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2011 ANNUAL REPORT

TRACKING WORK-RELATED ASTHMA IN MICHIGAN



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Work-Related Asthma Surveillance Program

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

Summary

This is the 21st 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

Acronyms

OA Occupational Asthma

AA Work-Aggravated Asthma

POA Possible Occupational Asthma

RADS Reactive Airways Dysfunction Syndrome

LARA MI Department of Licensing & Regulatory Affairs

MIOSHA Michigan Occupational Safety & Health Administration

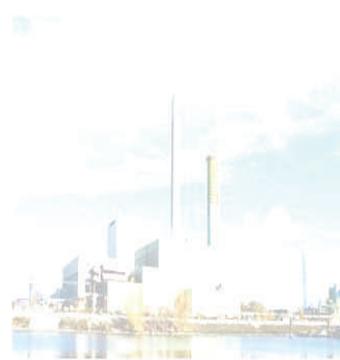
NAICS North American Industrial Classification System

NIOSH National Institute for Occupational Safety & Health

PEL Permissible Exposure Limit

REL Recommended Exposure Limit

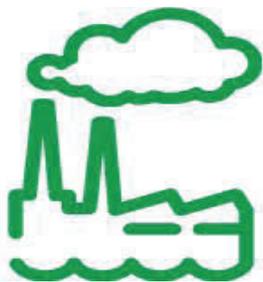
We sincerely appreciate the commitment of those health care providers who understand the public health significance of diagnosing a patient with an occupational illness, as well as the Michigan employees who took the time to share their experiences about their work and subsequent development of work-related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



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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 addressing the concerns of their patients regarding work-related triggers.



There are over 400 known asthma-causing agents used in the workplace. Thousands more substances have not been evaluated for their asthma-causing potential. The Association of Occupational & Environmental Clinics (AOEC) has a web site with an on-line look-up feature to identify asthma-causing agents.
<http://www.aoecdata.org/ExpCodeLookup.aspx>

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

Summary, continued...

- ◆ On average, 145 new cases of WRA are reported to LARA each year.
- ◆ From 1988-2011, 3,102 WRA cases have been identified through the MI tracking system.
- ◆ We estimate there are 65,000-97,000 adults in MI with WRA.
- ◆ 84% of the MI WRA patients have new-onset asthma; 16% have pre-existing asthma aggravated by an exposure at work.
- ◆ MIOSHA enforcement inspections at the workplaces where an individual with WRA was reported revealed that, on average, one out of every six of their fellow workers has asthma or respiratory symptoms compatible with asthma.
- ◆ Isocyanates-13%, and cleaning agents- 11%, are the most commonly reported exposures causing WRA in MI.
- ◆ About 1% of the MI workforce is employed in manufacturing where isocyanates are used.
- ◆ The average incidence rate of WRA among African Americans is 1.5 times greater than that of Caucasians.

Background

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

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

Work-Related Asthma Tracking Procedures...

SOURCES TO IDENTIFY PATIENTS

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

WRA Tracking Procedures in Michigan

IDENTIFY PATIENTS	INTERVIEW PATIENTS	WORKPLACE INSPECTION	FOLLOW UP ACTIVITIES
<ul style="list-style-type: none"> ◆ Review OD Reports -Submitted to LARA ◆ Known or Suspected -Work-Related Asthma ◆ Letter to Patient 	<ul style="list-style-type: none"> ◆ Telephone Interview -Medical and work history ◆ Obtain Medical Records -Breathing test results ◆ Physician Review 	<ul style="list-style-type: none"> ◆ Inspection Referral -MIOSHA determines inspection type ◆ On-Site Inspection -Assess exposures, conduct air monitoring -Injury & Illness Log -MSU interviews workers -Evaluate medical program ◆ Off-Site Inspection -Company addresses issues -MSU interviews co-workers -Report to company and MIOSHA 	<ul style="list-style-type: none"> ◆ Inspection Results -Company -Workers -Reporting Physician ◆ Letters to Individual Co-Workers -See doctor if breathing problems reported during interview ◆ Analyze Data -Annual Report -Other outreach & educational materials



INTERVIEW PATIENTS

A telephone interview with the suspected WRA patient is conducted, and medical records are obtained, including any pulmonary function test results. A board-certified internist and occupational medicine physician reviews all collected information.

WORK-RELATED ASTHMA REQUIRES

- A) Physician diagnosis of asthma.
- B) Onset of respiratory symptoms associated with a particular job that resolve or improve away from work.
- C) Work with a known allergen, or an association between work exposure and a decrease in pulmonary function.

THESE ARE THE 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.

A study of Michigan asthma patients found that as much as 54% of adult asthma was caused or aggravated by exposures in their job.

Workplace Inspections



Welding activities expose workers to heated metal fume, as well as surface contaminants such as oils or dirt and dust.

After the patient interview is completed and the work-relatedness is determined, a MIOSHA workplace enforcement inspection may be conducted, or the patient’s company may be directed by MIOSHA to conduct their own investigation.

With Either Approach:

- ◆ 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 is conducted.
- ◆ The company’s health and safety program is reviewed.

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.

OTHER FOLLOW UP ACTIVITIES

Outreach, educational activities, and recommendations may be developed based on the findings. An annual report summarizing the activity is completed each year.

Results

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

REPORTS

Table 1 shows that 3,102 people were confirmed with WRA between 1988—2011. The reports are divided into: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA) and Reactive Airways Dysfunction Syndrome (RADS). Seventy-seven additional patients have been confirmed since last year’s report. Figure 1 shows the overlap of the patients by reporting sources for 1988—2011.

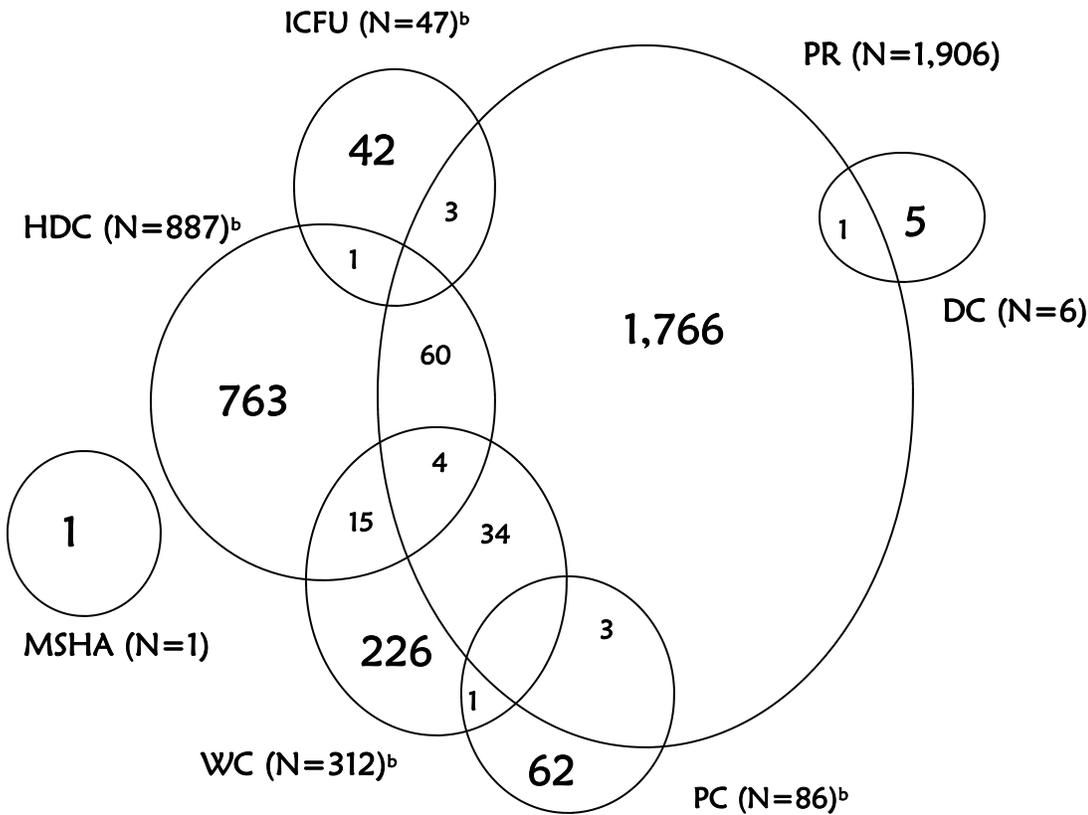
TABLE 1
Number of Confirmed Cases of Work-Related Asthma by Year and Type

<u>YEAR</u>	<u>OA</u>	<u>POA</u>	<u>AA</u>	<u>RADS</u>	<u>TOTAL</u>
1988	23	7	0	1	31
1989	43	12	3	5	63
1990	87	35	14	8	144
1991	55	30	14	16	115
1992	82	36	14	18	150
1993	75	69	13	19	176
1994	65	59	15	13	152
1995	57	34	19	17	127
1996	61	59	24	11	155
1997	53	74	19	16	162
1998	46	74	18	9	147
1999	48	65	16	12	141
2000	49	67	31	17	164
2001	50	51	20	19	140
2002	39	59	24	21	143
2003	29	64	28	23	144
2004	38	62	37	30	167
2005	42	67	21	23	153
2006	34	61	29	14	138
2007	20	41	34	28	123
2008	16	53	24	16	109
2009	19	42	31	8	100
2010	15	41	28	15	99 ^a
2011	15	27	14	3	59 ^a
Total	1,061	1,189	490	362	3,102

^aReports are still being processed for calendar years 2010 and 2011; an increase in these totals will be reflected in next year’s annual report.

84% of WRA in Michigan is new onset; 16% is pre-existing asthma aggravated by exposure to an allergen or trigger at work.

FIGURE 1
Overlap of Reporting Sources for 3,102 Confirmed
Work-Related Asthma Patients: 1988-2011^a



Doctors are the most frequent reporters of workers with occupational diseases.

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.

^a Ns represent the total number for that source.

Reporting Source: HDC=Hospital Discharge; PR=Physician Referral; DC=Death Certificate; WC=Workers' Compensation; ICFU=Index Case Follow-Up; MSHA=Mine Safety & Health Administration; PC=Poison Control Center.

^b There was an overlap of PC-HDC for 14 individuals and of PC-ICFU, and WC-PC-HDC for one individual each.

Demographics

GENDER

- ◆ Women 1,660, 54%
- ◆ Men 1,442, 46%

YEAR OF BIRTH

- ◆ Range 1905—1992
- ◆ Average 1957

RACE

- ◆ Caucasian 2,323, 77%
- ◆ African American 571, 19%
- ◆ Hispanic 60, 2%
- ◆ Alaskan/American Ind. 24, 1%
- ◆ Asian 14, <1%
- ◆ Other 33, 1%
- ◆ Unknown 77

ANNUAL INCIDENCE RATE

- ◆ African American 3.50
- ◆ Caucasian 2.27

The annual incidence rate for African Americans is 1.5X greater than that of Caucasians (95% CI 0.96, 2.47).

Numerator is the average number of WRA cases by race for 2005-2009 reporting years. Denominator Source: American Community Survey Civilian Labor Force by Race in MI, 2005-2009.

Location in State



Table 2 and Figure 2 show the annual average incidence rates of WRA among the working population, by county. The highest rates were in Clare (11.9 cases per 100,000), Luce (11.2 cases per 100,000), Osceola (7.0 cases per 100,000), Cheboygan (6.7 cases per 100,000), Sanilac (6.3 cases per 100,000), Genesee (6.1 cases per 100,000) and Montmorency and Tuscola (each with 6.0 cases per 100,000).

TABLE 2
Average Annual Incidence Rates of Work-Related Asthma
Among Michigan Workers by County of Exposure: 1989-2009^a

County	Avg Annual Inc		Cases 1989-2009	County	Avg Annual Inc		Cases 1989-2009
	# EE's ^b	Rate ^c			# EE's ^b	Rate ^c	
Alcona- Iosco	11,850	2.0	5	Isabella	28,625	2.7	16
Alger	3,375	1.4	1				
Alpena	14,400	3.6	11	Jackson	62,700	3.2	42
Antrim	5,975	1.6	2	Kalamazoo-Calhoun-Van Buren	212,700	1.9	83
Arenac	4,950	3.8	4	Kent-Ottawa-Muskegon-Allegan	583,700	1.3	160
Baraga	3,950	3.6	3	Lake	1,950	4.9	2
Barry	13,150	1.8	5	Luce	2,550	11.2	6
Berrien	72,100	1.8	27	Mackinac	5,600	0.9	1
Branch	15,375	5.9	19	Manistee	8,350	1.1	2
Cass	11,150	1.7	4	Marquette	28,450	3.2	19
Charlevoix	11,600	2.1	5	Mason	11,400	1.3	3
Cheboygan	8,475	6.7	12	Mecosta	13,500	1.4	4
Chippewa	15,775	1.2	4	Menominee	9,775	0.5	1
Clare	7,975	11.9	20	Montcalm	20,475	3.3	14
Clinton-Eaton- Ingham	234,600	2.5	123	Montmorency	2,400	6.0	3
Crawford	4,750	5.0	5	Newaygo	10,975	4.8	11
Delta	16,100	1.8	6	Oceana	7,450	1.9	3
Dickinson	14,825	3.5	11	Ogemaw	6,625	5.0	7
Emmet	16,950	1.4	5	Osceola	8,200	7.0	12
Genesee	175,000	6.1	226	Otsego	11,650	3.7	9
Gladwin	5,225	1.8	2	Roscommon	6,700	5.0	7
Gogebic	6,675	1.4	2	Sanilac	13,650	6.3	18
Grand Traverse- Benzie-Kalkaska-Leelanau	63,700	2.2	29	Schoolcraft	2,950	1.6	1
Gratiot	15,000	3.5	11	Shiawassee	20,450	1.4	6
Hillsdale	16,575	3.2	11	St. Joseph	25,725	1.9	10
Houghton- Keweenaw	15,975	2.4	8	Tuscola	15,150	6.0	19
Huron	14,750	4.8	15	Washtenaw-Lenawee-Livingston	277,500	3.7	215
Ionia	16,575	2.9	10	Wexford-Missaukee	18,800	1.5	6
Iron	4,225	3.4	3	Saginaw-Bay-Midland	181,500	3.9	147
				<u>Detroit, MSA^d</u>	<u>2,151,000</u>	<u>3.2</u>	<u>1,429</u>
				All Michigan Counties^e	4,566,000	3.0	2,845

^a 1989 through 2009 represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2010 and 2011 is not yet complete. Therefore, 1988, 2010 and 2011 reports are not included in this table.

