JANUARY 9TH 2012

2010
ANNUAL REPORT

TRACKING WORK-RELATED ASTHMA IN MICHIGAN

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Work-Related Asthma Surveillance Program

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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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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**.

Acronyms

OA Occupational Asthma

AA Work-Aggravated Asthma

POA Possible Occupational Asthma

RADS Reactive Airways Dysfunction Syndrome

MDLARA MI Department of Licensing & Regulatory Affairs

MIOSHA MI Occupational Safety & Health Administration

NAICS North American Industrial Classification System

NIOSH National Institute for Occupational Safety & Health

PEL Permissible Exposure Limit

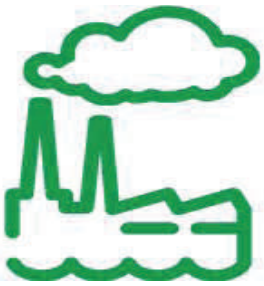
REL Recommended Exposure Limit

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

Summary

This is the 20th annual report on work-related asthma (WRA) in Michigan.

In 2010, in a publication in the Journal of Asthma, researchers found that in a random sample of Michigan adults 54.1% self-reported that their asthma was caused or aggravated by their work, and yet only 25% reported having a discussion with their health care provider about their concern about the effect of work on their asthma[1]. These same individuals were more symptomatic and had more health care usage than other Michigan adults with asthma. This study highlights the importance of health care providers 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, 147 new cases of WRA are reported to MDLARA each year.
- From 1988-2010, 3,025 WRA cases have been identified through the MI tracking system.
- We estimate there are 65,000-97,000 adults in MI with WRA.
- 85% of the MI WRA patients have new-onset asthma; 15% have pre-existing asthma aggravated by an exposure at work.
- MIOSHA enforcement inspections at the workplaces reveal that, on average, one out of every six 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 2.1 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 (MDLARA) 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 of these index patients.

Work-Related Asthma Tracking Procedures...

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

SOURCES TO IDENTIFY PATIENTS

- **Health Care Providers** Private practice, working for industry
- **Hospitals** ICD-9 506.0-.9 & 493, workers' compensation payer
- **Workers' Compensation Agency**
- **Poison Control Centers**
- **Reports from Co-Workers or MIOSHA Field Staff** confirmed by a health care provider
- **Death Certificates**

WRA Tracking Procedures in Michigan

IDENTIFY PATIENTS

- **Review OD Reports**
  -Submitted to MDLARA
- **Known or Suspected**
  -Work-Related Asthma
- **Letter to Patient**

INTERVIEW PATIENTS

- **Telephone Interview**
  -Medical and work history
- **Obtain Medical Records**
  -Breathing test results
- **Physician Review**

WORKPLACE INSPECTION

- **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

FOLLOW UP ACTIVITIES

- **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 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

85% of WRA in Michigan is new onset; 15% is pre-existing asthma aggravated by exposure to an allergen or trigger at work.

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

REPORTS

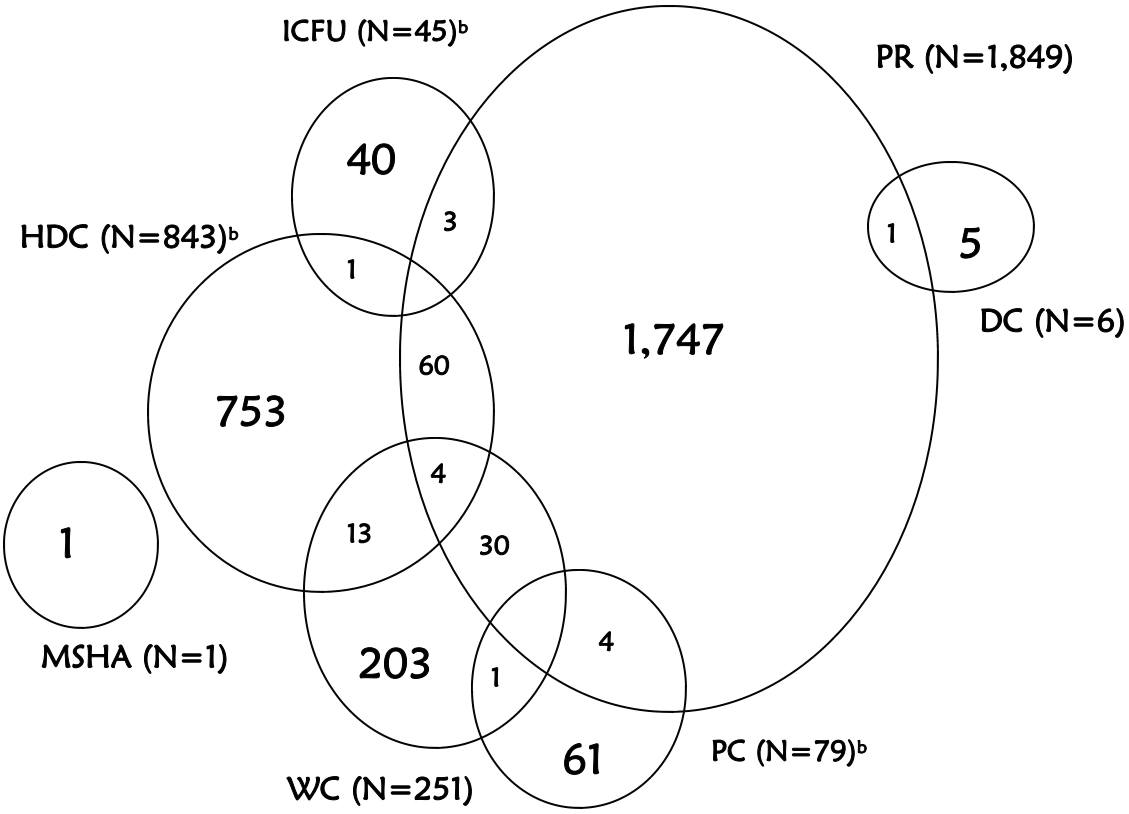
Table 1 shows that 3,025 people were confirmed with WRA between 1988—2010. The reports are divided into: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA) and Reactive Airways Dysfunction Syndrome (RADS). One hundred five additional patients have been confirmed since last year's report. Figure 1 shows the overlap of the patients by reporting sources, for 1988—2009.

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

	Disease Status				
YEAR	OA	POA	AA	RADS	TOTAL
1988	23	7	0	1	31
1989	43	12	3	5	63
1990	87	35	14	8	144
1991	55	30	14	16	115
1992	82	36	14	18	150
1993	75	69	13	19	176
1994	65	59	15	13	152
1995	57	34	19	17	127
1996	61	59	24	11	155
1997	53	74	19	16	162
1998	46	74	18	9	147
1999	48	65	16	12	141
2000	49	67	31	17	164
2001	50	51	20	19	140
2002	39	59	24	21	143
2003	29	64	28	23	144
2004	38	62	37	30	167
2005	42	67	21	23	153
2006	34	61	29	14	138
2007	19	42	34	28	123
2008	15	53	24	16	108[a]
2009	19	41	29	8	97[a]
2010	13	38	21	13	85[a]
Total	1,042	1,159	467	357	3,025

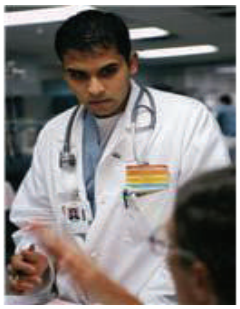
[a]Reports are still being processed for calendar years 2008, 2009 and 2010; an increase in these totals will be reflected in next year's annual report.

