicted, and FEV1/FVC was 106% of predicted. She no longer worked at this job. She was a former smoker having smoked one pack per month for two years in her 20s.

CONSTRUCTION

Exposure to Miscellaneous Chemicals and Dusts

AA4095. A male in his 20s experienced an exacerbation of his pre-existing asthma after being exposed to mold while working as a forklift operator at a supply chain and construction company. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment. He was prescribed Prednisone. He was away from work on workers' compensation. He was a lifelong non-smoker.

AA4068. A male in his 50s experienced an exacerbation of his pre-existing asthma after being exposed to dust while working as a carpenter. He developed wheezing and shortness of breath and sought medical treatment in the emergency department. He was prescribed Singulair, Prednisone, Levaquin, and Dulera. He was a lifelong non-smoker.

AA4060. A male in his 30s experienced an exacerbation of his pre-existing asthma after being exposed to asbestos and mold while working as an asbestos contractor supervisor for an asbestos abatement company. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He continued to work this job. He was a current smoker, having smoked an average of 15 cigarettes per day for the past 14 years.

AA4162. A male in his 20s experienced an exacerbation of his pre-existing asthma from exposure to cold air while pouring concrete on a construction site. He developed wheezing and shortness of breath and sought medical treatment in the emergency department. He was prescribed Albuterol. He was a lifelong non-smoker.

FOOD SERVICES

Exposure to Cleaning Agents

AA4132. A male in his 20s experienced an exacerbation of his pre-existing asthma after improperly mixing cleaning agents while working in the food industry. He developed shortness of breath and sought medical treatment in the emergency department. He was prescribed Prednisone. He was a lifelong non-smoker.

Exposure to Miscellaneous Substances

POA4078. A female in her 20s developed work-related asthma while working as a dishwasher at a restaurant. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Ventolin. She no longer worked at this job. She was a lifelong non-smoker.

AA4138. A female in her 30s experienced an exacerbation of her pre-existing asthma from exposure to construction dust while the restaurant she was a server at was being remodeled. She developed a cough, wheezing, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone and Albuterol. She quit that job. She formerly smoked an average of 3 cigarettes a day for 16 years.

AA4187. A female in her 20s experienced an exacerbation of her pre-existing asthma after exposure to a natural gas leak while working at a restaurant. She experienced wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was treated with Fluticasone and Vilanterol. She was a current every day smoker.

PUBLIC SERVICES

Exposure to Miscellaneous Substances

OA4062. A female in her 60s developed work-related asthma after being exposed to diesel fuel and second-hand smoke while working for a city as a bus operator. She had been working this job for seven years before developing symptoms. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency room at least 15 times. She was prescribed Proventil, Albuterol, and Dulera. She quit working at this job. She was a former smoker, having smoked four packs per day for 28 years.

RADS4087. A male in his 20s developed Reactive Airways Dysfunction Syndrome after being exposed to chemicals and vapors when a battery exploded while working as an equipment specialist for a county road commission. He had worked this job for seven years before the exposure. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment. He was prescribed Albuterol and Dulera. He was a lifelong non-smoker.

OA4074. A male in his 50s developed work-related asthma after being exposed to dust from a coated pipe while working as a welder for an energy company. He had worked this job for 27 years before being moved to a new location prior to developing symptoms. He developed a cough and shortness of breath and sought

medical treatment in the emergency department. He was prescribed Prednisone, Benzonatate, and Promethazine. On his spirometry, FVC was 83% predicted, FEV1 was 85% predicted, and FEV1/FVC was 89% predicted. He was a lifelong non-smoker.

RADS4092. A female in her 60s developed Reactive Airways Dysfunction Syndrome after being exposed to an unknown white dust while working as a security officer. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Albuterol, ProAir, Advair, Spiriva, and Prednisone. On her spirometry, FVC was 57% predicted, FEV1 was 50% predicted, and FEV1/FVC was 86% predicted. She quit working for this company. She was a current smoker, having smoked an average of one pack of cigarettes per day for the past 46 years.

POA4052. A male in his 50s developed work-related asthma after unknown exposures while working as an operations officer and pilot for a U.S. military branch. He developed a cough, wheezing, chest tightness, and shortness of breath. He sought medical treatment in the emergency department and was prescribed Spiriva, Asmanex, and Advair. On his spirometry, FVC was 70% predicted, FEV1 was 72% predicted, and FEV1/FVC was 81% predicted. He no longer worked at this job. He was a lifelong non-smoker.