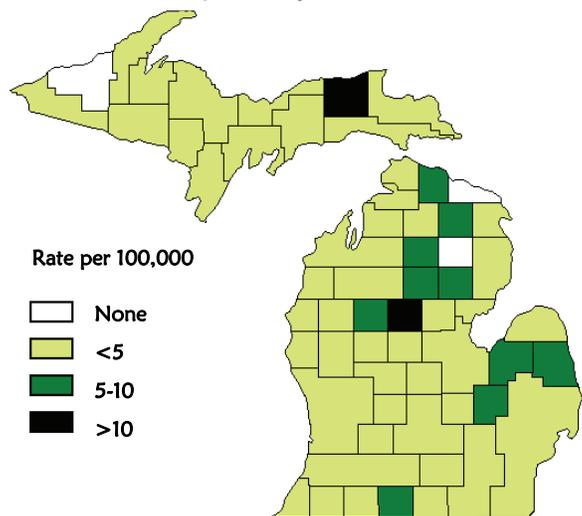
^b Source: MDCD/Employment Service Agency 1999 Annual Average Labor Statistics for Employment by Place of Work. Some employee population data is only at a multi-county level, as indicated (i.e., not available at a single county level). Therefore, some data is presented with grouped counties.

^c Rates are based on the average number of cases per year from 1989-2009, per 100,000 Michigan workers.

^d MSA=Metropolitan Statistical Area and includes Lapeer (29 cases), Macomb (256 cases), Monroe (26 cases), Oakland (376 cases), St. Clair (50 cases) and Wayne (692 cases) counties.

^e Forty-six cases had an out-of-state exposure and 22 had an unknown county of exposure, for the 1989-2009 reporting period.

FIGURE 2
Average Annual Incidence Rate of WRA by County of Exposure: 1989-2009^a



^a 1989 through 2009 represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2010 and 2011 is not yet complete. Therefore, 1988, 2010 and 2011 reports are not included in this figure.

Type of Industry

Table 3 shows the Michigan industries by NAICS codes, where the exposures to occupational allergens occurred from 1988 to 2011. The predominant industries were in manufacturing (60%) and health care and social assistance (12%).

The incidence rate of WRA by industry type ranges from 0.1 cases per 100,000 in utilities and management of companies to a high of 10.2 cases per 100,000 in manufacturing. Industries with the next highest annual average incidence rates were: mining with 5.6 cases per 100,000 workers and health care and social assistance with 3.3 cases per 100,000 workers.

Table 4 shows the average annual incidence rates for WRA cases *within manufacturing*.

TABLE 3
Primary Industrial Exposure for Confirmed Work-Related Asthma Patients: 1988-2011

2002 North American Industry Classification System		WRA Cases 1988-2011		Number of Employees ^a	Ann. Average Incidence Rate ^b	
		#	%		Rate	# Cases
11	Agriculture, Forestry, Fishing, & Hunting	19	0.6	81,664	1.0	17
21	Mining	12	0.4	9,300	5.6	11
22	Utilities	14	0.5	861,200	0.1	12
23	Construction	80	2.6	206,100	1.8	77
31-33	Manufacturing	1,842	59.4	823,100	10.2	1,770
42	Wholesale Trade	37	1.2	180,400	0.9	35
44-45	Retail Trade	84	2.7	548,800	0.7	75
48-49	Transportation & Warehousing	59	1.9	132,000	2.0	56
51	Information	19	0.6	76,000	1.1	18
52	Finance & Insurance	24	0.8	154,800	0.6	21
53	Real Estate & Rental & Leasing	16	0.5	55,500	1.2	14
54	Professional, Scientific & Technical Services	26	0.8	268,000	0.5	26
55	Management of Companies & Enterprises	1	<0.1	69,100	0.1	1
56	Administrative & Support & Waste Management	54	1.7	267,000	0.8	44
61	Educational Services	139	4.5	423,300	1.4	125
62	Health Care & Social Assistance	371	12.0	482,700	3.3	337
71	Arts, Entertainment & Recreation	23	0.7	61,500	1.4	18
72	Accommodation & Food Services	86	2.8	332,700	1.1	80
81	Other Services (except Public Administration)	67	2.2	176,900	1.6	61
92	Public Administration	117	3.8	685,000	0.7	103
00	Unknown	12	0.4	--	--	12
Total		3,102		4,645,864	3.0	2,913

^aSource: Non-Agriculture: MDLEG Bureau of Labor Market Information & Strategic Initiatives: Michigan Current Employment Statistics 2001. Agriculture: 2002 U.S. Census of Agriculture-State Data. Selected Operator Characteristics by Race: 2002.

^bRates are based on average number of cases from 1989-2009 per 100,000 adult workers in each industrial category, and represent complete years of reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2010 and 2011 is not yet complete. Therefore, 1988, 2010 and 2011 reports are not included in this table.

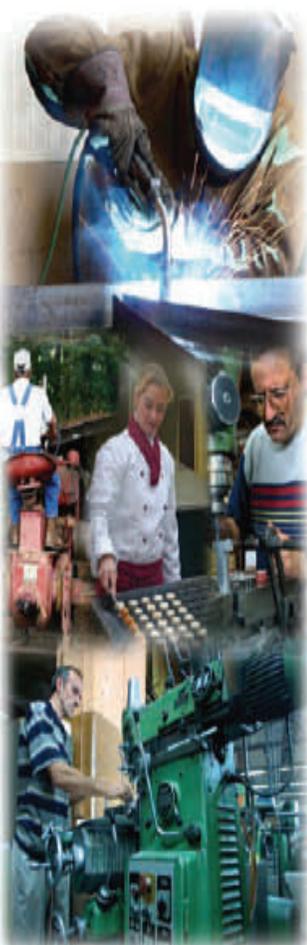
TABLE 4
1,770 Work-Related Asthma Cases from Manufacturing Industries:
1989-2009^a

	2002 North American Industry Classification System	WRA Cases #	Ann Avg Rate ^a	# Employees ^b
311	Food Mfg	55	7.4	35,300
323	Printing & Related Support Activities	18	3.9	21,900
325	Chemical Mfg	92	12.7	34,600
326	Plastics & Rubber Products Mfg	96	10.0	45,800
327	Nonmetallic Mineral Product Mfg	16	4.1	18,500
331	Primary Metal Mfg	62	9.4	31,400
332	Fabricated Metal Product Mfg	97	5.2	89,000
333	Machinery Mfg	134	7.1	89,600
334	Computer & Electronic Product Mfg	12	2.4	23,700
336	Transportation Equipment Mfg	1,062	16.0	317,000
337	Furniture & Related Product Mfg	12	1.5	36,900
	Miscellaneous Mfg (*includes NAICS: 312-16,321-322,324,335,339)	114	6.8	79,400

^aAverage annual incidence rate, based on cases from 1989-2009 per 100,000 adult workers in each industrial category, and represents years with complete reporting. Reporting in 1988 was begun mid-year and is incomplete. Reporting for 2010 and 2011 is not yet complete. Therefore, 1988, 2010 and 2011 reports are not included in this table.

^bSource: MDLEG Bureau of Labor Market Information & Strategic Initiatives: Michigan Current Employment Statistics 2001.

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



Type of Exposure

Table 5 shows the exposures associated with WRA among Michigan workers. The most frequent exposure reflect the heavy auto manufacturing industry base of the State, and the widespread use of cleaning products across all industry sectors. Most frequently identified exposures include: isocyanates (MDI, TDI, HDI and others) accounting for 389 (12.5%) of the WRA case exposures and cleaning products, associated with 351 (11.3%) of Michigan’s WRA patients. Metal working fluids (coolants) accounted for 310 (10.0%) of Michigan worker exposures.

There is ongoing interest in ingredients in cleaning products that can cause new-onset asthma and aggravate existing asthma. These products, used both in the home and in all industry sectors (services, manufacturing, etc.) can con-

tain disinfectants, often in the form of quaternary amines, which have been repeatedly shown to cause asthma among workers who use them.

Welding is the fifth most common cause of work-related asthma 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.

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**.

TABLE 5
Top Work Place Exposures Associated with
Confirmed WRA Patients: 1988-2011

<u>Exposure Agent</u>	<u>#</u>	<u>%</u>
Isocyanates	389	12.5
Cleaning Solutions	351	11.3
Metal Working Fluids	310	10.0
Unknown (Mfg.)	232	7.5
Unknown (Office)	190	6.1
Exhaust/Smoke/Fumes	159	5.1
Welding Fume-Stainless & Other	139	4.5
Solvents	111	3.6
Paint Fumes	76	2.5
Epoxy	68	2.2
Formaldehyde	65	2.1
Fungus	64	2.1
Latex/Rubber	59	1.9
Acids	57	1.8
Chlorine	44	1.4
Plastic Fumes	42	1.4
Fire	40	1.3
Acrylates	38	1.2
Chemicals Used in Construction	32	1.0
Cobalt	30	1.0
Animal Dander	25	0.8
Wood Dust	25	0.8
Flour	24	0.8
Ammonia	23	0.7
Styrene	23	0.7
Fragrances	22	0.7
Cigarette Smoke	20	0.6
Herbicide/Pesticide	20	0.6
Aldehydes	18	0.6
Fiberglass	17	0.5
Chromium	14	0.5
Caustics	13	0.4
Cement Dust	13	0.4
Amines	12	0.4
Grain Dust	12	0.4
Printing Inks	12	0.4
Cosmetology Chemicals	11	0.4
Medication	11	0.4
Rust Inhibitor	11	0.4
Anhydrides	10	0.3
Plants/Organic Matter	9	0.3
Asphalt	8	0.3
Insecticides	7	0.2
Meat Wrapper's Asthma	7	0.2
<u>Other^a</u>	<u>239</u>	<u>7.7</u>
Total	3,102	100.0

^aThere were 6 cases each w/exposure to: Azodicarbonamide, Fire Extinguisher Powder, Heat, Nitrogen, Paper Dust, Pickling Ingredients, Sewage.

There were 5 cases each w/exposure to: 1,1,1 Trichloroethane, Enzymes, Photo Developing Fluids, Polyurethane, Solder Fume, Sulfur Dioxide, Textile Lint.

There were 4 cases each w/ exposure to: Asbestos, Coal Dust, Freon, Rose Hips, Sulfonate, Trichloroethylene, X-Ray Developing Fluids.

There were 3 cases each w/exposure to: Cadmium Solder, Colophony, Copier Toner, Dimethyl Benzyl Ammonium Chloride, Drywall Dust, Glaze, Hydraulic Oil, Lime Dust, Mold Release Spray, Natural Gas, Nickel, Polyethylene, Sand, Sludge, Tar Fume, Zinc Oxide.

There were 2 cases each w/exposure to: Acetates, Ammonium Chloride, Cellulose, Concrete Sealer, Copper Oxide, Exercise, Fireproofing Chemicals, Gas and Oil Refinery Exposures, Kerosene, Methamphetamine Lab, Ozone, Pepper Gas, Perchloroethylene, Phosgene, Polyester, Polyvinyl Butyrate, Sulfite, Teflon, Zinc.

There was 1 case each w/exposure to: 1,3-Dichloro-2-Propanol, 1,3 Dichloro 5 5-Dimethyl Hydrantoin, Ammonium Bifluoride, Anesthesia, Benzoate Esters, Blood, Blue Prints, Capsaicin, Car Window Sealant, Ceramic Powder, Cold Air, Cooking Oil, Crude Oil, Cyanide, Deck Stain, Dry Ice, Ethylene Oxide, Explosion, Fertilizer, Flares, Flux, Gortex, Heated Polyvinyl Chloride, Iodine, Isopropyl Alcohol, Methanol, Mica, Monoammonium Phosphate, Ninhydrin, Nylon-polyhexamethylene Adipamide, Odor, Phenol, Pigment, Plasma Cutting, Plating Chemicals, Platinum, Potassium Aluminum Fluoride, Polybutadiene, Soda Ash, Sodium Chlorite, Soot, Stress, Swimming Pool Shock, Talcum Powder, Tuberculosis Vaccine, White Lithium, World Trade Center Exposure, Zinc Borate.