FIGURE 1
Overlap of Reporting Sources for 2,940 Confirmed Work-Related Asthma Patients: 1988-2009[a]



[a] Ns represent the total number for that source.
Reporting Source: HDC=Hospital Discharge; PR=Physician Referral; DC=Death Certificate; WC=Workers' Compensation; ICFU=Index Case Follow-Up; MSHA=Mine Safety & Health Administration; PC=Poison Control Center.

[b] There was an overlap of PC-HDC for 12 individuals and of PC-ICFU for one individual.



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.

Demographics

GENDER

- Women 1,613, 53%
- Men 1,412, 47%

YEAR OF BIRTH

- Range 1905—1992
- Average 1957

RACE

- Caucasian 2,271, 77%
- African American 552, 19%
- Hispanic 59, 2%
- Alaskan/American Ind. 24, 1%
- Asian 13, <1%
- Other 33, 1%
- Unknown 73

ANNUAL INCIDENCE RATE

- African American 5.2
- Caucasian 2.5

The annual incidence rate for African Americans is 2.1X greater than that of Caucasians.

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 (11.8 cases per 100,000), Osceola (7.3 cases per 100,000), Cheboygan (6.5 cases per 100,000), Genesee and Montmorency (each with 6.3 cases per 100,000) and Branch and Sanilac (each with 6.2 cases per 100,000).

TABLE 2
Average Annual Incidence Rates of Work-Related Asthma Among Michigan Workers by County of Exposure: 1989-2008

County	# EE's[a]	Avg Annual Inc Rate[b]	Cases 1989-2008	County	# EE's[a]	Avg Annual Inc Rate[b]	Cases 1989-2008
Alcona- Iosco	11,850	2.1	5	Isabella	28,625	2.8	16
Alger	3,375	1.5	1				
Alpena	14,400	2.8	8	Jackson	62,700	3.3	42
Antrim	5,975	1.7	2	Kalamazoo-Calhoun-Van Buren	212,700	1.9	80
Arenac	4,950	4.0	4	Kent-Ottawa-Muskegon-Allegan	583,700	1.3	157
Baraga	3,950	3.8	3	Lake	1,950	5.1	2
Barry	13,150	1.5	4	Luce	2,550	11.8	6
Berrien	72,100	1.9	27	Mackinac	5,600	0.9	1
Branch	15,375	6.2	19	Manistee	8,350	1.2	2
Cass	11,150	1.8	4	Marquette	28,450	3.2	18
Charlevoix	11,600	2.2	5	Mason	11,400	1.3	3
Cheboygan	8,475	6.5	11	Mecosta	13,500	1.1	3
Chippewa	15,775	1.3	4	Menominee	9,775	0.5	1
Clare	7,975	11.9	19	Montcalm	20,475	3.4	14
Clinton-Eaton-Ingham	234,600	2.5	116	Montmorency	2,400	6.3	3
Crawford	4,750	5.3	5	Newaygo	10,975	4.1	9
Delta	16,100	1.9	6	Oceana	7,450	2.0	3
Dickinson	14,825	3.4	10	Ogemaw	6,625	4.5	6
Emmet	16,950	1.5	5	Osceola	8,200	7.3	12
Genesee	175,000	6.3	219	Otsego	11,650	3.9	9
Gladwin	5,225	1.9	2	Roscommon	6,700	5.2	7
Gogebic	6,675	1.5	2	Sanilac	13,650	6.2	17
Grand Traverse-Benzie-Kalkaska-Leelanau	63,700	2.2	28	Schoolcraft	2,950	1.7	1
				Shiawassee	20,450	1.5	6
Gratiot	15,000	3.7	11	St. Joseph	25,725	1.6	8
Hillsdale	16,575	3.0	10	Tuscola	15,150	5.9	18
Houghton-Keweenaw	15,975	2.5	8	Washtenaw-Lenawee-Livingston	277,500	3.7	206
Huron	14,750	5.1	15	Wexford-Missaukee	18,800	1.6	6
Ionia	16,575	3.0	10	Saginaw-Bay-Midland	181,500	3.8	139
Iron	4,225	3.6	3	Detroit, MSA[c]	2,151,000	3.2	1,384
				All Michigan Counties[d]	**4,566,000**	**3.0**	**2,745**

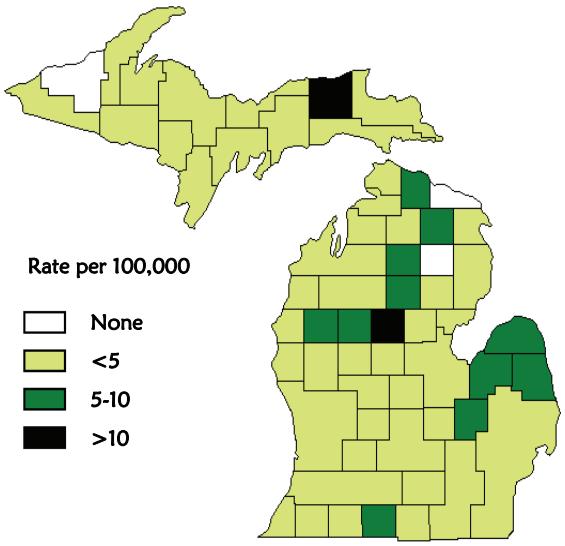
[a] Source: MDCD/Employment Service Agency 1999 Annual Average Labor Statistics for Employment by Place of Work. Some employee population data is only at a multi-county level, as indicated (i.e., not available at a single county level). Therefore, some data is presented with grouped counties.

[b] Rates are based on the average number of cases per year from 1989-2008, per 100,000 Michigan workers.

[c] MSA=Metropolitan Statistical Area and includes Lapeer (27 cases), Macomb (248 cases), Monroe (25 cases), Oakland (363 cases), St. Clair (49 cases) and Wayne (672 cases) counties.

[d] Forty-five cases had an out-of-state exposure and 22 had an unknown county of exposure, for the 1989-2008 reporting period.

FIGURE 2
Average Annual Incidence Rate of WRA by County of Exposure: 1989-2008



Type of Industry

Table 3 shows the Michigan industries by NAICS codes, where the exposures to occupational allergens occurred from 1988 to 2010. 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 10.5 cases per 100,000 in manufacturing. Industries with the next highest annual average incidence rates were: mining with 5.9 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: 1988-2010

2002 North American Industry Classification System		WRA Cases 1988-2010		Number of Employees[a]	Ann. Average Incidence Rate[b]	
		#	%		Rate	# Cases
11	Agriculture, Forestry, Fishing, & Hunting	18	0.6	81,664	1.0	16
21	Mining	12	0.4	9,300	5.9	11
22	Utilities	11	0.4	861,200	0.1	10
23	Construction	76	2.5	206,100	1.7	72
31-33	Manufacturing	1,814	60.0	823,100	10.5	1,736
42	Wholesale Trade	36	1.2	180,400	1.0	35
44-45	Retail Trade	82	2.7	548,800	0.6	68
48-49	Transportation & Warehousing	57	1.9	132,000	2.0	52
51	Information	18	0.6	76,000	1.1	17
52	Finance & Insurance	22	0.7	154,800	0.7	21
53	Real Estate & Rental & Leasing	15	0.5	55,500	1.2	13
54	Professional, Scientific & Technical Services	26	0.9	268,000	0.5	25
55	Management of Companies & Enterprises	1	<0.1	69,100	0.1	1
56	Administrative & Support & Waste Management	52	1.7	267,000	0.8	41
61	Educational Services	136	4.5	423,300	1.4	120
62	Health Care & Social Assistance	357	11.8	482,700	3.3	315
71	Arts, Entertainment & Recreation	19	0.6	61,500	1.4	17
72	Accommodation & Food Services	83	2.7	332,700	1.2	78
81	Other Services (except Public Administration)	65	2.1	176,900	1.6	58
92	Public Administration	113	3.7	685,000	0.7	94
00	Unknown	12	0.4	--	--	12
Total		3,025		4,645,864	3.0	2,812

[a]Source: 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.
[b]Rates are based on average number of cases from 1989-2008 per 100,000 adult workers in each industrial category.