AA4150. A female in her 40s experienced an exacerbation of her pre-existing asthma after responding to an emergency event that was in an abandoned house with many exposures while working as a police officer. She developed a cough, wheezing, chest tightness, and shortness of breath. She was prescribed Prednisone, Albuterol, and a rescue inhaler. She continued to work this job. She was a lifelong non-smoker.

AA4219. A male in his 20s experienced an exacerbation of his pre-existing asthma while fighting a fire in full protective equipment as a fireman. He developed shortness of breath and wheezing and sought medical treatment in the emergency department. He was prescribed Albuterol and Pulmicort. He was a lifelong non-smoker.

POA4210. A male in his 30s developed work related asthma while fighting a fire in full protective equipment as a fireman. He developed shortness of breath and wheezing and sought medical treatment in the emergency department. He was prescribed Albuterol and Medrol Dosepak. He was a lifelong non-smoker.

AA4206. A female in her 40s experienced an exacerbation of her pre-existing asthma while working in a police office that was being renovated. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Albuterol and Pulmicort. She was a lifelong non-smoker.

MISCELLANEOUS SERVICES & INDUSTRIES

Exposure to Cleaning Products

AA4058. A male in his 60s experienced an exacerbation of his pre-existing asthma after being exposed to mold, cleaning products, welding smoke, and potential other irritants while working as an accountant for a country club. He worked this job for five months before developing symptoms. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Spiriva. On his spirometry, FVC was 84% of predicted, FEV1 was 89% of predicted, and FEV1/FVC was 107% of predicted. He no longer worked at this job. He was a lifelong non-smoker.

AA4057. A female in her 30s experienced an exacerbation of her pre-existing asthma after being exposed to cleaning chemicals while working as a housekeeper. She developed a cough, wheezing, chest tightness, and shortness of breath. She sought medical treatment in the emergency department and was prescribed a Z-Pak and Prednisone. She was a current smoker and smoked an average of one pack of cigarettes per day.

AA4134. A woman in her 60s experienced an exacerbation of her pre-existing asthma from exposure to cleaning agents while working for a cleaning company. She developed a cough, chest tightness, and shortness of breath and sought medical treatment at the emergency department. She was prescribed Albuterol and Ventolin. She formerly smoked an average of 30 cigarettes per day for 18 years.

AA4127. A female in her 40s experienced an exacerbation of her pre-existing asthma from exposure to cleaning agents while working for a cleaning company. She developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. She was prescribed Prednisone and Albuterol. She smoked an average of 5 cigarettes per day for the past 31 years. She quit working for this cleaning company.

Exposure to Miscellaneous Substances

AA4091. A male in his 20s experienced exacerbation of his pre-existing asthma after being exposed to unknown irritants while working to clean out abandoned houses for a property management company. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency room. He was prescribed Albuterol. He no longer worked at this job. He was a lifelong non-smoker.

POA4161. A male in his 40s developed work-related asthma from exposure to exhaust fumes while working as a mechanic. He developed a cough and shortness of breath and sought medical treatment from a family health center. He formerly smoked 6 cigarettes a day for 15 years.

AA4133. A male in his 30s experienced an exacerbation of his pre-existing asthma from exposure to oil-based paint fumes. He developed a cough, wheezing, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Albuterol and Medrol Dosepak. He was a lifelong non-smoker.

OA4207. A male in his 30s developed work-related asthma from exposure to a pesticide while working on a fruit farm. He developed wheezing and shortness of breath and sought medical treatment in the emergency department. He was a lifelong non-smoker.

RADS4137. A female in her 60s developed Reactive Airways Dysfunction Syndrome from exposure to a chemical agent used to treat furnaces. She developed a cough and shortness of breath and sought medical treatment in the emergency department. She was prescribed Breo, Albuterol, and Singulair. She was a lifelong non-smoker.

POA4173. A male in his 40s developed work-related asthma from exposure to moldy beans and dust in a bean processing factory. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He quit this job. He was a lifelong non-smoker.

AA4163. A female in her 50s experienced an exacerbation of her pre-existing asthma while working on an orchard as a tractor driver where she was exposed to particulate matter. She developed wheezing and shortness of breath and sought medical treatment in the emergency department. She was prescribed Symbicort and Prednisone. She was a current everyday smoker.

OA4175. A male in his 50s developed work-related asthma from exposure to dust while working maintenance in an industrial shop. He developed a cough, wheezing, chest tightness, and shortness of breath and sought medical treatment in the emergency department. He was prescribed Albuterol and Prednisone. He quit this job. He was a lifelong non-smoker.