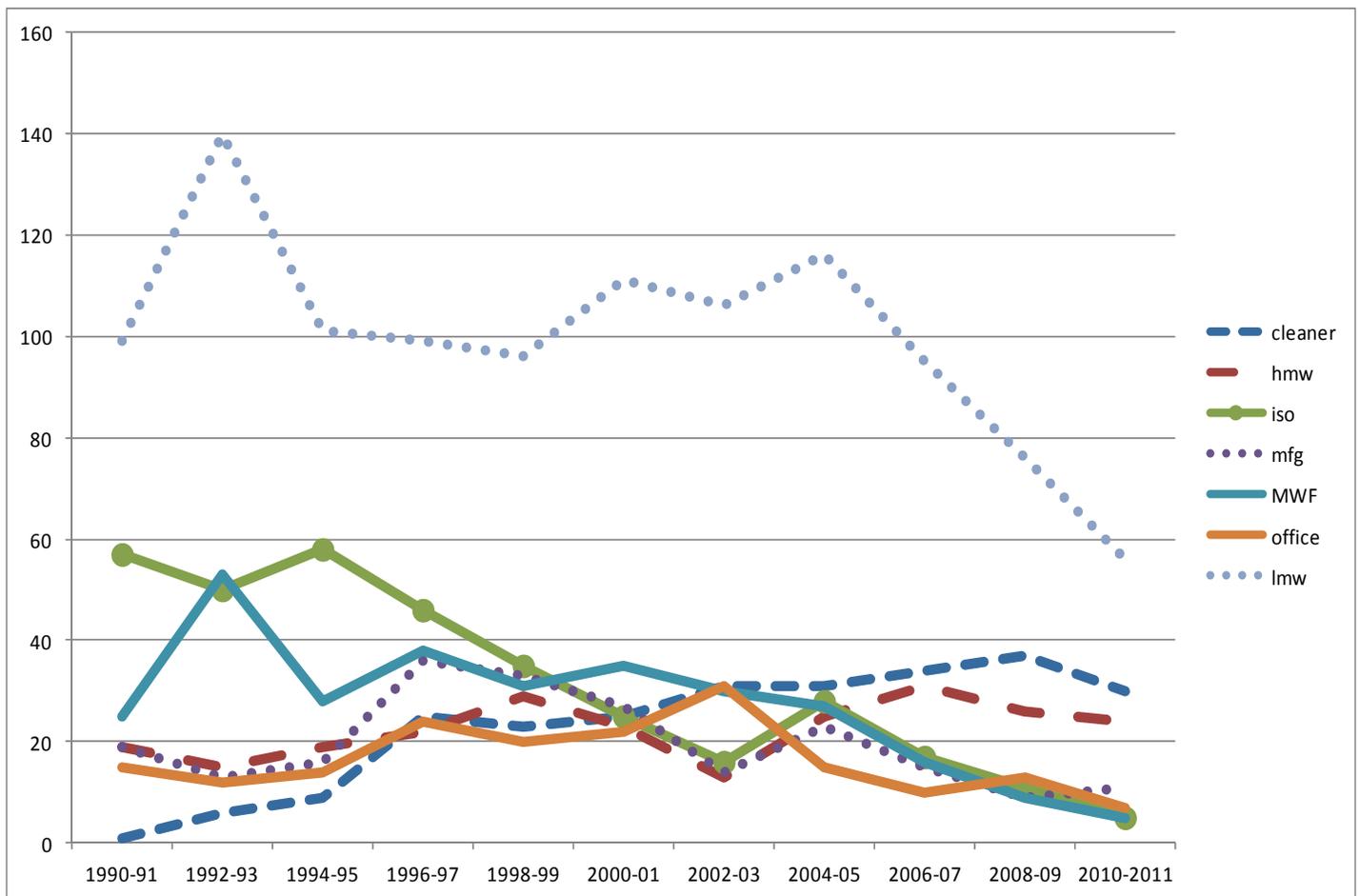
Type of Exposure, continued...

EXPOSURE TRENDS

Figure 3 shows the number of individuals with work-related asthma by type of exposure from 1988-2011. 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 diisocyanates, metal-working fluids and low molecular weight agents appears to be trending downward. Office and high molecular weight agents appear unchanged and cleaning agents appear to be trending upward.

FIGURE 3
WRA Patients by the Five Most Common Types of Exposures* and All of the Other High and Low Molecular Weight Compounds, Trend by 2-Year Time Periods: 1988-2011



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

Medical Results

The percentage of Michigan adult smokers has varied over time, from a high of 28.4% in 1998, to a low of 20.5% in 2010, and an increase in 2011 to 23.3%.

SMOKING STATUS

Table 6 shows patients' cigarette smoking status. Twenty percent of patients were smoking when their asthma developed. This is slightly lower than the state average (23.3%) and markedly lower than that found in blue collar working populations.

ALLERGIES AND ASTHMA

Forty-four percent of WRA patients had a family history of allergies.

Fourteen percent of the asthma patients

had a personal history of allergies and asthma (Table 7). Forty-eight 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 in their lifetime, and 36% had at least one hospitalization for their work-related asthma (Table 8). The average number of ED visits was 5.7 and the average number of hospitalizations was 3.9.

TABLE 6
Cigarette Smoking Status of 3,011^a
Confirmed WRA Patients: 1988-2011

	Smoking Status						TOTAL
	Current		Ex-Smoker		Non-Smoker		
	#	%	#	%	#	%	
OA	215	20.7	408	39.2	418	40.2	1,041
POA	176	15.1	482	41.5	504	43.4	1,162
AA	99	21.5	133	28.9	229	49.7	461
RADS	97	28.0	131	37.8	119	34.3	347
All	587	19.5	1,154	38.3	1,270	42.2	3,011

^aMissing data on 91 patients.

TABLE 7
Personal History of Allergies or Asthma Among
2,843^a Confirmed WRA Patients: 1988-2011

	Personal History of...							
	Allergies & Asthma		Asthma Only		Allergies Only		No Allergies or Asthma	
	#	%	#	%	#	%	#	%
OA	53	5.4	46	4.7	292	29.6	595	60.3
POA	76	7.0	53	4.9	375	34.4	585	53.7
AA	259	55.0	185	39.3	11	2.3	16	3.4
RADS	17	5.7	34	11.4	73	24.6	173	58.2
All	405	14.2	318	11.2	751	26.4	1,369	48.2

^aMissing data on 259 patients.

TABLE 8

Health Care Usage Among Confirmed WRA Patients: 1988-2011

Lifetime History of Health Care Usage			
ED Visit ^a		Hospitalized ^b	
Yes	No	Yes	No
# (%)	# (%)	# (%)	# (%)
1,879 (66)	984 (34)	974 (36)	1,758 (64)
Range		Range	
1-300 visits		1-200 hospitalizations	
AVG 5.7 ±15.3		AVG 3.9 ±10.5	

^aMissing data on 239 patients.

^bMissing data on 370 patients.

SYMPTOMS

Two thousand five hundred thirty-one of the patients with WRA had persistence of their asthma symptoms (Table 9). 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.

Medical Results, continued...

OBJECTIVE MEDICAL TESTING

The percentage of WRA patients who had different types of pulmonary function testing was:

- ◆ Pre-post bronchoprovocation 55%
- ◆ Methacholine challenge 20%
- ◆ Peak flow monitoring at work & home 3%
- ◆ Pre-post work-shift 3%
- ◆ Specific antigen challenge 1%

Workplace Investigations

WORKERS' COMPENSATION

About half of the WRA patients applied for workers' compensation benefits; about a third of those who applied for benefits were awarded compensation for their breathing problems.

- ◆ Applied 49%....among those who applied:
 - Pending approval 48%
 - Received benefits 35%
 - Denied benefits 17%

TABLE 9
Persistence of Symptoms and Medication Use in 2,840
Confirmed WRA Patients: 1988-2011

Still Exposed?	Total	Breathing Problems Still Present?				Still Taking Asthma Medications?			
		Yes		Less		Yes		Less	
		#	%	#	%	#	%	#	%
Yes	833	801	96.2	251	30.1	719	86.3	153	18.4
No	2,007	1,730	86.2	971	48.4	1,595	79.5	575	28.6
Total	2,840 ^a	2,531		1,222		2,314		728	

^aInformation missing on 262 individuals.

INDUSTRIAL HYGIENE

A total of 760 workplace inspections have been conducted since 1988 (Table 10); 122 of those facilities had been inspected more than once. Thirteen inspections have been completed since last year's report.

Air sampling for allergens was conducted during 542 inspections (Table 11); 24 (4.5%) of the 538 facilities with a MIOSHA standard for the allergen were above the enforceable permissible exposure limit.

TABLE 10
Status of Facilities Where Confirmed WRA Patients Were Exposed to Allergens: 1988-2011

Inspection Status	# Patients Represented	Companies	
		#	%
Inspected	1,195	760 ^a	34.1
No Follow-up Planned	1,703	1,282	57.5
Scheduled for Inspection	6	6	0.3
Out of Business	70	62	2.8
No Longer Use Occupational Allergen	26	25 ^b	1.1
<u>Sent Company Letter to Check Exposures^d</u>	<u>102</u>	<u>96</u>	<u>4.3</u>
Total	3,102	2,231 ^c	100.1

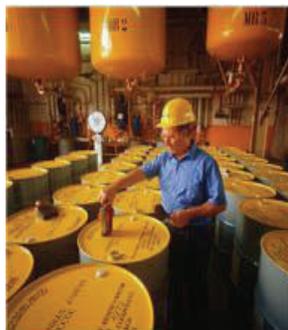
^a760 inspections were conducted in 638 different workplaces.

^bEight companies that no longer use the allergen were previously inspected.

^cRepresents 2,109 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.

TABLE 11
Air Monitoring Results from 760
Workplace Inspections: 1988-2011



Many substances have no method for air monitoring or have not been evaluated for their asthma-causing potential.

<u>Air Sampling – NIOSH Standard</u>	<u>#</u>	<u>%</u>
Above NIOSH Standard	64	8.4
Below NIOSH Standard	456	60.0
No NIOSH Standard	23	3.0
Unknown (no report yet)	7	0.9
Did Not Sample for an Allergen	26	3.4
<u>Did Not Sample</u>	<u>184</u>	<u>24.2</u>
Total	760	99.9^a

<u>Air Sampling – MIOSHA Standard</u>	<u>#</u>	<u>%</u>
Above MIOSHA Standard	24	3.2
Below MIOSHA Standard	514	67.6
No MIOSHA Standard	4	0.5
Unknown (no report yet)	7	0.9
Did Not Sample for an Allergen	27	3.6
<u>Did Not Sample</u>	<u>184</u>	<u>24.2</u>
Total	760	100.0

^aPercentages do not add to 100 due to rounding.

AIR MONITORING

Table 12 shows the allergens that were above the NIOSH and/or MIOSHA limits. The top four allergens found to be above the NIOSH REL were:

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

The top four allergens found to be above the MIOSHA enforceable PEL were:

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

TABLE 12
Allergens Above the MIOSHA Permissible Exposure Limit (PEL) and/or
NIOSH Recommended Exposure Limit (REL): Michigan 1988-2011

<u>Asthma-Causing Agents</u>	<u>Above NIOSH REL</u>		<u>Above MIOSHA PEL</u>	
	<u>#</u>	<u>%</u>	<u>#</u>	<u>%</u>
Formaldehyde	28	43.8	1	4.2
Cobalt	6	9.4	4	16.7
Styrene	6	9.4	4	16.7
Metal-Working Fluids	5	7.8	1	4.2
Glutaraldehyde	4	6.3	3	12.5
HDI	4	6.3	No PEL	--
MDI	3	4.7	0	--
Wood Dust	3	4.7	2	8.3
Chromic Acid	1	1.6	1	4.2
Ethylene Oxide	1	1.6	0	--
Phthalic Anhydride	1	1.6	1	4.2
Starch	1	1.6	0	--
Total Dust (Dry Plant Materials)	1	1.6	0	—
Welding Fume (Total Particulate)	No REL	--	5	20.8
<u>Flour Dust</u>	<u>No REL</u>	<u>--</u>	<u>2</u>	<u>8.3</u>
TOTAL	64	100.4^a	24	100.1^a

^aPercentages do not add to 100 due to rounding.

Workers exposed to asthma-causing agents BELOW permissible limits can still develop work-related asthma.

Co-Worker Interviews at Workplace Investigations

Co-workers were interviewed at 584 of the 760 inspections. They reported daily or weekly breathing symptoms associated with work or new onset asthma since beginning to work at 383 of the 584 (66%) companies. The average percentage of co-workers with symptoms in these 383 companies was 20.5%. All 1,566 co-workers from the remaining 201 companies reported no daily or weekly breathing symptoms associated with work. One thousand five hundred forty-five of the 9,921 (15.6%) co-workers interviewed had symptoms consistent with work-related

asthma (Table 13).

The MIOSHA Injury and Illness Logs (Form 300) kept by employers listed 578 workers from 132 companies with asthma or asthma-like symptoms. Only nine workers identified in the interviews with daily or weekly chest tightness, shortness of breath or wheezing were also listed on the MIOSHA Log. Combining the information from the interviews and Injury and Illness Log, a total of 2,114 symptomatic workers were identified during the 760 MIOSHA enforcement inspections.



1 in 6 co-workers of the index patient with asthma reported similar breathing problems in the workplace.

TABLE 13

Breathing Symptoms Among Co-Workers of the 3,102 Confirmed WRA Patients: 1988-2011

Symptoms	Disease Status of the Index Patient									
	ALL		OA		POA		AA		RADS	
	#	%	#	%	#	%	#	%	#	%
Daily or Weekly SOB, Wheezing or Chest Tightness	1,545	15.6	1,069	16.0	431	15.0	6	13.3	39	13.2
Workers Interviewed	9,921		6,698		2,882		45		296	
OSHA Log	578	17.4	398	20.4	167	13.4	2	7.7	11	14.8
# Companies w/Employee on Log	132		89		38		1		4	
# Companies Inspected	<u>760</u>		<u>436</u>		<u>284</u>		<u>13</u>		<u>27</u>	
Total ^a	2,123		1,467		598		8		50	

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

Work-Related Asthma Deaths

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

There were no work-related asthma

deaths identified in calendar years 2009 through 2011.

We have published articles on some of the work-related asthma deaths^{4,5}.



Limiting asthma management to just the treatment of symptoms is an unacceptable way to manage work-related asthma.

Michigan Workforce Exposed to Isocyanates

Isocyanates are the most commonly reported cause of WRA in Michigan. 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. Isocyanates are one of the 650 substances for which reporting is required. 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 who are potentially exposed to isocyanates. This estimate under-counts non-manufacturing exposed employees such as auto body paint shop repairers because the EPA does not include non-manufacturing establishments. Conversely, it over-counts manufacturing employees because the total number of employees at

each facility that reported isocyanate use are included, even though not all workers at these facilities would have worked with or around isocyanates.