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

TABLE 4
1,736 Work-Related Asthma Cases from Manufacturing Industries: 1989-2008

	2002 North American Industry Classification System	WRA Cases #	Ann Avg Rate[a]	# Employees[b]
311	Food Mfg	50	7.1	35,300
323	Printing & Related Support Activities	18	4.1	21,900
325	Chemical Mfg	91	13.2	34,600
326	Plastics & Rubber Products Mfg	94	10.3	45,800
327	Nonmetallic Mineral Product Mfg	15	4.1	18,500
331	Primary Metal Mfg	61	9.7	31,400
332	Fabricated Metal Product Mfg	94	5.3	89,000
333	Machinery Mfg	132	7.4	89,600
334	Computer & Electronic Product Mfg	12	2.5	23,700
336	Transportation Equipment Mfg	1,048	16.5	317,000
337	Furniture & Related Product Mfg	12	1.6	36,900
	Miscellaneous Mfg (*includes NAICS: 312-16,321-322,324,335,339)	109	6.9	79,400

[a]Average annual incidence rate, total number of cases for 1989-2008 (the years with complete case reporting results). Rates are based on average number of cases from 1989-2008 per 100,000 adult workers in each industrial category.
[b]Source: MDLEG Bureau of Labor Market Information & Strategic Initiatives: Michigan Current Employment Statistics 2001.

Type of Exposure

Table 5 shows the exposures associated with WRA among Michigan workers. The most frequent exposure reflects the heavy auto manufacturing industry base of the State. Most frequently identified exposures include: isocyanates (MDI, TDI, HDI and others) accounting for 383 (12.7%) of the WRA case exposures and cleaning products, associated with 336 (11.1%) of Michigan's WRA patients. Metal working fluids (coolants) accounted for 306 (10.1%) of Michigan worker exposures.

There is ongoing interest in ingredients in cleaning products that can cause new-onset asthma and aggravate existing asthma. These products, used both in the home and in all industry sectors (services, manufacturing, etc.) can contain disinfectants, often in the form of quaternary amines, which have been repeatedly shown to cause asthma among workers who use them.

Welding is the 5th 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 recent publication highlights the morbidity and high health care costs from asthma associated with welding[3].

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: 1988-2010

Exposure Agent	#	%
Isocyanates	383	12.7
Cleaning Solutions	336	11.1
Metal Working Fluids	306	10.1
Unknown (Mfg.)	226	7.5
Unknown (Office)	189	6.2
Exhaust/Smoke/Fumes	157	5.2
Welding Fume-Stainless & Other	136	4.5
Solvents	108	3.6
Paint Fumes	72	2.4
Epoxy	65	2.1
Formaldehyde	62	2.0
Fungus	61	2.0
Latex/Rubber	59	2.0
Acids	56	1.9
Plastic Fumes	42	1.4
Chlorine	41	1.4
Acrylates	38	1.3
Fire	37	1.2
Chemicals Used in Construction	32	1.1
Cobalt	30	1.0
Wood Dust	25	0.8
Ammonia	23	0.8
Animal Dander	23	0.8
Flour	23	0.8
Styrene	23	0.8
Fragrances	22	0.7
Cigarette Smoke	20	0.7
Fiberglass	17	0.6
Herbicide/Pesticide	17	0.6
Glutaraldehyde	16	0.5
Chromium	14	0.5
Caustics	13	0.4
Amines	12	0.4
Grain Dust	12	0.4
Printing Inks	12	0.4
Cement Dust	11	0.4
Cosmetology Chemicals	11	0.4
Rust Inhibitor	11	0.4
Anhydrides	10	0.3
Plants/Organic Matter	9	0.3
Asphalt	8	0.3
Insecticides	8	0.3
Meat Wrapper's Asthma	7	0.2
Other[a]	242	8.0
Total	**3,025**	**100.5**

[a]There were 6 cases each w/exposure to: Azodicarbonamide, Fire Extinguisher Powder, Heat, Nitrogen, Paper Dust, Pickling Ingredients.

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

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

There were 3 cases each w/exposure to: Cadmium Solder, Coal Dust, Colophony, Copier Toner, 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, Dimethyl Benzyl Ammonium Chloride, 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, 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, Soot, Stress, Swimming Pool Shock, Talcum Powder, Tuberculosis Vaccine, White Lithium, World Trade Center Exposure, Zinc Borate.

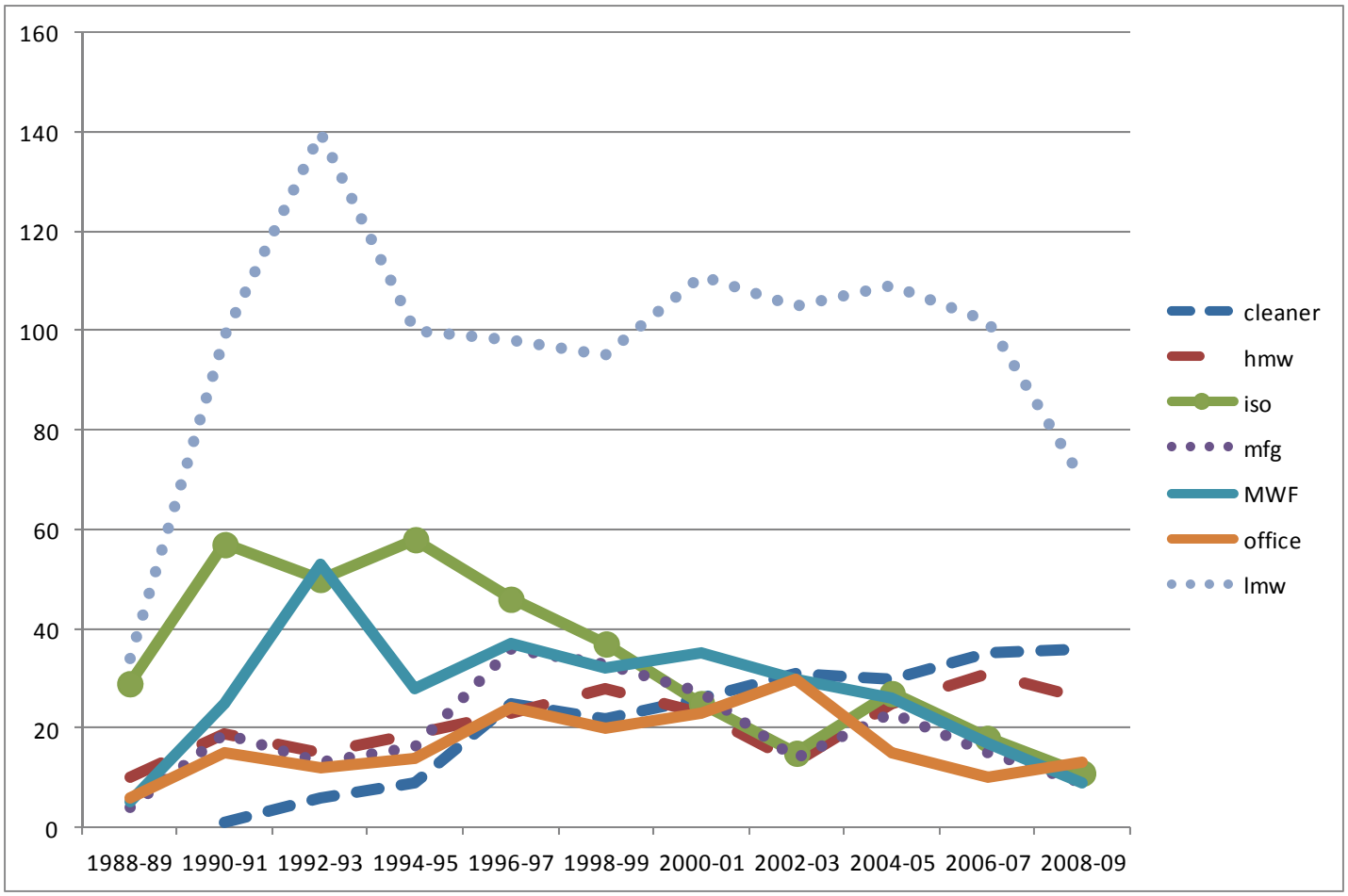
Type of Exposure, continued...

EXPOSURE TRENDS

Figure 3 shows the number of individuals with work-related asthma by type of exposure from 1988-2009. 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 high molecular weight agents appears to be trending downward. Office and low molecular weight agents appears unchanged and cleaning agents appears 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: 1988-2009



*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 decreased over time, from a high of 28.4% in 1998, to a low of 20.5% in 2010.

SMOKING STATUS

Table 6 shows patients' cigarette smoking status. Twenty percent of patients were smoking when their asthma developed. This is similar to the state average (20.5%) 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 (data not shown).

Fourteen percent of the asthma patients had a personal history of allergies and asthma (Table 7). Forty-nine percent had no history of allergies or asthma.

HEATH CARE USAGE

Sixty-five 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 ER visits was 5.8 and the average number of hospitalizations was 3.8.

TABLE 6
Cigarette Smoking Status of 2,936[a] Confirmed WRA Patients: 1988-2010

	Smoking Status						
	Current		Ex-Smoker		Non-Smoker		TOTAL
	#	%	#	%	#	%	
OA	215	21.0	400	39.1	408	39.9	1,023
POA	174	15.4	471	41.6	487	43.0	1,132
AA	97	22.1	122	27.8	220	50.1	439
RADS	96	28.1	129	37.7	117	34.2	342
All	582	19.8	1,122	38.2	1,232	42.0	2,936

[a]Missing data on 89 patients.

TABLE 7
Personal History of Allergies or Asthma Among 2,768[a] Confirmed WRA Patients: 1988-2010

	Personal History of...							
	Allergies & Asthma		Asthma Only		Allergies Only		No Allergies or Asthma	
	#	%	#	%	#	%	#	%
OA	53	5.5	45	4.7	280	29.0	586	60.8
POA	74	7.0	49	4.6	367	34.6	571	53.8
AA	247	55.0	176	39.2	10	2.2	16	3.6
RADS	17	5.8	34	11.6	73	24.8	170	57.8
All	391		304		730		1,343	

*Missing data on 257 patients.

TABLE 8
Health Care Usage Among Confirmed WRA Patients: 1988-2010

Lifetime History of Health Care Usage			
ER Visit[a]		Hospitalized[b]	
Yes	No	Yes	No
# (%)	# (%)	# (%)	# (%)
1,822 (65)	966 (35)	950 (36)	1,711 (64)
Range		Range	
1-300 visits		1-200 hospitalizations	
AVG 5.8 ±15.5		AVG 3.8±10.4	

[a]Missing data on 237 patients.
[b]Missing data on 364 patients.

SYMPTOMS

Two thousand four hundred seventy-five 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

Few of the WRA patients had objective pulmonary function testing performed.

- 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%
- Pending approval 48%
- Received benefits 36%
- Denied benefits 17%

TABLE 9
Persistence of Symptoms and Medication Use in 2,774 Confirmed WRA Patients: 1988-2010

Still Exposed?	Total	Breathing Problems Still Present? Yes #	Yes %	Less #	Less %	Still Taking Asthma Medications? Yes #	Yes %	Less #	Less %
Yes	817	785	96.1	249	30.5	703	86.0	153	18.7
No	1,957	1,690	86.4	951	48.6	1,553	79.4	559	28.6
Total	2,774[a]	2,475		1,200		2,256		712	

[a]Information missing on 251 individuals.

INDUSTRIAL HYGIENE

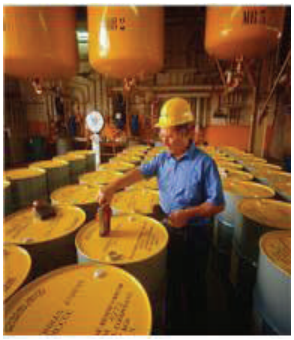
A total of 747 workplace inspections have been conducted since 1988 (Table 10); 109 of those facilities had been inspected more than once. Fourteen inspections have been completed since last year's report.

Air sampling for allergens was conducted during 534 inspections (Table 11); 24 (4.5%) of the 534 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: 1988-2010

Inspection Status	# Patients Represented	Companies #	Companies %
Inspected	1,181	747[a]	34.4
No Follow-up Planned	1,633	1,232	56.7
Scheduled for Inspection	13	12	0.6
Out of Business	70	62	2.9
No Longer Use Occupational Allergen	26	25[b]	1.1
Sent Company Letter to Check Exposures[d]	102	96	4.4
Total	3,025	2,174[c]	100.1

[a]747 inspections were conducted in 638 different inspections.
[b]Eight companies that no longer use the allergen were previously inspected.
[c]Represents 2,065 different facilities.
[d]The company was sent information on how to address potential exposures including indoor air issues in their workplace that may be causing respiratory health problems.



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

TABLE 11
Air Monitoring Results from 747 Workplace Inspections: 1988-2010

Air Sampling – NIOSH Standard	#	%
Above NIOSH Standard	64	8.6
Below NIOSH Standard	450	60.2
No NIOSH Standard	21	2.8
Unknown (no report yet)	9	1.2
Did Not Sample for an Allergen	26	3.5
Did Not Sample	177	23.7
Total	747	100.0

Air Sampling – MIOSHA Standard	#	%
Above MIOSHA Standard	24	3.2
Below MIOSHA Standard	506	67.7
No MIOSHA Standard	4	0.5
Unknown (no report yet)	9	1.2
Did Not Sample for an Allergen	27	3.6
Did Not Sample	177	23.7
Total	747	99.9[a]

[a]Percentages 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

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

TABLE 12
Allergens Above the MIOSHA Permissible Exposure Limit (PEL) and/or NIOSH Recommended Exposure Limit (REL): Michigan 1988-2010

	Above NIOSH REL		Above MIOSHA PEL	
Asthma-Causing Agents	#	%	#	%
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
Flour Dust	No REL	--	2	8.3
TOTAL	64	100.4[a]	24	100.1[a]

[a]Percentages do not add to 100 due to rounding.

Co-Worker Interviews at Workplace Investigations

Co-workers were interviewed at 572 of the 747 inspections. They reported daily or weekly breathing symptoms or new onset asthma since beginning to work at 376 of the 572 (66%) companies. The average percentage of co-workers with symptoms in these 376 companies was 20.4%. All 1,528 co-workers from the remaining 196 companies reported no breathing symptoms. One thousand five hundred twenty-seven of the 9,785 (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 577 workers from 131 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. A total of 2,095 symptomatic workers were identified during the 747 MIOSHA enforcement inspections.