There were 103 companies that reported the use of at least 10,000 pounds of isocyanates in calendar year 2011 (the most recent year available), which is up from 94 companies in 2009. The 103 companies can be found in Table 14. The number of workers employed in companies that use isocyanates, the total number of workers in these counties, and the percentage of workers where isocyanates are used is listed. The 30,496 workers potentially exposed to isocyanates in 2011 is down from the 31,442 potentially exposed in 2010.

TABLE 14

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

County	Company Name ^c	# Workers Employed ^a by Isocyanate-Using Facilities	Total # Workers in the County ^b	% Workers Potentially Exposed to Isocyanates
ALLEGAN	HAWORTH INC			
	JOHNSON CONTROLS INTERIORS PMSC	2900	48269	6.0
	JOHNSON CONTROLS INTERIORS-MAPLEWOOD FAC			
BARRY	BRADFORD WHITE CORP	1100	26327	4.2
BAY	RENOSOL- Bay City Plant	45	46711	0.1
BERRIEN	LECO CORP			
	VAIL RUBBER WORKS, INC.	910	65673	1.4
CALHOUN	BOSTIC-MARSHALL			
	CELLO-FOIL PRODUCTS	67	58781	0.1
	COMCAST URETHANE			
CHARLEVOIX	EAST JORDAN FOUNDRY	500	11162	4.5
CLARE	RENOSOL	300	10598	2.8
CLINTON	INNOVATIVE POLYMERS INC	10	34920	<0.1
DICKINSON	GREDE	580	12204	4.8

Table 14, continued...

County	Company Name ^c	# Workers Employed ^a by Isocyanate-Using Facilities	Total # Workers in the County ^b	% Workers Potentially Exposed to Isocyanates
DICKINSON	LOUISIANA-PACIFIC-SAGOLA OSB			
EATON	AXSON N AMERICA	2726	50623	5.4
	GM LANSING DELTA TWP			
GENESEE	ASI PACKAGING COMPANY			
	DELPHI ELECTRONICS & SAFETY	29	164302	<0.1
	FERGUSON BLOCK CO., INC.			
HILLSDALE	DOW CHEMICAL	85	16987	0.5
INGHAM	HUNTSMAN ADVANCED MATERIALS	190	130735	0.1
	WILLIAMSTON PRODUCTS INC			
ISABELLA	DELFIELD CO	550	33723	1.6
JACKSON	ADCO PRODUCTS			
	MILSCO MICHIGAN SEAT	1150	64075	1.8
	TAC MFG			
KALAMAZOO	AZON USA	120	114013	0.1
	PARKER HANNIFIN CORP			
KENT	GRAND RAPIDS FOAM TECHNOLOGIES			
	HB FULLER			
	LEON PLASTICS	669	278213	0.2
	PURFORMS INC			
	RICHWOOD INDUSTRIES INC			
LAPEER	ITW TACC	10	35225	<0.1
LENAWEE	ANDERSON DEVELOPMENT			
	CLINTON-PILKINGTON	415	39535	1.0
	INSULSPAN			
LIVINGSTON	ATREUM HOWELL (INTIER AUTOMOTIVE)			
	ATREUM-BRIGHTON	430	79924	0.5
	PACKAGE DESIGN & MFG			
LUCE	LOUISIANA-PACIFIC CORP-NEWBERRY SIDING	111	2161	5.1
MACOMB	CHRYSLER STERLING HTS ASSY			
	DUPONT MT CLEMENS PLT			
	FAURECIA INTERIOR SYSTEMS			
	INTERNATIONAL CASTING CORP	2234	356457	0.6
	ROMEO RIM ONC			
	SHELBY FOAM SYSTEM			
	WOLVERINE BRONZE			

Table 14, continued...

County	Company Name ^c	# Workers Employed ^a by Isocyanate-Using	Total # Workers in the County ^b	% Workers Potentially Exposed to Isocyanates
MASON	DUNA-Ludington Plant	219	12673	1.7
	GREAT LAKES CASTING			
MECOSTA	WOLVERINE WORLD WIDE	540	17610	3.1
MIDLAND	DOW CHEMICAL CO	2000	38281	5.2
MONTCALM	AGA MARVEL	208	22217	0.9
	KENT FOUNDRY			
MUSKEGON	MICHIGAN STEEL INC	100	73756	0.1
OAKLAND	ARMALY SPONGE	1377	528805	0.3
	BEHR AMERICA			
	CASS POLYMERS OF MI			
	EAGLE INDUSTRIES			
	EXOTIC RUBBER AND PLASTICS COR			
	FANUC ROBOTICS-Corporate Headquarters			
	LYMTAL INTERNATIONAL			
	OTTO BOCK POLYURETHANE TECHNOLOGIES			
	POLYSPEC-ITW FUTURA COATINGS			
	RECTICEL INTERIORS N AMERICA			
RECTICEL UREPP N AMERICA				
OGEMAW	TAYLOR BUILDING PRODUCTS	75	8061	0.9
ONTONAGON	K & W LANDFILL	9	2326	0.4
OTTAWA	DAKE OEM	144	117606	0.1
	EAGLE PACKAGING			
	MAGNA-SEALING & GLASS SYSTEMS			
SAGINAW	FILTRONA POROUS TECHNOLOGIES	3960	81393	4.9
	GLASTENDER			
	NEXTEER AUTOMOTIVE CORP			
	SAGINAW METAL CASTING OPERATIONS			
SANILAC	GRUPO ANTOLIN	800	16843	4.7
	MIDWEST RUBBER CO			
	NUMATICS SANDUSKY MAIN			
	TRELLEBORG YSH INC			
ST CLAIR	IAC PORT HURON	450	66164	0.7
	INTERNATIONAL AUTOMOTIVE COMPONENTS			
ST JOSEPH	DAVID A. CHENOWETH ROOFING	635	24768	2.6
	IAC MENDON			

Table 14, continued...

VAN BUREN	BASF CORP	182	32062	0.6
	SPECIAL-LITE INC			
WASHTENAW	ACH-SALINE PLT	1500	168067	0.9
	WOODBIDGE CORPORATION			
WAYNE	ALPHA RESINS			0.4
	BASF CORP			
	BASF CORP			
	CHRYSLER JNAP			
	COLLINS & AIKMAN - WESTLAND			
	CYGNET AUTOMATED CLEANING			
	EFTEC			
	EQ DETROIT (Environmental Quality)	2791	719175	
	MERITOR			
	PLASTOMER CORP			
	POOF-SLINKY INC			
	RECYCLED POLYMERIC MATERIALS			
	UNIVAR USA/ROMULUS			
WOODBIDGE CORP				
WEXFORD	REC BOAT HOLDINGS-CRUISER PLANT	375	11725	3.2
TOTAL		30,496	3,622,150	0.8

^aSource: Michigan Manufacturers' Directory, 2010 and www.acinet.org accessed February 14, 2013.

^bSource: Michigan Labor Market Information, Data Explorer, www.milmi.org accessed November 17th, 2010.

^cSource: U.S. Environmental Protection Agency, Toxics Release Inventory, Michigan Companies Using Isocyanates in 2011 (report February 13, 2013).

^dSource: Michigan Department of Environmental Quality, FOIA Request for SARA Title III Emergency Planning and Release Reporting of select chemicals (isocyanates), received November 29, 2012.

Michigan Workforce Exposed to Selected Causes of WRA

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

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. The companies listed are current as of November 29, 2012, the date of the report generated by the Michigan DEQ.

The chemicals shown can be categorized in two ways: those 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, Phthalic Anhydride and Styrene. Ammonia and Chlorine are classified as irritants.

TABLE 15

**Michigan Facilities by County, Reporting Toxic Chemicals to the
Michigan Department of Environmental Quality (DEQ) Under Section 313
of the Emergency Planning and Right-to-Know Act (EPCRA)^a**

SUBSTANCES CAPABLE OF CAUSING ASTHMA:

Cobalt, Epichlorohydrin, Formaldehyde, Methyl Acrylate, Phthalic Anhydride, & Styrene

SUBSTANCES CAPABLE OF CAUSING REACTIVE AIRWAYS DYSFUNCTION SYNDROME:

Ammonia & Chlorine

**A=Ammonia, CH=Chlorine, CO=Cobalt, E=Epichlorohydrin, F=Formaldehyde,
M=Methyl Acrylate, P=Phthalic Anhydride, S=Styrene**

County	Company Name	Type of Exposure
ALGER	NEENAH PAPER - MICHIGAN INC	A
ALLEGAN	Birds Eye Foods LLC	A, CH
	Hamilton Farm Bureau - Hamilton Main	A
	JBS Plainwell, Inc.	A
	Van Elderen Inc.	F
	Water Renewal	CH
	Wayland	CH
ALPENA	ALPENA SUPPLY COMPANY	CH
ARENAC	Whitestone Pumping Station	CH
BARAGA	CUSTOM COMPOSITES DIVISION	S
BAY	BAY City Municipal Water Treatment Plants	CH
	CROP PRODUCTION SERVICES	A
	Dow Corning Corporation - Auburn Site	A, CH
	ESSEXVILLE WASTEWATER TREATMENT	CH
	MAMMEL, MICHAEL/FARM	A
	Mersen USA BN. Corp.	CH
	QUANTUM COMPOSITES, INC.	S
	WEST BAY COUNTY REGIONAL WASTEWATER	CH
BENZIE	FRANKFORT COLD STORAGE	A
	GRACELAND FRUIT, INC.	A
	PLATTE RIVER ST FISH HATCHERY	F
	SMELTZER ORCHARD COMPANY	A
BERRIEN	ADVANCE PRODUCTS CORPORATION	A
	Benton Harbor	A
	BENTON HARBOR WATER PLANT	CH
	BUCHANAN AGRONOMY & PETROLEUM	A
	BUCHANAN WATER & WASTEWATER TREATMENT PLANT	CH
	COLOMA FROZEN FOODS INC	A
	GREG ORCHARDS & PRODUCE INC	A
	HANSON COLD STORAGE-NAPIER & PIPESTONE	A

Table 15, continued...

County	Company Name	Type of Exposure
BERRIEN	LECO CORPORATION	A
	MODAR INC.	F
	NCP COATINGS INC.	A, P
	NEW BUFFALO WATER PLANT	CH
	NILES, CITY - DECKER, FORT & FRONT WELLS & IRON REMOVAL	CH
	Old Europe Cheese, Inc.	A
	SAINT JOSEPH WATER PLANT	CH
	SANDVIK MATERIALS TECHNOLOGY	A
BRANCH	WILBUR-ELLIS COMPANY-WATERVLIET	F
	ALERIS SPECIFICATION ALLOYS, INC.	CH
	CONAGRA FOODS INC	A
	STAR OF THE WEST MILLING COMPANY	CH
CALHOUN	WATER TREATMENT PLANT/COLDWATER	CH
	Albion Plant	A
	ANATECH, LTD.	F
	BATTLE CREEK WATER TREATMENT & WWTP	CH
	EATON CORP PSCO	A
	GUARDIAN FIBERGLASS INC.	F
	HOUSE OF RAEFORD FARMS, INC	A
	MUSASHI AUTO PARTS-MICHIGAN INC	A
	Post Foods - Battle Creek	CH
	PRAIRIE FARMS DAIRY, INC.	A
	THE ANDERSONS ALBION ETHANOL, LLC	A
CASS	VERONA PUMPING STATION	CH
	The Mennel Milling Co. of Michigan	CH
CHARLEVOIX	Charlevoix	CH
CHEBOYGAN	CITY OF CHEBOYGAN WELLHOUSE #4 & #7 & WWTP	CH
CLINTON	Crop Production Services 622	A
	MAHLE ENGINE COMPONENTS USA, INC.	A
	Michigan Milk Producers Association	A
	SAVE-A-LOT LTD	A
	SCCMUA	CH
	Vanderhoof Farms	A
	Wastewater Treatment Facility	CH
CRAWFORD	Williams Farms	A
	ARCTIC GLACIER INC	A
	GRAYLING GENERATING STATION	CH
DELTA	WEYERHAEUSER NR COMPANY	F
	ESCANABA PAPER COMPANY	A, CH

Table 15, continued...

County	Company Name	Type of Exposure
DICKINSON	Verso Paper Quinnesec	CH
EATON	AXSON NORTH AMERICA INC.	S
	CASS POLYMERS OF MICHIGAN INC	S
	ETM Enterprises Inc.	S
	S.P.KISH INDUSTRIES	A
EMMET	ODEN STATE FISH HATCHERY	F
	Petoskey	CH
GD TRAVERSE	CentreICE	A
	CENTURY SUN METAL TREATING	A
	CHERRY GROWERS INC - GRAWN & TC PLTS	A
	MICHIGAN PLANT	A
	SARA LEE BAKERY	A
	TCS TRAVERSE COLD STORAGE LLC	A
	Traverse City	CH
GENESEE	ANTHONY RAGNONE TREATMENT PLAN	CH
	Cupid Farms	A
	Flint	CH
	FLINT WATER PLANT	CH
	HENDERSON ROAD PUMP STATION	CH
	KELSEY-HAYES COMPANY	CH
	KOEGEL MEATS INC.	A
	Oginsky Farm	A
	STOKES STEEL TREATING COMPANY	A
	Taylor Farms	A
	VanGilder- Malone Farm	A
	WATER POLLUTION CONTROL FACILITY	CH
	Woodworth Inc. Flint	A
GOGEBIC	CITY OF IRONWOOD WATER PUMP ST	CH
GRATIOT	ALMA WASTEWATER PLANT	CH
	CITY OF ST. LOUIS WWTP	CH
	CROP PRODUCTION SERVICES	A
HILLSDALE	BEF Foods Inc.	A
	CITY OF OTSEGO WWTP & WELLS #3, #4 & #5	CH
	HILLSDALE WASTEWATER TREATMENT	CH
	PRATTVILLE FERTILIZER & GRAIN, INC.	A
	THE ANDERSONS LITCHFIELD FARM	A
HOUGHTON	MICHIGAN-AMERICAN WATER COMPANY	CH
	Osmose Hubbell	A

Table 15, continued...