1 in 5 co-workers of the index patient with asthma reported similar breathing problems in the workplace.

TABLE 13
Breathing Symptoms Among Co-Workers of the 3,025 Confirmed WRA Patients

	Disease Status of the Index Patient									
Symptoms	ALL		OA		POA		AA		RADS	
	#	%	#	%	#	%	#	%	#	%
Daily or Weekly SOB, Wheezing or Chest Tightness	1,527	15.6	1,068	16.0	416	14.9	4	16.0	39	13.2
Workers Interviewed	9,785		6,671		2,793		25		296	
OSHA Log	577	17.5	398	20.6	166	13.4	2	9.1	11	14.8
# Companies w/Employee on Log	131		89		37		1		4	
# Companies Inspected	747		432		277		11		27	
Total[a]	2,104		1,466		582		6		50	

[a]Nine 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 either calendar year 2009 or 2010.

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 facilities that use any one of 650 different chemicals in amounts greater than 10,000 pounds per year and are a manufacturer, a mine or an electrical generator and have at least 10 employees. 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 that use 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 fewer of those workers would have worked with or around isocyanates and therefore have been potentially exposed to isocyanates.

There were 94 companies that reported the use of isocyanates in calendar year 2009 (the most recent year available), which is down from 106 companies in 2008. The 94 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 31,442 workers potentially exposed to isocyanates in 2010 is down from the 32,860 potentially exposed in 2009.

TABLE 14
Michigan Workers Employed in Manufacturing Facilities Where Isocyanates are Used, by County

County	# Workers Employed[a] by Isocyanate-Using Facilities	Total # Workers in the County[b]	% Workers Potentially Exposed to Isocyanates	Company Name[c]
Allegan	1,000	46,870	2.1	Johnson Controls Parker Hannifin
Barry	1,100	25,640	4.3	Bradford White
Berrien	500	67,185	0.7	Tyler Refrigeration
Calhoun	223	59,863	0.4	Bostik Cello-Foil Products Comcast Urethane
Charlevoix	500	11,609	4.3	East Jordan Iron Works
Clare	300	10,711	2.8	Renosol Seating
Clinton	225	33,359	0.7	Pilkington North America[d]
Dickinson	580	12,496	4.6	Grede Foundry Louisiana-Pacific Sagola OSB

Table 14, continued...

County	# Workers Employed[a] by Isocyanate-Using Facilities	Total # Workers in the County[b]	% Workers Potentially Exposed to Isocyanates	Company Name[c]
Eaton	2,726	51,345	5.3	Axson North America GM/Lansing Delta Township
Genesee	1,000	167,941	0.6	ASI Packaging Co.[d] Delphi Energy & Chassis Flint East
Hillsdale	85	17,160	0.5	Dow Chemical Company
Ingham	190	133,137	0.1	Huntsman Advanced Materials Williamston Products
Isabella	550	34,539	1.6	Delfield
Jackson	1,200	65,423	1.8	ADCO Products[d] Milsco/MI Seat/Hurst & Brooklyn TAC Manufacturing
Kalamazoo	60	118,647	0.1	Azon USA
Kent	2,218	276,957	0.8	Conway Products/Emerald Spas Grand Rapids Foam Technologies HB Fuller Leon Plastics[d] N American Fuels System Remanufacturing Purforms Richwood Industries[d] Venture[d] Wolverine World Wide
Lapeer	10	35,780	<0.1	ITW/TACC
Lenawee	415	40,516	1.0	Anderson Development Insulspan[d] Pilkington Clinton
Livingston	400	80,637	0.5	Atreum Howell[d]
Luce	111	2,337	4.7	Louisiana-Pacific Corporation
Macomb	924	351,380	0.3	Cadence Innovation/Malyn[d] DuPont Mount Clemens Plant Faurecia Automotive Seating International Casting Corporation Michigan Metal Technologies[d] Romeo Rim
Mason	215	12,705	1.7	DUNA—USA [d] Great Lakes Castings

Table 14, continued...

County	# Workers Employed[a] by Isocyanate-Using Facilities	Total # Workers in the County[b]	% Workers Potentially Exposed to Isocyanates	Company Name[c]
Mecosta	540	17,517	3.1	Wolverine World Wide
Midland	1,000	38,281	2.6	Dow Chemical
Monroe	175	63,182	0.3	Sunrise Windows
Montcalm	208	22,043	0.9	Kent Foundry Northland Corporation
Muskegon	130	74,337	0.2	Brunswick Bowling[d] MI Steel
Oakland	1,224	528,640	0.2	Armaly Sponge Behr America Cass Polymers of Michigan Eagle Industries Exotic Rubber & Plastics[d] Fanuc Robotics[d] ITW Devcon Futura Lymantal International[d] Recticel Interiors North America Recticel UREPP North America
Ogemaw	75	8,236	0.9	Taylor Building Products
Ottawa	585	113,493	0.5	Eagle Packaging Izzy/Counterpoint Magna Donnelly Corporation
Saginaw	3,960	81,812	4.8	Filtrona Porous Technologies Glastender Nexteer Automotive Corporation Saginaw Metal Casting Operations
St. Clair	450	67,800	0.7	IAC Port Huron IACNA
St. Joseph	35	24,373	0.1	Chenowith Roofing[d]
Sanilac	1,080	17,160	6.3	Grupo Antolin Marlette Midwest Rubber Co. Numatics Trelleburg YSH
Van Buren	182	34,491	0.5	BASF Construction Chemicals Special-Lite
Washtenaw	1,500	168,054	0.9	Automotive Components Holdings

Table 14, continued...

County	# Workers Employed[a] by Isocyanate-Using Facilities	Total # Workers in the County[b]	% Workers Potentially Exposed to Isocyanates	Company Name[c]
Wayne	5,766	730,087	0.8	Arvinmeritor[d] Auto Alliance International[d] BASF Corporation, Livonia & Wyandotte Collins & Aikman[d] Chrysler JNAP EQ Detroit Plastomer Corporation Poof-Slinky Progressive Distribtion[d] Recycled Polymeric Materials Univar USA[d] Woodbridge Corporation
TOTAL	31,442	4,211,000	0.7	

[a]Source: Michigan Manufacturers' Directory, 2010 and www.acinet.org accessed November 17th, 2010.

[b]Source: Michigan Labor Market Information, Data Explorer, www.milmi.org accessed November 17th, 2010.

[c]Source: U.S. Environmental Protection Agency. Toxics Release Inventory, Michigan Companies Using Isocyanates in 2009 (report June 22, 2011).

[d]Source: Michigan Department of Environmental Quality, FOIA Request for SARA Title III Emergency Planning and Release Reporting of select chemicals (isocyanates), received December 16th, 2011.

Michigan Workforce Exposed

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 December 16, 2011, 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

County	Company Name	Type of Exposure
Alger	Neenah Paper—Michigan Inc.	Ammonia
Allegan	Birds Eye Foods	Ammonia, Chlorine
	Hamilton Farm Bureau Co-Op	Ammonia
	Otsego City of, Waste Water Treatment Plant (WWTP)	Chlorine
	Otsego City of, Wells #3, #4, #5	Chlorine
	JBS Plainwell	Ammonia
	Plainwell City of, Water Renewal	Chlorine
	Van Elderen Inc.	Formaldehyde
Bay	Bay City of, Bay Metropolitan Water Treatment	Chlorine
	Cooperative Elevator Co.	Ammonia
	Crop Production Services	Ammonia
	Mersen USA BN Corp.	Chlorine
	Quantum Composites, Inc.—Premix	Styrene
	West Bay County Regional Waste Water	Chlorine
Benzie	Frankfort Cold Storage	Ammonia
	Graceland Fruit	Ammonia
	MI DNR—Platte River St. Fish Hatchery	Formaldehyde
	Smeltzer Orchard Company	Ammonia
Berrien	Advanced Products	Ammonia
	Buchanan Agronomy & Petroleum	Ammonia
	Buchanan Waste Water Treatment Plant	Chlorine
	Buchanan Water Treatment Plant	Chlorine
	Coloma Frozen Foods	Ammonia
	Greg Orchards & Produce	Ammonia
	Hanson Cold Storage	Ammonia
	Harbor Metal Treating	Ammonia
	Leco Corporation	Ammonia
	NCP Coatings	Ammonia, Phthalic Anhydride
	New Buffalo Water Plant	Chlorine
	Niles City of, Airport, Decker, Front and Fort St. Wells	Chlorine
	Niles Water Department—Iron Removal Plant	Chlorine
	Old Europe Cheese	Ammonia
	Saint Joseph Water Plant	Chlorine
	Sandvik Materials Technology	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Branch	Aleris Specification Alloys, Inc.	Chlorine
	Colwater Water Treatment Plant	Chlorine
	Conagra Foods	Ammonia
	Star of the West Milling	Chlorine
Calhoun	Airgas Great Lakes	Chlorine
	Anatech	Formaldehyde
	Battle Creek City of, Waste Water Treatment Plant	Chlorine
	Battle Creek City of, Verona Pumping Station	Chlorine
	Continental Carbonic—Albion Plant	Ammonia
	Guardian Fiberglass	Formaldehyde
	Musashi Auto Parts	Ammonia
	Post Foods	Chlorine
	The Andersons Albion Ethanol	Ammonia
Cass	Mennel Milling Company of Michigan	Chlorine
Cheboygan	Cheboygan City of, Waste Water Treatment Plant	Chlorine
	Cheboygan City of, Well House #4, #7	Chlorine
Clinton	Crop Production Services	Ammonia
	Mahle Engine Components USA	Ammonia
	Michigan Milk Producers Association	Ammonia
	Save-A-Lot, Moran Foods	Ammonia
	SCCMUA	Chlorine
	St. Johns City of, Waste Water Treatment Facility	Chlorine
Crawford	Arctic Glacier	Ammonia
	Grayling Generating Station	Chlorine
	Weyerhaeuser NR Company	Formaldehyde
Delta	Escanaba Paper Company—Newpage Corporation	Ammonia, Chlorine
Dickinson	Verso Paper Company—Quinnesec Mill	Chlorine
Eaton	Axson North America	Styrene
	Cass Polymers of Michigan	Styrene
	Citizens, Otto Rd. Plant	Ammonia
	Owens Brockway Glass	Ammonia
	S.P. Kish Industries	Ammonia
Emmett	Michigan DNR—Oden State Fish Hatchery	Formaldehyde
Genesee	Airgas Great Lakes—Flint	Chlorine
	Flint City of, Water Plant	Chlorine
	Flint City of, Water Pollution Control Facility	Chlorine
	Genesee County Drain Commission—Ragnone Trt. Plt.	Chlorine
	Genesee County Water—Henderson Road Pump Station	Chlorine
	GMC Powertrain Flint, North (Motors Liquidation Co.)	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Genesee	Kelsey Hayes Co.	Chlorine
	Koegel Meats	Ammonia
	Woodworth Inc.	Ammonia
	Stokes Steel Treating Company	Ammonia
Grand Traverse	Airgas Great Lakes—Traverse City	Chlorine
	CentreICE	Ammonia
	Century Sun Metal Treating	Ammonia
	Cherry Growers	Ammonia
	Sara Lee Bakery	Ammonia
	Shoreline Fruit — Michigan Plant	Ammonia
	Traverse Cold Storage	Ammonia
Gratiot	Alma City of, Waste Water Plant	Chlorine
	Crop Production Services	Ammonia
	St. Louis City of, Waste Water Treatment Plant	Chlorine
	Terry Asphalt Materials, Inc.	Ammonia
Hillsdale	Bob Evans Farms	Ammonia
	Hillsdale Waste Water Treatment	Chlorine
	Prattville Fertilizer & Grain	Ammonia
	The Andersons Litchfield Farm	Ammonia
Houghton	Michigan—American Water Company	Chlorine
	Peninsula Copper Inds.	Ammonia
Huron	Bad Axe City of, Waste Water Treatment Plant	Chlorine
	Cooperative Elevator Company	Ammonia
	Crop Production Services	Ammonia
	Dow Agrosciences	Ammonia
	Harbor Beach Waste Water Treatment Plant	Chlorine
	Harbor Beach Water Works	Chlorine
	Thumb Tool & Engineering	Ammonia
Ingham	Airgas Great Lakes—Lansing Mint Road & Empire Way	Ammonia
	Aldi Inc., Webberville	Ammonia
	Alexander Chemical Corporation	Ammonia, Chlorine
	Arctic Glacier—Lansing Plant	Ammonia
	Aurora Specialty Chemistries	Epichlorohydrin
	Cremer Farm Center, Inc.	Ammonia
	East Lansing—Meridian Water & Sewer	Ammonia
	Jorgensen Farm Elevator	Ammonia
	Lansing Board of Water & Light—Dye Water Cond. Plt.	Ammonia
	Leslie City of, WWTP	Chlorine
	Mason City of, POTW Plant	Chlorine
	MBI	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Ingham	Meijer Lansing Distribution	Ammonia
	Nitrex—Michigan Operations	Ammonia
	Quality Dairy Company	Ammonia
	Symmetry Medical—Jet Engineering	Cobalt
	The Andersons Webberville	Ammonia
Ionia	Belding Tank Technologies	Styrene
	Caledonia Farmers Elevator	Ammonia
	Carbon Green Bioenergy	Ammonia
	Cargill Kitchen Solutions	Ammonia
	Crop Production Services	Ammonia
	Herbruck Poultry Ranch	Ammonia
	Portland City of, Waste Water Treatment Plant	Chlorine
	Stahlin Enclosures	Styrene
	TRW Automotive US	Ammonia
	Twin City Foods	Ammonia, Chlorine
Iosco	Farmers Coop Grain Co.	Ammonia
	Huron Shore Regional Utility—Earth Tech	Chlorine
	Rose Ice Company	Ammonia
	Tawas Utility Authority WWTP	Chlorine
	Tip-Top Screw Mfg.	Ammonia
Jackson	Industrial Steel Treating	Ammonia
	Jackson City of, Water Treatment	Chlorine
	Summit Township—Coventry Pk, JCC, Kimmel Rd, Meadow Hts, Southview & West Chester	Chlorine
Kalamazoo	Cytec Industries	Epichlorohydrin, Formaldehyde
	Haviland Products	Formaldehyde
	Kalamazoo City of, Water Division Stations: 1-5, 8-9, 11-12, 14, 17, 18, 22, 24-25, 28, 31, 39	Chlorine
	Knappen Milling	Chlorine
	Pharmacia & Upjohn—Pfizer Manufacturing Complex	Ammonia, Chlorine, Epichlorohydrin, Formaldehyde
	Precision Heat Treating Company	Ammonia
	Thermo Fisher Scientific	Formaldehyde
	Total Logistics Control	Ammonia
Kent	Airgas Great Lakes—Grandville	Ammonia, Chlorine
	Allied Finishing	Formaldehyde
	Brenntag Great Lakes	Ammonia, Formaldehyde
	Butterball Farms	Ammonia
	Coca-Cola Bottling	Ammonia
	Cook Composites & Polymers	Ammonia, Phthalic Anhydride