County	Company Name	Type of Exposure
HURON	Bad Axe Wastewater Treatment Plant	CH
	CO-OP ELEVATOR ELKTON NH3 SITE	A
	COOPERATIVE ELEVATOR COMPANY - BAD AXE & RUTH	A
	CROP PRODUCTION SERVICES 892	A
	DOW AGROSCIENCES LLC	A
	FARMERS CO-OP GRAIN CO.	A
	HARBOR BEACH WATER WORKS & WWTP	CH
	PORT AUSTIN AREA SEWER & WATER	CH
	THUMB TOOL & ENGINEERING	A
	VILLAGE OF CASEVILLE WTP	CH
INGHAM	ALDI INC - WEBBERVILLE	A
	ALEXANDER CHEMICAL CORPORATION	A, CH
	AURORA SPECIALTY CHEMISTRIES	E
	CITY OF LESLIE WASTEWATER TREATMENT PLANT	CH
	CREMER FARM CENTER, Inc.	A
	DYE WATER CONDITIONING PLANT	A
	E LANSING-MERIDIAN WATER & SEWER AUTHORITY	A
	HAWKINS, SID/FARM	A
	JORGENSEN FARM ELEVATOR	A
	Lansing Mint Rd.	A
	LANSING PLANTS - EMPIRE WAY & COMMERCE	A, CH
	MASON P.O.T.W. PLANT	CH
	MBI	A
	MEIJER LANSING DISTRIBUTION	A
	MELODY FARMS LLC	A
	NITREX INC - MICHIGAN OPERATION	A
	Pidd Brothers Farm	A
	QUALITY DAIRY COMPANY	A
	RICE, DONALD/FARM	A
	RIVER INTAKE HOUSE	CH
	SYMMETRY MEDICAL INC-LANSING	CO
	THE ANDERSONS WEBBERVILLE AG PRODUCTS	A
	WALNUT VU FARM/FARM	A
	Watters & Sons Farm	A
	Zeitz Farms Inc.	A
	IONIA	BELDING TANK TECHNOLOGIES, INC
CALEDONIA FARMERS ELEVATOR		A

County	Company Name	Type of Exposure
IONIA	Carbon Green BioEnergy	A
	Cargill Kitchen Solutions	A
	CROP PRODUCTION SERVICES	A
	HENNERY	A
	PORTLAND WWTP	CH
	STAHLIN ENCLOSURES	S
	TRW AUTOMOTIVE US LLC - PORTLAND PLANT	A
	TWIN CITY FOODS	A, CH
IOSCO	HURON SHORE REGIONAL UTILITY A	CH
	ROSE ICE COMPANY	A
	TAWAS UTILITY AUTHORITY WWTP	CH
	TIP-TOP SCREW MFG IN	A
JACKSON	CITY OF JACKSON WATER TREATMENT	CH
	Coventry Park	CH
	INDUSTRIAL STEEL TREATING	A
	JCC Well House	CH
	Kimmel Road well house	CH
	Meadow Heights Well	CH
	SOUTHVIEW PUMP STATION	CH
	SPRINGPORT ELEVATOR INC	A
	TENNECO - JACKSON ENGINEERING FACILITY	A
	Westchester Pump Station	CH
KALAMAZOO	AGA GAS, INC.	A, CH
	CITY OF KALAMAZOO- STATIONS #28 & #39	CH
	CYTEC INDUSTRIES INC.	F
	HAVILAND PRODUCTS COMPANY	F
	KALAMAZOO WATER DIV/STA #1-#5, #8, #9, #11, #12, #14, #17, #18, #22, #24, #25, #31	CH
	KLC1	A
	KNAPPEN MILLING CO	CH
	PHARMACIA & UPJOHN LLC - PFIZER INC MFG COMPLEX	A, CH, E, F
	PHARMACIA AND UPJOHN BLDG 212	F
	PRECISION HEAT TREATING COMPANY	A
	Thermo Fisher Scientific	F
	TLC WAREHOUSING SVCS INC MDC2	A
KENT	Allied Finishing Inc	F
	ARKEMA INC.	P
	BRENNTAG GREAT LAKES LLC	F
	BUTTERBALL FARMS INC	A

Table 15, continued...

County	Company Name	Type of Exposure
KENT	Coca-Cola Grand Rapids	A
	ConAgra Foods Grand Rapids	A
	COUNTRY FRESH LLC	A
	Distribution Center #1	A
	Eagles Ice Center	A
	Earthgrains Baking Companies Inc.	A
	Emerald Spa Corporation	S
	FINISHMASTER INC #990 DIST CR	S
	FORTY-FOURTH STREET FACILITY	A
	GM COMPONENTS HOLDINGS, LLC	A
	GORDON FOOD SERVICE - CLAY AVE & 50TH ST	A
	GRAND RAPIDS CONTROLS COMPANY LLC	F
	Grand Rapids Edge Ice Arena	A
	Grandville	A, CH
	GRF INDUSTRIES, INC	F
	JACK BROWN PRODUCE INC	A
	KENT QUALITY FOODS INC	A
	KING MILLING COMPANY	CH
	LACKS TRIM SYSTEM - AIRLANE PLANT	F
	LACKS WHEEL SYSTEMS	F
	LOWELL WWTP & WATER TREATMENT & FILTRATION	CH
	MACDONALDS INDUSTRIAL PRODUCTS - PLANT 3	F
	MICHIGAN NATURAL STORAGE CO	A
	MICHIGAN TURKEY PRODUCERS - HALL ST & CHICAGO DR	A
	NBHX Trim USA	S
	PATTERSON ICE CENTER	A
	PLASTIC PLATE, INC. (PLANT II)	F
	REMICO STREET FACILITY	CH, F
	RIDGEKING APPLE PACKING AND STORAGE	A
	S1	A
	SPARTA FACILITY	A
	SPARTAN STORES DISTRIBUTION	A
	SPECIALTY HEAT TREATING, INC.	A
	STATE HEAT TREATING COMPANY	A
	SUPERIOR SEAFOOD INC.	A
	SUPERIOR STONE PRODUCTS INC	S
	SYSCO GRAND RAPIDS, LLC	A

Table 15, continued...

County	Company Name	Type of Exposure
KENT	UNIVAR USA/GRAND RAPIDS/WYOMING	S
	VI-CHEM CORPORATION	S
	VILLAGE OF SPARTA WATER DEPT	CH
	WILBUR-ELLIS COMPANY-SPARTA	F
	WYOMING CLEAN WATER PLANT	CH
	YOUNG CHEMICAL COMPANY	F
LAPEER	LAPEER GRAIN EAST	A
	Lapeer Plating & Plastics	F
LEELANAU	LEELANAU FRUIT COMPANY	A
LENAWEE	ADC Main Plant	F, S
	ADC-NF3 PLANT	A
	Airgas Carbonic, Inc	A
	BIOLAB INC.	A, CH
	CROP PRODUCTION SERVICES 634 & 641	A
	DAIRY FARMERS OF AMERICA	A
	War-Ag Farms Services LLC	A
	Wellhouse #3 #8 #9 #10 #11 #12 & #14	CH
	WILBUR-ELLIS COMPANY - MUNSON	A
LIVINGSTON	ALPHA TECHNOLOGY CORPORATION	S
	CHEMCO PRODUCTS, INC.	F
	General Chemical Corp.	A
	GORDON FOOD SERVICE	A
	May and Scofield	S
	PEPSI COLA METROPOLITAN BOTTLING	A
	WATER PLANT & WWTP	CH
MACKINAC	WATER TREATMENT PLANT & WWTP	CH
MACOMB	CHEMTECH FINISHING SYSTEM, INC	E, F
	CHRYSLER-STERLING HEIGHTS ASSEMBLY	F
	DU PONT- MT CLEMENS PLANT	F, S
	EVERFRESH / LA CROIX BEVERAGES	A
	FINI FINISH PRODUCTS INC	CH
	FORMSPRAG LLC	A
	GM LLC TECHNICAL CENTER	A
	METALLURGICAL PROCESSING COMPANY	A
	NITRO-VAC HEAT TREATING	A
	NORBROOK PLATING	A
	REINHART FOODSERVICE LLC	A
	SPECIALTY STEEL TREATING, INC.	A

Table 15, continued...

County	Company Name	Type of Exposure
MACOMB	STEEL PROCESSING COMPANY LLC	A
	TI AUTOMOTIVE SYSTEMS	CH
	TURRI'S ITALIAN FOODS, INC	A
MANISTEE	Main	S
MARQUETTE	AIRGAS NORTH CENTRAL INC	CH
	KI SAWYER WWTP	CH
	NEGAUNEE WASTEWATER TREATMENT	CH
MASON	HOUSE OF FLAVORS INC	A
	JOS. SANDERS INC	A
	Ludington Wastewater Plant	CH
	MICHIGAN FOOD PROCESSORS	A
MECOSTA	LEPRINO FOODS COMPANY REMUS	A
	UNITED STATES MARBLE INC.	S
MENOMINEE	L.E. JONES COMPANY	CO
	MENOMINEE WATER TREATMENT PLANT & WWTP	CH
	RULEAU BROS INC	A
MIDLAND	CITY OF MIDLAND - WATER TREATMENT & WWTP	CH
	Dow Corning - Midland Plant	A, CH
	HOMESTEAD TOOL - SMC PLANT	S
	Mersen USA Midland-MI Inc	CH
	Michigan Operations	A, CH, E, S
	Midland Dow, James Savage & BLDG 1612	CH
MONROE	Styron LLC - MI Operations	M, S
	ADVANCED HEAT TREAT CORP	A
	DETROIT EDISON - MONROE POWER PLANT	A
	HOME CITY ICE COMPANY- Toledo	A
	INDEPENDENT DAIRY INC	A
	MAYBEE FARMERS INC	A
	MEIJER NEWPORT DISTRIBUTION	A
	OTTAWA LAKE CO-OP ELEVATOR	A
	ROYSTER-CLARK, INC. 655	A
MONTCALM	Crop Production Services	A
	MUD/DME	A
MUSKEGON	ALLOY RESOURCE CORPORATION	CH
	BAYER CROPS SCIENCE USA	A
	COLE'S QUALITY FOODS, INC.	A
	ESCO COMPANY, LLC	P
	GMI Composites, Inc	S

Table 15, continued...

County	Company Name	Type of Exposure
MUSKEGON	HOWMET CORPORATION - PLANTS 1, 3, 5 & 10	CO
	L-3 COMBAT PROPULSION SYSTEMS	A
	LAKE WELDING SUPPLY COMPANY INC	A
	SNAPPY APPLE FARMS INC	A
	SUN CHEMICAL CORPORATION	A
	WEBB CHEMICAL SERVICE CORP INC.	F
NEWAYGO	GERBER PRODUCTS COMPANY	A
OAKLAND	BEHR AMERICA INC	A
	CHEMICAL BLENDING	F
	CHOR INDUSTRIES INC.	A
	COMMERCIAL STEEL TREATING CORP	A
	Detroit Skating Club	A
	Detroit Steel Treating Co.	A
	ENGINEERED HEAT TREAT INC	A
	FARMINGTON HILLS ICE ARENA	A
	Ferndale	A, CH
	FOGLERS ORCHARD & FARM MARKET	A
	GENERAL MOTORS PROVING GROUND	CH
	HAZEL PARK VIKING ARENA	A
	JOHN LINDELL ICE ARENA	A
	LAKELAND ARENA	A
	LAKELAND HIGH SCHOOL	CH
	MACDERMID INCORPORATED	F
	MARBELITE CORPORATION	S
	Matheson Valley	A
	NOVI ICE ARENA	A
	ONYX-ROCHESTER ICE ARENA	A
	Palace Sports & Entertainment Inc.	A
	RMT Woodworth, Southfield	A
	SPECIALTY STEEL TREATING INC	A
	STONE SOAP COMPANY INC	F
	SUBURBAN TRAINING CENTER	A
	SULZER METCO (US) INC	CO
	SUN STEEL TREATING INC	A
	US Foods Inc.	A
	VILLAGE OF HOLLY WWTP	CH
	VILLAGE OF MILFORD IRON REMOVAL PLANT	CH
	WATERFORD IRON REMOVAL PLANT 5-1, 12-1, 14-1, 16-1 & 2, MS-1, 19-1, 24-1, 25-1 & 2, 28-1, 31-1	CH

Table 15, continued...

County	Company Name	Type of Exposure
OCEANA	2nd Street Storage	A
	Arbre Farms Corporation	A
	Hart Division	A
	MICHIGAN FREEZE PACK	A
	OCEANA COUNTY FREEZER STORAGE,	A
	PETERSON FARMS MAIN CAMPUS	A
OGEMAW	SANDVIK HARD MATERIALS	CO
OSCEOLA	ADVANCED FIBERMOLDING	S
	DEAN DAIRY HOLDINGS,LLC dba LIBERTY DAIRY COMPANY	A
	VENTRA EVART, LLC	F
	YOPLAIT REED CITY	A
OTSEGO	Gaylord	CH
	JORDAN RIVER NAT FISH HATCHERY	F
OTTAWA	Allendale Plant	A
	B & B FARMS	A
	Beuschel Fruit & Dairy	A
	BOAR'S HEAD PROVISIONS CO INC	A
	County Line Dairy	A
	CREME CURLS BAKERY, INC.	A
	Crisp Hill Dairy Farm	A
	CSD	A
	Dietrich Orchards	A
	Fitzpatrick Farm	A
	GEORGETOWN ICE CENTER	A
	Gerrit VanDenTop Farm	A
	Greenly Street Plant	A
	Gruppen Farms	A
	HUDSONVILLE CREAMERY & ICE CREAM LLC	A
	INTERSTATE WAREHOUSING LLC	A
	J.B.SIMS GENERATING STATION	CH
	Juana's Packing Co., LLC-Main Plant	A
	Ken Zeinstra Farms	A
	LAKE WELDING SUPPLY COMPANY INC	A
LAKESHORE FILTRATION PLANT	CH	
MEAD JOHNSON AND COMPANY, LLC	CH	
MICHIGAN CELERY PROMOTION CO-O	A	
Midway Dairy	A	
MIEDEMA PRODUCE INC	A	

Table 15, continued...