County	Company Name	Type of Exposure
Kent	Country Fresh	Ammonia
	Eagles Ice Center	Ammonia
	Earthgrains Baking Co.	Ammonia
	Electro-Chemical Finishing Company—44th St. Facility	Ammonia
	Electro-Chemical Finishing Company—Remico St. Facility	Chlorine, Formaldehyde
	Emerald Spas	Styrene
	Everfresh	Ammonia
	Finishmaster, Inc.	Styrene
	GM Components Holdings	Ammonia
	Gordon Food Service — Clay Ave & 50th St. Facilities	Ammonia
	Grand Rapids Edge Ice Arena	Ammonia
	Haviland Products Co.	Formaldehyde
	Jack Brown Produce	Ammonia
	Kent Quality Foods	Ammonia
	King Milling	Chlorine
	Lack's Trim System—Airline Plant	Formaldehyde
	Lack's Wheel Systems	Formaldehyde
	Lowell City of, WWTP	Chlorine
	Lowell City of, Water Treatment & Filtration	Chlorine
	Michigan Natural Storage	Ammonia
	Michigan Turkey Producers	Ammonia
	Patterson Ice Center	Ammonia
	Ridgeking Apple Packing	Ammonia
	Sellner-Behr Corporation	Styrene
	Sparta Village of, Water Department	Chlorine
	Spartan Stores Distribution	Ammonia
	Specialty Heat Treating	Ammonia
	State Heat Treating	Ammonia
	Superior Seafood	Ammonia
	Superior Stone Products	Styrene
	SYSCO Food Services of Grand Rapids	Ammonia
	Univar—Grand Rapids	Formaldehyde
	Van Eerden Foodservice Co.	Ammonia
	Vi-Chem Corporation	Styrene
	Wyoming Clean Water Plant	Chlorine
Keweenaw	Susan's Big Dummy	Ammonia
Lapeer	Lapeer Grain—East	Ammonia
	Lapeer Plating & Plastics	Formaldehyde
Lenawee	Anderson Development—Main Plant	Formaldehyde, Styrene
	Anderson Development—NF3 Plant	Ammonia
	Biolab—Chemtura	Ammonia, Chlorine
	Crop Production Services	Ammonia
	Dairy Farmers of America	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Lenawee	Munson Agri-Services	Ammonia
	Pain Enterprises	Ammonia
	Tecumseh City of, Well House #3, #8-#12 & #14	Chlorine
	War-Ag Farms Services	Ammonia
Livingston	Alpha Technology Corporation	Styrene
	Chemco Products	Formaldehyde
	Cor-Met Inc.	Cobalt
	General Chemical Corp.	Ammonia
	Gordon Food Service	Ammonia
	Howell City of, Waste Water Treatment Plant	Chlorine
	Howell City of, Water Plant	Chlorine
	Pepsi Cola Metropolitan Bottling	Ammonia
Mackinac	Department of Public Works—WWTP	Chlorine
	Department of Public Works—Water Treatment Plant	Chlorine
Macomb	Chrysler Sterling Heights Assembly	Formaldehyde
	Du Pont—Mt. Clemens Plant	Formaldehyde, Styrene
	Everfresh/La Croix Beverages	Ammonia
	Fini Finish Products	Chlorine
	GMC Technical Center	Ammonia
	Metallurgical Processing Company	Ammonia
	Mt. Clemens City of, Waste Water Treatment Plant	Chlorine
	New Baltimore City of, WWTP	Chlorine
	Nitro-Vac Heat Treating	Ammonia
	Norbrook Plating	Ammonia
	Reinhart Foodservice	Ammonia
	Specialty Steel Treating	Ammonia
	Steel Processing Company	Ammonia
	TI Automotive Systems	Chlorine
	Turri's Italian Foods	Ammonia
	Warren City of, Waste Water Treatment	Chlorine
Manistee	Specialized Custom Fiberglass	Styrene
Marquette	KI Sawyer WWTP	Chlorine
	Negaunee Waste Water Treatment	Chlorine
Mason	House of Flavors	Ammonia
	Jos, Sanders	Ammonia
	Ludington City of, Waste Water Plant	Chlorine
	Michigan Food Processors	Ammonia
Mecosta	Leprino Foods Company—Remus	Ammonia
	United States Marble	Styrene

Table 15, continued...

County	Company Name	Type of Exposure
Menominee	L.E. Jones Company	Ammonia, Cobalt
	Menominee Paper Company	Chlorine
	Menominee Waste Water Treatment Plant	Chlorine
	Menominee Water Treatment Plant	Chlorine
	Ruleau Brothers	Ammonia
Midland	Dow Chemical USA—Midland Operations—MI Division	Ammonia, Chlorine Epichlorohydrin, Methyl Acrylate, Styrene
	Dow Corning—Midland Plant	Ammonia, Chlorine
	Homestead Tool & Machine—SMC Plant	Styrene
	Mersen USA	Chlorine
	Midland City of, Waste Water Plant	Chlorine
	Midland City of, Water Treatment	Chlorine
Monroe	Advanced Heat Treat	Ammonia
	Detroit Edison—Monroe Power	Ammonia
	Home City Ice Company	Ammonia
	Independent Dairy	Ammonia
	Maybee Farmers	Ammonia
	Meijer Newport Distribution	Ammonia
	Ottawa Lake Co-Op Elevator	Ammonia
Montcalm	Crop Production Services	Ammonia
Muskegon	Alloy Resource Corp.	Chlorine
	Bayer Cropscience USA	Ammonia
	Brunswick Bowling & Billiards	Styrene
	Cannon—Muskegon, Precision Castparts	Cobalt
	Cole's Quality Foods	Ammonia
	ESCO Company LTD Partnership	Phthalic Anhydride
	GMI Composites	Styrene
	Howmet Corporation—Plants 1 & 3	Cobalt
	Howmet Corporation—Plant 5	Cobalt
	Howmet Corporation—Plant 10	Cobalt
	L-3 Combat Propulsion Systems	Ammonia
	Lake Welding Supply Company	Ammonia
	Snappy Apple Farms	Ammonia
	Sun Chemical Corporation	Ammonia
	Webb Chemical Service Corporation	Formaldehyde
Newaygo	Gerber Products Company	Ammonia
Oakland	Airgas Great Lakes—Ferndale	Chlorine, Ammonia
	Behr America	Ammonia
	Chor Industries	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Oakland	Commercial Steel Treating	Ammonia
	Detroit Skating Club	Ammonia
	Detroit Steel Treating	Ammonia
	Drayton Pool & Spa Supply	Chlorine
	Engineered Heat Treat	Ammonia
	Farmington Hills Ice Arena	Ammonia
	Foglers Orchard & Farm Market	Ammonia
	General Motors Proving Ground	Chlorine
	Hazel Park Viking Arena	Ammonia
	Holly Village of, Waste Water Treatment Plant	Chlorine
	John Lindell Ice Arena	Ammonia
	Lakeland Arena	Ammonia
	MacDermid	Formaldehyde
	Marbelite	Styrene
	Milford Village of, Iron Removal Plant	Chlorine
	Milford Village of, Waste Water Treatment Plant	Chlorine
	ND Industries, Chemical Blending	Formaldehyde
	Novi Ice Arena	Ammonia
	Onyx-Rochester Ice Arena	Ammonia
	Palace Sport & Entertainment	Ammonia
	RMT Southfield	Ammonia
	Specialty Steel Treating	Ammonia
	Stone Soap Company	Formaldehyde
	Suburban Training Center	Ammonia
	Sulzer Metco (US)	Cobalt
	Sun Steel Treating	Ammonia
	US Foodservice	Ammonia
	Waterford Township Iron Removal Plants	Chlorine
Oceana	Arbre Farms Corp.	Ammonia
	Hanson Logistics Group	Ammonia
	Michigan Freeze Pack	Ammonia
	NJ Fox 2nd Street Storage	Ammonia
	Oceana County Freezer Storage	Ammonia
	Peterson Farms Main Plant	Ammonia
Ogemaw	Sandvik Hard Materials	Cobalt
Osceola	Advanced Fibermolding	Styrene
	Liberty Dairy Company (Dean Dairy Holdings)	Ammonia
	Ventra Evart	Formaldehyde
	Yoplait USA	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Otsego	Airgas Great Lakes—Gaylord	Chlorine
	Jordan River Nat Fish Hatchery	Formaldehyde
Ottawa	Boar's Head Provisions	Ammonia
	Brooks Beverage	Ammonia
	Crème Curls Bakery	Ammonia
	Edge Ice Arena	Ammonia
	Georgetown Ice Center	Ammonia
	Grand Haven Board of Light—JB Sims Generating Station	Chlorine
	Hudsonville Creamery & Ice Cream, LLC	Ammonia
	Interstate Warehousing	Ammonia
	Juana's Packing Company– Brady Farms	Ammonia
	Lake Welding Supply Company	Ammonia
	Lakeshore Filtration Plant—Grand Rapids	Chlorine
	Leprino Foods—Allendale Plant	Ammonia
	Mead Johnson & Company	Chlorine
	Michigan Celery Promotion	Ammonia
	Miedema Produce	Ammonia
	Polyply Composites	Styrene
	Quincy Street	Ammonia
	Request Foods	Ammonia
	Sara Lee Foods—Zeeland	Ammonia
	Sherwin Williams Co.	Ammonia
	Specialty Heat Treating of Holland	Ammonia
	Superior Sales	Ammonia
	Tiara Yachts	Styrene
	Total Logistic Control	Ammonia
	Vertellus Specialties	Ammonia
	Zeeland Farm Services	Ammonia
Saginaw	Airgas Great Lakes—Saginaw Stoker Drive	Chlorine
	Bridgeport Waste Water Treatment Plant	Chlorine
	Buena Vista Waste Water Treatment Plant	Chlorine
	Dow Corning	Ammonia
	Frankenmuth City of, Waste Water Treatment Plant	Chlorine
	Hi-Tech Steel Treating	Ammonia
	Linear Motion	Ammonia
	Nexteer Automotive	Ammonia
	Saginaw Charter Township Retention Basin	Chlorine
	Saginaw City of, Water Treatment Plant	Chlorine
	Saginaw City of, WWTP	Chlorine