County	Company Name	Type of Exposure
OTTAWA	Neil Jacobsen Farm	A
	Neubecker Farms	A
	Polyply Composites LLC.	S
	QUINCY STREET, INC	A
	REQUEST FOODS	A
	Richard Bos Farm	A
	SARA LEE - ZEELAND	A
	SHERWIN - WILLIAMS COMPANY-HOLLAND	A
	SPECIALTY HEAT TREATING OF HOLLAND INC	A
	SUPERIOR SALES INC	A
	THE EDGE ICE ARENA	A
	TIARA YACHTS, INC.	S
	TOTAL LOGISTIC CONTROL, LLC	A
	UNIFORM COLOR COMPANY	M
	VERTELLUS SPECIALTIES - ZEELAND FACILITY	A
	Visser Dairy Farm - COOPERSVILLE & JENISON	A
	Zeeland Farm Services, Inc	A
SAGINAW	AGRILIANCE	A
	BRIDGEPORT WWTP	CH
	BUENA VISTA WWTP	CH
	Dow Corning Corporation - Healthcare Industries Materials Site	A
	FRANKENMUTH CITY OF WATER TREATMENT & WWTP	CH
	HI-TECH STEEL TREATING, INC.	A
	Nexteer Automotive	A
	SAGINAW CHARTER TOWNSHIP RETENTION BASIN & WWTP	CH
	Saginaw Stoker Drive	CH
	Thomson Aerospace & Defense	A
WATER TREATMENT PLANT, SAGINAW & WWTP	CH	
SANILAC	CROP PRODUCTION SERVICES - BROWN CITY, DECKERVILLE & SANDUSKY	A
	CROSWELL WATER PLANT	CH
	DGP INCORPORATED	S
SHIAWASSEE	Airgas Specialty Products - Owosso	A
	Bandkau Farms	A
	BENJAMIN, BEN FARM	A
	Brant Farms	A
	Crambell Farm	A
	CROP PRODUCTION SERVICES	A

Table 15, continued...

County	Company Name	Type of Exposure
SHIAWASSEE	Demerly Farm	A
	Durling Farms, LLC	A
	HARVEST MILLS	A
	Hull Farms	A
	KONDEL FARMS	A
	Luchenbill Farm	A
	MACHINE TOOL & GEAR, INC.	A
	Norder Farm	A
	Picnik Farms	A
	Spezia Farms	A
	V V Farms	A
	WAUSAUKEE COMPOSITES INC.	S
	Zdunic Farm	A
ST CLAIR	DUNN PAPER, INC.	CH
	LAKE HURON WATER TREATMENT PLANT	CH
	Marysville Ethanol	A
	MARYSVILLE, CITY OF WWTP	CH
	Port Huron	CH
	Z F Marysville LLC	A
ST JOSEPH	Abbott Nutrition - Sturgis	A
	Aquatic Co.	S
	GRAV-I-FLO CORPORATION (MAIN P	F
	Mendon Unit 635	A
	MICHIGAN MILK PRODUCERS ASSOC	A
	STURGIS WASTEWATER TREATMENT PLANT	CH
TUSCOLA	Three Rivers Wastewater Treatment Plant	CH
	Agrium Advanced Technologies (U.S.), Inc.	A
	CARO WASTEWATER TREATMENT PLANT	CH
	CASS CITY WWTP	CH
	COOPERATIVE ELEVATOR CO	A
	DYKHOUSE PICKLE COMPANY	A
VAN BUREN	PRECISION CONCEPTS, INC.	S
	ALLOY STEEL TREATING CO INC	A
	City of South Haven, WWTP	CH
	Decatur	A
	FRUIT BELT CANNING COMPANY INC	A
	Grand Junction Facility	A
HARTFORD WAREHOUSE	A	

Table 15, continued...

County	Company Name	Type of Exposure
VAN BUREN	LAWRENCE FREEZER CORP.	A
	Paw Paw River Produce	A
	Paw-Paw Plant	A
	RYDER PAW PAW LOGISTIC CENTER	A
	SHAFER LAKE FRUIT, INC	A
	SILL FARMS MARKET, INC	A
	ST. JULIAN WINE COMPANY INC	A
	The Coca-Cola Company	A, CH
	WELCH FOODS, INC.	A
WASHTENAW	Ann Arbor	A, CH
	ANN ARBOR ICE CUBE	A
	Arctic Glacier Inc. Ypsilanti	A
	ASTRO CAP MANUFACTURING	S
	CHELSEA MILLING CO	CH
	CROP PRODUCTION SERVICES	A
	DAPCO INDUSTRIES	A
	ELECTRO ARC MFG. COMPANY	A
	PHOTO SYSTEMS, INC./BOTTCHEMER AMERICA INC.	F
	THETFORD CORPORATION - ANN ARBOR & DEXTER	F
WAYNE	A&R Packing Co Inc	A
	ARCTIC COLD STORAGE	A
	ARTED CHROME PLATING INC	CH
	BASF CORPORATION	A, E, S
	Bld Canton	A
	BOTTLING GROUP LLC, PEPSI BOTT	A
	C. F. BURGER CO	A
	Canton - Detroit COC	CH
	CARDINAL HEALTH	F
	CHRYSLER-JEFFERSON NORTH ASSEMBLY PLANT	E, F
	CITY SPORTS CENTER	A
	CLASSIC PLATING	A
	COMPUWARE ARENA	A
	COUNTRY FRESH, LLC - LIVONIA	A
	CREST INDUSTRIES INC	S
	DAIRY FRESH FOODS INC	A
	dba Aldoa Company	E
	DETROIT EDISON COMPANY-TRENTON CHANNEL PWR PLANT	A

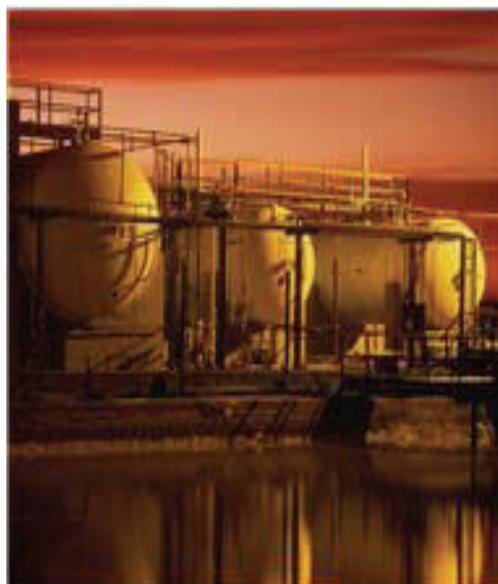
Table 15, continued...

County	Company Name	Type of Exposure
WAYNE	Detroit Production	A
	DETROIT WASTEWATER TREATMENT PLANT	CH
	Diversitak - Detroit & HIGHLAND PARK	E
	DURCON INC.	P
	Dynamic Surface Technologies International LLC	A
	EDDIE EDGAR ARENA	A
	FARMER'S COLD STORAGE, LLC.	A
	Faygo Beverages Inc.	A
	Freezer & Dry Storage LLC	A
	FREEZER SERVICES OF MI LLC	A
	FRITZ PRODUCTS	CH
	Gas Recovery Systems LLC - Arbor Hills	A
	Great Lakes Frozen & Dairy	A
	GUTTER SUPPLIERS	F
	HOME CITY ICE COMPANY - Detroit	A
	Inland Waters Pollution Control, Inc.	S
	Interstate Chemical Company, Inc.	A, F
	JCI JONES CHEMICALS INC.	CH
	LINCOLN DISTRIBUTING	S
	Mastronardi Produce	A
	MCLANE FOOD SERVICE - PLYMOUTH	A
	MICHIGAN DAIRY	A
	MICHIGAN REF DIV-STAFF	A
	NORTHEAST WATER PLANT	CH
	POLYCHEMIE INC	F
	POLYMER CONCRETE CORPORATION	S
	PRAXAIR DISTRIBUTION INC	A
	PVS NOLWOOD CHEMICALS, INC.	F
	PVS TECHNOLOGIES, INC.	CH
	QUAKER CHEMICAL CORPORATION	F
	S & F FOODS	A
	Santemp	A
	SHERWOOD FOOD DIST	A
	SOUTH HURON VALLEY WWTP	CH
	SOUTHWEST WATER PLANT	CH
	SPRINGWELLS WATER TREATMENT PLANT	CH
	SYSCO DETROIT, LLC	A

Table 15, continued...

County	Company Name	Type of Exposure
WAYNE	TANNER INDUSTRIES, INC/HAMMLER	A
	TRENTON, CITY OF WASTEWATER TREATMENT PLANT	CH
	UNISTRUT-WAYNE MANUFACTURING	A
	WATER WORKS PARK PLANT	CH
	WHITE TOWER INDUSTRIAL LAUNDRY	CH
	WOLVERINE PACKING COMPANY DIST PLT & LAMB & VEAL PLANT	A
	WOODWORTH INCORPORATED	A
	WYANDOTTE Power Plant	CH
	Yack Arena	A
	WEXFORD	AAR MOBILITY SYSTEMS
Cadillac		CH
CADILLAC PLANT		S
Cruiser Division		S
HARING TOWNSHIP WATER SUPPLY		CH
Sport Division		S

^aSource: Michigan Department of Environmental Quality (DEQ). Michigan Facilities' Guide to SARA Title III, Emergency Planning and Release Reporting, December 2007, 6th edition. The chemicals listed in this table are subject to reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) section 313, which is triggered by threshold amounts of 25,000 pounds manufactured or processed or 10,000 pounds otherwise used at facilities in Michigan. The companies listed in this table were current as of a report generated by the Michigan DEQ on November 29, 2012.



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. Studies suggest that work exposures are important etiologic agents in a significant percentage (15%) of adults with asthma. This percentage does not include pre-existing asthma that is aggravated by work exposures.⁶ The American Thoracic Society (ATS) released a consensus statement in 2011 that estimated 21.5% of adults with asthma have work-aggravated asthma.⁷ The combined estimates from these consensus statements suggest 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 (Source: Michigan Department of Community Health (MDCH). Michigan Asthma Call Back Survey, 2008-2010). Table 16 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.

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.⁸

On average, 145 new people each year are reported to the Michigan Department of Licensing and Regulatory Affairs (LARA) with confirmed WRA. One hundred reports were confirmed in 2009, the most recent year with complete data. Although the total number of WRA cases has not varied significantly (100-176), the number of individuals with exposure to a known occupational sensitizer (disease category OA) appears to show a downward trend, although there was a slight

increase in 2004 that persisted in 2005 (Table 1). The reason for this trend is unknown and may be related to changes in reporting sources or to the success of workplaces in better controlling their employees' exposures to known sensitizers.

Based on responses from the 2005 BRFSS random sample of Michigan residents, we estimate that up to 62,000 (95% CI 42,000—83,000) Michigan adults have their asthma caused or aggravated by work.¹ Based on the medical literature we would estimate that there are 97,500 Michigan adults with WRA.⁶ Using capture-recapture analysis, we estimate 228—801 adults in Michigan develop WRA each year.⁹

Workers 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 1.5 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.

Another concern is the hiring of temporary workers. As companies trim costs, especially in light of reduced production schedules, more temporary workers are being hired to do work on an as-needed basis. The transient nature of temporary work underscores the potential for under-counting of cases of WRA when employees move from job to job, especially those jobs that have a high potential for exposure to sensitizing agents.

Individuals in the Michigan work force tend to 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 isocyanates (13%), cleaning products (11%) and metal working fluids (10%). Until recently, metal working fluids were the second most frequently reported exposure at work.

The trend of fewer individuals with the known causes of WRA such as diisocyanates, 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 lack of change in cases secondary to office and manufacturing exposures, and the increase in WRA secondary to cleaning agents suggests that exposures in these situations have proven more difficult to control (Figure 3).

We updated the table first presented in the 2002 Work-Related Asthma Annual Report (Table 14) on the number of manufacturing workers in companies that use isocyanates. In some counties, more than 5% of the work force is employed in facilities where isocyanates are used: Allegan (6.0%), Eaton (5.4%), Midland (5.2%) and Luce (5.1%). Health care providers can use this information to heighten their awareness of potential exposures to isocyanates among their patients with asthma.

Table 15 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 persist despite removal from the precipitating work exposures (Table 9). Studies show that the sooner an individual is removed from the exposure after symptoms develop, the more likely the individual’s symptoms will resolve.¹⁰ On the average, among the 2,007 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.¹¹ We do not have cost estimates for Michigan, but given the fact that only 49% of individuals applied for Workers’ Compensation benefits and

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.

TABLE 16

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

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 6-8).

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 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 1,545 fellow workers with symptoms compatible with WRA (Table 13). Five hundred seventy-eight 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 nine individuals of co-workers reporting symptoms on co-worker interviews and those being reported on the MIOSHA Log. Part of the reason for the lack of overlap is that half of the symptomatic individuals indicate they have never seen a doctor for their respiratory symptoms.

Medical monitoring is particularly relevant to reducing the burden of work-related causes of asthma. The longer a person with asthma remains exposed, the more likely their asthma will become a chronic problem.¹⁰

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 about advising their patients to leave their work exposure.

Cessation of exposure is the most important aspect of treatment; patients who are removed from exposure the soonest have the best prognosis.¹⁰ Effective asthma

treatment requires that the health care providers consider a patient's asthma triggers. Many times the health care provider reacts to concerns that their patient raises about workplace exposures, rather than proactively inquiring whether their patient has triggers at work that contribute to their respiratory symptoms. One of the factors related to a 2005 death caused by isocyanate exposure was that the primary care physician waited until the patient requested a medical restriction, rather than instructing the patient at an earlier time that he needed to be removed from any further exposure to isocyanates at work.

The report of a patient with known or suspected WRA is a sentinel health event that is critical to effective occupational disease surveillance. Case reporting from physicians offers the opportunity for the most timely workplace interventions, compared to receiving reports from hospitals. 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 that work causes or aggravates their work-related asthma must be integrated into all asthma initiatives planned on surveillance and education, both for health care providers and the public.

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APPENDIX

2011 PATIENT NARRATIVES BY TYPE OF INDUSTRY & EXPOSURE

Abbreviations:

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

The patient narratives that follow are based on information collected from interviews of patients about their health and work status.

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MANUFACTURING

EXPOSURE TO ISOCYANATES

OA3100. A woman developed work-related asthma in her 50s from exposure to isocyanates, including MDI. She had worked for approximately two years as a laboratory technician at a chemical manufacturing plant before her asthma developed. She developed wheezing, cough, chest tightness and shortness of breath. Her symptoms worsened during her workday and as the work week progressed, and improved on weekends and vacations. She had a positive methacholine challenge and was prescribed Symbicort and Proair. Peak Flow Monitoring showed a positive relationship between work and her symptoms. She continues to work at this job, and still experiences asthma symptoms, which she controls with her asthma medication. She has never smoked cigarettes.

OA3181. A man developed asthma in his 40s from exposure to isocyanates in his job at an auto parts manufacturing facility. He was a maintenance pipefitter and reported working on the robots in the paint booth. He developed a cough, wheezing, shortness of breath and chest tightness that worsened during his workday, improved on weekends and vacations, and worsened as the work week progressed. He was prescribed Prednisone, Albuterol and another inhaler. He continues to work at the facility, and reports having made three trips to the local hospital Emergency Room since his diagnosis. He smoked a pack of cigarettes a day for 30 years in his mid teens to his mid 40s. A pulmonary function test showed moderate obstruction.

AA3053. A woman in her 30s with asthma since her childhood experienced an exacerbation of her asthma from exposure to isocyanates in her job packing auto parts for shipment. Until the asthma flare up, she only occasionally required asthma medications. With the start of a new job at the auto parts manufacturing facility where she worked, she had three trips to the Emergency Department of a local hospital and required a greater amount of medication, including theophylline, and daily steroids. The process where she was exposed to isocyanates was a 2-part bag operation for packing fragile, expensive auto parts. She continues to be assigned to the same job, and reports a worsening of her asthma and

a greater amount of asthma medication use. She smokes half a pack of cigarettes a day, and has done so since her late teenage years.

AA3168. A man in his 30s experienced an exacerbation of his childhood asthma while working at an automotive manufacturing facility. He had worked at the facility for over 10 years when he was assigned to a new job spraying isocyanate-based foam. Doing this job aggravated his asthma and he was reassigned to a different job at the plant so he would no longer be exposed to isocyanates. Since being reassigned, his asthma has improved and he requires less asthma medication. He is a lifelong nonsmoker.

EXPOSURE TO METAL WORKING FLUIDS

AA3134. A woman in her 60s with pre-existing asthma experienced an exacerbation of her symptoms when there was a leak of coolant at the auto parts manufacturer where she had been working for over 30 years. After the leak was repaired, her asthma symptoms improved and she required less asthma medication at work. She had smoked a pack of cigarettes a day for over 20 years from her teens to her 30s. She continues to work at the facility.

OA3189. A woman developed asthma in her 30s, approximately one year after beginning work at an auto manufacturer. She was exposed to coolants. Her wheezing, shortness of breath, chest tightness and cough got worse as the work day progressed and improved on weekends and vacations. She has continued to work at the facility, and over 10 years later reports that her asthma has remained unchanged, although she requires more asthma medication. Her current medication is Singulair, Albuterol and Prednisone. She had formerly smoked cigarettes in her 20s, less than half a pack a day for about six years.

OA3206. A man developed asthma in his 40s after having worked at an automotive manufacturing plant for over 10 years. He was exposed to metal working fluids in his job as a pipefitter at the plant. He developed wheezing and shortness of breath and was prescribed Albuterol. He had briefly smoked cigarettes in his 20s.

EXPOSURE TO FORMALDEHYDE

OA3164. A man developed asthma in his 20s while working for several months as a temporary employee at an auto manufacturing facility. He was exposed to formaldehyde when he hand sanded auto parts. He developed wheezing, a cough, chest tightness and shortness of breath, and was treated and prescribed Albuterol, Prednisone and Flovent. He left that job because of his breathing problems. He was a current half a pack a day cigarette smoker, since his late teens.

OA3173. A woman developed asthma in her 50s after working at an auto manufacturer for almost 10 years. She worked on an assembly line and was exposed to formaldehyde from melted plastic as well as epoxy resin. She continued to work for seven years after her diagnosis, until she had to quit due to her worsening asthma. Ten months after leaving this job, her asthma had improved, although she required more asthma medication. Her medication included Singular, Advair, Albuterol, Proventil, Prednisone and Loratadine. Pulmonary function testing showed moderate obstruction. Her FEV₁ was 53% of predicted. Post test showed severe obstruction with a significant response to a bronchodilator. She was a lifelong non-smoker.

EXPOSURE TO WELDING FUME

POA3150. A man developed asthma in his 30s while working as a welder at a manufacturing facility. He developed a cough and shortness of breath for which he was prescribed Prednisone and Albuterol. His asthma improved when he was away from work, on weekends and vacations. He continues to work at the facility.

EXPOSURE TO FLOUR

AA3227. A woman in her 30s experienced an exacerbation of her pre-existing asthma from exposure to flour dust. She was placed through a temporary employment agency to work at a facility that prepared and packaged flour mixes for industrial and commercial sales. She had an asthma attack within one week of working at the facility. She left that job on her doctor's advice, because of her asthma, and was still not working approximately one year later. She formerly smoked half a pack of cigarettes a day for 20 years from her early teens to early 30s.

EXPOSURE TO PHARMACEUTICAL AGENTS

OA3155. A woman developed asthma in her 20s while working for a pharmaceutical manufacturer. She had

worked for over five years before she was diagnosed with asthma. She was exposed to an antihistamine powder for the first time, which immediately caused her to experience wheezing, chest tightness and shortness of breath. She was treated in an Emergency Room and prescribed Albuterol. Approximately half a year later, staying out of the area where her asthma was triggered, her asthma improved and she required less asthma medication. She formerly smoked a half a pack of cigarettes a day for 10 years from her mid teens to mid 20s.

EXPOSURE TO MISCELLANEOUS CHEMICALS AND DUSTS

POA3130. A woman developed asthma in her 20s while working at an auto parts manufacturer. Her symptoms began after about a year of exposure to wood dust and glues. She was prescribed Advair, Pulmicort and Albuterol. She continued to work in that environment for three more years until she was reassigned to a new job at the company. Since then, her asthma has improved and she requires less asthma medication. She is a lifelong non-smoker.

POA3265. A woman developed asthma in her 30s while working at an automotive parts manufacturing facility. She was exposed to paint fume. She developed wheezing, cough and shortness of breath. She was prescribed Albuterol. She continues to work at the facility. She is a lifelong non-smoker.

AA3094. A woman in her 50s experienced an exacerbation of her pre-existing asthma when she was exposed to a cyanoacrylate-containing glue in her job as an assembler at a small motor manufacturing facility. She had only worked at the company for a couple of weeks before she experienced an asthma attack. She was fired shortly after this asthma attack, and since that time her asthma has improved although she now requires a greater amount of asthma medication. Spirometry after the incident showed moderate severe obstructive ventilator impairment with a significant response to a bronchodilator.

POA3070. A man developed asthma in his 50s after working about five years at an automotive parts manufacturer. He developed wheezing, chest tightness, shortness of breath and a cough that got worse during the shift when he worked, was worse on first days back to work (after weekends or vacations), got better away from work (weekends or vacations) and got progressively worse as the work week progressed. He worked with the above symptoms for a couple years before he was diagnosed with asthma and prescribed an inhaler. Pulmonary function testing showed mild expiratory airflow obstruction. He described his work environment as dusty, especially from shot blasting activities to de-scale metal parts. He continues to work at the facility, seven years after his diagnosis, and reports a worsening of his asthma and that he requires a greater amount of asthma medication to control his symptoms. He formerly smoked almost a pack of cigarettes a day for 40 years, but quit when he was diagnosed with asthma.

POA3259. A man in his 30s developed asthma from exposure to glues within a month of beginning to work at a chemical manufacturing plant. His job was to mix chemicals in reactors. He developed a cough, wheezing, chest tightness and shortness of breath and was treated with Albuterol at a local hospital Emergency Department. He was fired for missing so much work due to his asthma, and since then his asthma has improved and he requires less asthma medication. He has since found other employment at another factory. He is a pack a day cigarette smoker, and has been smoking cigarettes for over 20 years.

POA3131. A woman developed asthma in her 40s after working for over 20 years at a shoe factory. At first, she experienced wheezing and a cough, which then progressed to chest tightness and shortness of breath about five years after her initial symptoms began. At the time her symptoms worsened, she was exposed to a small solvent spill at the factory, which resulted in a trip to the local hospital Emergency Department and prescription for Albuterol and Prednisone. After the spill, she was assigned to a new location at the factory and since that time her asthma has improved and she requires less asthma medication. She is a lifelong nonsmoker.

POA3175. A woman developed asthma in her 20s shortly after beginning to work at an automotive 3rd party parts inspection facility. She described the shop as very dusty. She developed wheezing, cough, shortness of breath and chest tightness, and was prescribed Advair, Flovent, Prednisone and Albuterol. She has not returned to work since her asthma was diagnosed. Since then her asthma has improved and she requires less asthma medication. She formerly smoked a pack of cigarettes a day since her mid teens till her mid 20s, but had quit smoking the year before she started this job.

POA3210. A man developed asthma in his 30s shortly after he began working at a cement products manufacturing facility. He was exposed to Portland cement, and his only symptom initially was wheezing. Two years later, he developed cough, shortness of breath and chest tightness. At that time, he was then prescribed Albuterol, Advair and Spiriva. After

continuing to work in this environment for an additional five years, he quit upon his doctor's advice. Since leaving this job, his asthma had remained the same and he requires the same amount of medication. He formerly smoked a pack of cigarettes a day for 20 years, but had quit the year before he started working in this job.

POA3138. A man developed asthma in his 50s after working at an automotive engine and transmission plant for almost 30 years. At the plant, he described exposure to cement dust, diesel fume, and paint fume. He initially experienced wheezing and shortness of breath, then three years later developed chest tightness during construction activities at the plant involving removal of old flooring in the production area. At that time, he visited a local hospital Emergency Department where he was prescribed Symbicort, Spiriva and Albuterol. He continues to work at the facility. He quit smoking cigarettes after his symptoms worsened during construction activities at the plant; prior to this, he had smoked a pack of cigarettes a day for over 40 years.

POA3052. A man developed asthma in his 20s after working for about one year at a foundry in the Shake Out Department. He developed wheezing, chest tightness and shortness of breath from working in the foundry atmosphere. He continued to work in this environment for 20 years until he quit upon his doctor's advice. Almost 20 years after leaving this work environment, his asthma symptoms have remained unchanged and he still requires Advair and Albuterol. He was a former half a pack a day cigarette smoker for 20 years since his teenage years. He has not worked since leaving the foundry for health reasons.

EDUCATIONAL SERVICES

EXPOSURE TO INDOOR AIR CONTAMINANTS

POA3205. A woman developed asthma in her 40s while working in a basement office at a university. She developed a cough and shortness of breath and was prescribed Advair, Albuterol, Allegra and Nasacort. She described poor ventilation and exposure to cleaning products. She had never smoked cigarettes.

AA3228. A teacher in her 40s experienced an exacerbation of her pre-existing asthma when she was exposed to raw sewage fumes from a sewage pipe that was damaged during construction activities near her classroom. The sewage fumes entered her classroom through an air duct. Since the incident, which wasn't detected till half a year later, she has required a greater amount of asthma medication. She is a lifelong nonsmoker.

EXPOSURE TO CLEANING PRODUCTS

AA3192. A school bus driver in her 50s with pre-existing asthma experienced an exacerbation of her symptoms when she entered a bus where an unknown chemical had been sprayed. She thinks the chemical was a disinfectant. She immediately experienced an asthma attack and was treated at a local hospital Emergency Room. She was given oxygen and prescribed an Advair inhaler. Since that exposure, her asthma worsened and she requires a greater amount of asthma medication, including a nebulizer three times per day, even though she has remained off work for almost one year. She had previously smoked 3 packs of cigarettes a day for over 30 years, from her early teens to her late 40s.

HEALTH CARE SERVICES

EXPOSURE TO CLEANING PRODUCTS

OA3172. A man in the housekeeping department developed asthma in his 20s after working for two years at a hospital. He was used to a cleaning product containing a quaternary amine disinfectant. He developed his asthma when a new cleaning product was introduced, and this product immediately caused him to wheeze and become short of breath. He was treated at his hospital's Emergency Room, with Albuterol. He had one hospitalization and three additional ER visits until the use of the cleaning product was discontinued. His symptoms have remained unchanged and he requires more asthma medication since his diagnosis. He has never smoked cigarettes.

POA3082. A nurse at a hospital developed asthma in her 30s from exposure to floor strippers with a deodorant mixed in. She had worked at the hospital for almost 10 years prior to the development of her wheezing, chest tightness

and shortness of breath. She had a positive methacholine challenge. She was prescribed Prednisone, Advair and Albuterol. She avoids areas where floors are being stripped, and since then her asthma has improved and she has been able to discontinue her asthma medication. She is a lifelong non-smoker.

OA3145. A woman developed asthma in her 50s after working at a hospital for over 10 years. She was exposed to disinfectant wipes used to sterilize surgical instruments and operating rooms. The main sensitizer in the disinfectant wipes was a quaternary amine—dimethyl benzyl ammonium chloride. She developed a cough, chest tightness and shortness of breath but continued to work in that environment and same job for ten more years. Ten years after her initial diagnosis, she developed wheezing. She was prescribed Prednisone, Advair, Albuterol and Singulair. She was then taken off work, but had a worsening of her asthma symptoms and required more asthma medication. Pulmonary function testing showed a mixed mild restrictive/obstructive defect. She is a lifelong non-smoker.

OA3083. A woman developed asthma in her 30s after working at a hospital as an endoscopy technician for one year. She experienced wheezing, chest tightness, shortness of breath and a cough from exposure to OPA (ortho-phalaldehyde) and formaldehyde, both used to clean the endoscopes. She was prescribed Advair, Prednisone and Albuterol. She was put on medical disability leave, and two months after being out of the exposures at the hospital, her asthma had improved, although she still required asthma medication. She is a lifelong non-smoker.

POA3133. A woman developed asthma in her 60s after working as a housekeeper at a hospital for five years. She was exposed to floor cleaners/stripper and floor wax. She developed wheezing, cough and shortness of breath and was prescribed an inhaler, which she uses 3-4 times per week. She continues to work at the hospital in the same job, and her asthma has remained unchanged. She formerly smoked a half a pack of cigarettes a day for 20 years from her mid-teens to her mid 30s.

POA3183. A woman developed asthma in her 50s after having worked almost 20 years at a hospital as a surgical instrument technician. Her job was to disinfect the surgical instruments. She developed wheezing, cough, chest tightness and shortness of breath. She was assigned to a different job since her symptoms began, her asthma has improved and she does not require medication. She is a lifelong non-smoker.

AA3092. A woman in her 50s with pre-existing asthma experienced an asthma attack from exposure to a disinfectant spray after having worked for a month at a nursing home as a housekeeper. After her asthma attack, the nursing home switched to a different disinfectant. She continues to work at the home, her asthma remains the same, and her asthma medication use is unchanged. She is a lifelong non-smoker.

POA3219. A man developed asthma in his 40s while working in the housekeeping department at a hospital. He was exposed to cleaning agents, and developed wheezing, cough and shortness of breath. He was prescribed Albuterol and Advair. He continues to work at the hospital. In the past year he has been treated three times at the hospital Emergency Department for asthma attacks. He has smoked half a pack of cigarettes a day for over 20 years.

OA3163. A woman developed asthma in her 50s from exposure to disinfectants used to sterilize equipment in the Endoscopy Department at the hospital where she worked. Her asthma worsened when the hospital changed procedures so that the Endoscopy Technicians were required to sterilize the endoscopy scopes. Previously the hospital had hired dedicated staff to clean the endoscopes. She ended up leaving this job because of her asthma, although since that time her asthma has worsened and she requires a greater amount of asthma medication. She has not been able to find new employment since leaving the hospital. She had formerly smoked a pack of cigarettes a day for over 20 years, but quit about 10 years before her asthma developed.

EXPOSURE TO PHARMACEUTICAL AGENTS

OA3260. A nurse developed asthma in her 20s after working in a nursing home for 10 years. She was exposed on a daily basis to psyllium dust from mixing up the laxative for the nursing home residents. She developed wheezing, a cough, and shortness of breath and visited a local hospital Emergency Room where she was treated and prescribed Albuterol. A year later, her asthma remained the same although she required more asthma medication. She is a lifelong non-smoker.

EXPOSURE TO INDOOR AIR CONTAMINANTS

AA3196. A nurse experienced an exacerbation of her pre-existing asthma when the air conditioning at the hospital

was not functioning for several days. She suffered an asthma attack, but since the air conditioning was repaired she has not had any asthma attacks at work. She is a lifelong non-smoker.

AA3177. A nurse in her 40s experienced an exacerbation of her pre-existing asthma while working at a hospital. She described exposure to dust from construction activities as well as floor strippers. She continues to work at the hospital. Her asthma flare ups have worsened, and she requires a greater amount of asthma medication. She is a lifelong non-smoker.

RETAIL SERVICES

EXPOSURE TO CLEANING PRODUCTS

AA3119. A woman in her 50s with pre-existing asthma experienced an exacerbation of her asthma at her job at a retail grocery store. She was a cashier, and was exposed to floor wax strippers and floor wax. These products aggravated a cough, chest tightness and shortness of breath. She obtained a new prescription for an inhaler. She was fired for too many absences and since that time her asthma has improved and she no longer requires her inhaler. She is a lifelong non-smoker.

EXPOSURE TO FORMALDEHYDE

OA3043. A woman developed asthma in her 40s while working at a pet shop. She was exposed to formaldehyde that was an ingredient in a fungicide used to treat the water in the fish tanks. She had worked at the shop almost 10 years before her asthma developed. She developed wheezing, cough, chest tightness and shortness of breath and was prescribed Advair, Proair and Flovent. She stopped working at the pet shop and since that time her asthma has improved and her physician took her off her asthma medication. She has been unable to find new employment six months after she left her job. She formerly smoked over a half a pack of cigarettes a day for almost 25 years, but quit when her asthma developed.

OFFICE

EXPOSURE TO INDOOR AIR CONTAMINANTS

POA3214. A woman developed asthma in her 30s after working in an office setting for seven months. She developed a cough, wheezing, shortness of breath and chest tightness and was treated at a local hospital Emergency Department and prescribed Prednisone, Albuterol and Promethazine. She described the office environment as a very old building that was moldy and dusty. She left this job less than a year after beginning to work at the office and since then her symptoms have improved and she was able to discontinue taking her asthma medication. She had never smoked cigarettes.

POA3132. A woman developed asthma in her 30s shortly after starting a new job in an office setting. She described the work environment as having visible reddish mold throughout the bathroom area. She experienced chest tightness and shortness of breath and was prescribed Singulair, Pulmicort and Albuterol. She required one visit to a local hospital Emergency Department. She quit her job and since that time her asthma has improved and she requires less asthma medication. She is a lifelong non-smoker.

FARM

EXPOSURE TO CLEANING PRODUCTS

OA3249. A man developed asthma in his 40s while working at a poultry farm. He was exposed to chlorine that was used to clean the poultry knives in a room with poor ventilation. He developed a cough, was treated in a local Emergency Department, and was prescribed Albuterol. He continues to work at the poultry farm. He does not smoke cigarettes.

MISCELLANEOUS SERVICES & INDUSTRIES

EXPOSURE TO ANIMAL DANDER

OA3174. A woman developed asthma in her 20s shortly after beginning employment at a museum with live animals. She was exposed to animal dander in the farm setting where she worked as a historical presenter. She developed wheezing, cough, chest tightness and shortness of breath, which worsened as the work week progressed and improved on days off. She was prescribed Singulair and Albuterol. She continues to work at the museum. She has experienced a worsening of her asthma in the three years since she developed asthma, and requires a greater amount of asthma medication. She is a lifelong nonsmoker.

EXPOSURE TO SMOKE FROM FIRE

RADS3156. A firefighter in his 40s developed RADS while fighting a fire. He had been a firefighter for over 10 years when he was acutely exposed to smoke from a house fire when the seal of his mask broke. He immediately experienced wheezing, chest tightness and shortness of breath and was prescribed a steroid inhaler. Since that incident, exhaust from the fire trucks and the smell of smoke on his gear trigger his asthma, although overall his asthma has improved. He formerly smoked half a pack of cigarettes a day for about 15 years from his late teens till his mid 30s.

EXPOSURE TO PESTICIDES

AA3238. A woman in her 20s with pre-existing asthma was exposed to pesticides in her job as a housekeeper for a hotel. She was cleaning rooms in an area being fumigated with an unknown pesticide to control insects. The pesticide applicator wore a protective mask. She left the area as soon as she saw the cloud of fumes, but experienced a severe exacerbation of her asthma that required a visit to the local hospital Emergency Room.

POA3101. A woman developed asthma in her 40s while working as a housekeeper at an apartment complex. One of the apartments recently vacated was infested with bed bugs. She developed wheezing, cough, chest tightness and shortness of breath from exposure to a commercial pesticide other employees had sprayed in the affected apartment to kill the bugs. She was prescribed ProAir. After this incident, the apartment building owners switched to a different pesticide. The housekeeper continues to work for the apartments, with an improvement in her asthma since cessation of exposure. She has never smoked cigarettes.

POA3208. A woman who had been a lifeguard off and on for six years developed asthma in her 20s from exposure to chloramines at the indoor water park where she worked. She developed a cough and shortness of breath after a period of days when the ventilation was not functioning properly. She was treated at a hospital Emergency Department and prescribed Albuterol and a steroid inhaler. She left that employment and since then she requires less asthma medication and her symptoms have improved.

EXPOSURE TO PAINT FUME

POA3140. A woman developed asthma in her 40s after working for 10 years in auto sales. She was exposed to paint and markers used on the vehicles as they were reconditioned. She developed wheezing and shortness of breath and was prescribed Alvesco and Singulair. Her asthma improved on weekends and vacations. Her symptoms got worse during each shift that she worked, and as the work week progressed. She went on medical leave approximately a year after her asthma diagnosis, and since that time her asthma symptoms and medication use has remained the same. She had a positive methacholine challenge test. She was an ex-cigarette smoker, having smoked half a pack a day for approximately 10 years from her late 20s to early 40s.

OA3165. A man developed asthma in his 40s from exposure to isocyanates in paint. He was an auto body painter for over 10 years before he experienced wheezing, chest tightness, shortness of breath and cough. He was prescribed Flovent and Ventolin. He did wear a cartridge respirator when painting. His asthma improved and he required less asthma medication one month after being placed on medical leave. He is a lifelong non-smoker.

EXPOSURE TO CLEANING PRODUCTS

POA3171. A woman developed asthma in her 50s while working at a youth camp. Within a few months of being

exposed to cleaning agents at the facility, she developed wheezing, chest tightness, shortness of breath and a cough. The cleaning agents contained hydrochloric acid and alcohol ethoxylate. She was treated at a local hospital Emergency Room and prescribed Prednisone, ProAir and Atrovent. She had a total of three ER visits and was hospitalized once because of her severe asthma symptoms. She left this employment shortly after her diagnosis, and several months later reported a worsening of her asthma. Pulmonary function testing showed moderate severe obstructive air flow limitation. FEV₁ was 36% of predicted. She had been smoking half a pack of cigarettes a day for over 30 years.

AA3153. A man with pre-existing asthma experienced an exacerbation of his symptoms in his 50s at the water treatment plant he had worked at for approximately five years. He was exposed to a chlorine spill, which sent him to the hospital Emergency Room and he was hospitalized for an asthma attack. After the spill, he remained off work because of his worsening asthma. He formerly smoked a half a pack of cigarettes a day for 30 years, but quit in his early 50s.

POA3201. A woman developed asthma in her 50s while working as a housekeeper at a hotel. She had worked at the hotel for five years before she developed wheezing, shortness of breath, chest tightness and cough from exposure to hydrochloric acid in a new cleaning agent used on tile. She was prescribed ProAir and Prednisone. After her asthma developed, the hotel discontinued use of the cleaner. She formerly smoked a couple cigarettes a day for 40 years, but quit when her asthma was diagnosed.

POA3224. A woman developed asthma in her 20s while working for a janitorial service company. Her primary job was cleaning bathrooms. She developed wheezing, shortness of breath and chest tightness shortly after starting this job. She was prescribed Albuterol and steroids. She was exposed to cleaning solutions, and sometimes to these solutions being mixed together. Upon her physician's advice, she left this job, and was hired at a new company as a production worker. She continues to experience asthma symptoms since leaving the janitorial service job six months earlier. She never smoked cigarettes.

AA3137. A woman in her 20s with preexisting asthma experienced an exacerbation of her childhood asthma while working as a housekeeper in an office building. She had a flare up of her asthma while using a ceiling tile cleaner, within 24 hours of using the cleaner. She continues to work at the building, although her physician has urged her to quit this job. She is a lifelong nonsmoker.

EXPOSURE TO MISCELLANEOUS CHEMICALS AND DUSTS

POA3184. A man developed asthma in his 40s after working as a maintenance man at a wastewater treatment plant for six years. He was exposed to chemicals used to treat the waste water, which he reported dripped from the pipes in the various buildings. He developed wheezing, cough, shortness of breath and chest tightness and was prescribed Albuterol, Advair and Prednisone. He continues to work at this plant. He smoked a half a pack of cigarettes a day for over 30 years, but quit when he was diagnosed with asthma.

JUSTICE, PUBLIC ORDER, & SAFETY

EXPOSURE TO CLEANING PRODUCTS

POA3223. A woman developed asthma in her 40s after having worked for five years at a prison complex. She was exposed to cleaning products. She developed wheezing, chest tightness and shortness of breath and was prescribed Albuterol and Singulair. She continues to work at the prison, and her asthma has worsened. She is a lifelong nonsmoker.

CONSTRUCTION

RADS3075. An iron worker in his 30s developed Reactive Airways Dysfunction Syndrome while torching painted metal beams. Within two days of performing this activity, he developed wheezing, cough and shortness of breath. He was treated at a local Emergency Room and prescribed Prednisone, Advair and Albuterol. Almost six months after this incident, he continues to have asthma symptoms, but does not take asthma medication because he cannot afford to pay for it. He is an ex-cigarette smoker, having smoked half a pack a day from his teens to his 30s.

POA3226. A man in his 30s developed asthma while working as an electrical contractor. He was installing cameras and a security system at a job site that was particularly dusty. He developed wheezing and a cough and was prescribed Albuterol. His symptoms improved once the job was completed, although he still requires asthma medication. He is a life-long nonsmoker.

TRANSPORTATION

RADS3154. A truck driver in his 50s developed RADS after an electrical fire in his semi-truck. He immediately experienced a cough, chest tightness, shortness of breath and wheezing. He had been a truck driver for over 10 years before this incident. After the fire, he was prescribed Albuterol, Symbicort and Xopenex. His asthma symptoms improved, although since this incident, other exposures cause his asthma to flare up, especially diesel fume and exhaust. He is a lifelong non-smoker.