Table 15, continued...

County	Company Name	Type of Exposure
Saginaw	Winfield Solutions	Ammonia
Saint Clair	Airgas Great Lakes — Port Huron	Chlorine
	Dunn Paper	Chlorine
	Lake Huron Water Treatment Plant	Chlorine
	Marysville Ethanol	Ammonia
	Z F Marysville LLC	Ammonia
Saint Joseph	Abbott Nutrition	Ammonia
	Aquatic Co.	Styrene
	Crop Production Services—Mendon Unit	Ammonia
	Michigan Milk Producers	Ammonia
	Sturgis City of, Waste Water Treatment Plant	Chlorine
	Three Rivers Waste Water Treatment Plant	Chlorine
Sanilac	Crop Production Services	Ammonia
	Croswell Water Plant	Chlorine
	DGP	Styrene
Shiawassee	Airgas Specialty Products	Ammonia
	Crop Production Services	Ammonia
	Harvest Mills	Ammonia
	Machine Tool & Gear	Ammonia
	Wausaukee Composites	Styrene
Tuscola	Agrium Advanced Technologies	Ammonia
	Caro Village of, Waste Water Treatment Plant	Chlorine
	Cass City Village of, Waster Water Treatment Plant	Chlorine
	Dykhouse Pickle Company	Ammonia
Van Buren	Alloy Steel Treating	Ammonia
	Coca-Cola North America	Ammonia, Chlorine
	Dole Packaged Foods—Decatur	Ammonia
	Fruit Belt Foods, Canning	Ammonia
	Hanson Logistics, Hartford Warehouse	Ammonia
	Lawrence Freezer	Ammonia
	MBG Marketing—Grand Junction Facility	Ammonia
	Paw Paw Canners	Ammonia
	Paw Paw River Produce	Ammonia
	Shafer Lake Fruit	Ammonia
	Sill Farms Market	Ammonia
	South Haven City of, Water Filtration Plant	Chlorine
	St. Julian Wine Company	Ammonia
	Total Logistic Control—Paw Paw Logistic Center	Ammonia
	Welch Foods	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Washtenaw	Airgas Great Lakes—Ann Arbor	Ammonia, Chlorine
	Ann Arbor Ice Cube	Ammonia
	Arctic Glacier—Ypsilanti	Ammonia
	Chelsea Milling Company	Chlorine
	Crop Production Services	Ammonia
	Dapco Industries	Ammonia
	Electro Arc Manufacturing	Ammonia
	GM Powertrain — Willow Run	Ammonia
	Photo Systems	Formaldehyde
	Thetford Corporation	Formaldehyde
Wayne	A & R Packing	Ammonia
	Aldoa Company	Epichlorohydrin
	Arctic Cold Storage	Ammonia
	Arted Chrome Plating	Chlorine
	BASF Corporation	Ammonia, Epichlorohydrin, Styrene
	Blue Line Food Service Dist.	Ammonia
	Bottling Group, LLC, Pepsi Bottling	Ammonia
	C.F. Burger Company	Ammonia
	Cardinal Health	Formaldehyde
	Chrysler JNAP	Epichlorohydrin, Formaldehyde
	City Sports Center	Ammonia
	Classic Plating	Ammonia
	Coca Cola Enterprises	Ammonia
	Compuware Arena	Ammonia
	Country Fresh—Livonia	Ammonia
	Dairy Fresh Foods Inc., Detroit City Dairy	Ammonia
	Detroit City of, NE, SE, SW Park & Springwells Water Plts	Chlorine
	Detroit City of, Waste Water Treatment	Chlorine
	Detroit Edison Company—Trenton	Ammonia
	Durcon Laboratory Tops	Phthalic Anhydride
	Dynamic Surface Technologies	Ammonia
	Eddie Edgar Arena	Ammonia
	Faygo Beverages	Ammonia
	Freezer & Dry Storage	Ammonia
	Freezer Services of MI	Ammonia
	Fritz Products	Chlorine
	Gas Recovery Systems LLC	Ammonia
	Great Lakes Frozen & Dairy	Ammonia
	Home City Ice Company	Ammonia
	Inland Waters Pollution Control	Styrene
	Interstate Chemical	Ammonia, Formaldehyde

Table 15, continued...

County	Company Name	Type of Exposure
Wayne	JCI Jones Chemicals	Chlorine
	Lincoln Distributing—Painters Supply & Equipment	Styrene
	Mastronardi Produce	Ammonia
	McLane Food Service—Plymouth	Ammonia
	Michigan Dairy—The Kroger Company	Ammonia
	Michigan Ref Div—Staff	Ammonia
	Northeast Water Plant	Chlorine
	Polychemie	Formaldehyde
	Praxair Distribution	Ammonia
	Progressive Distribution Centers—Evans Distribution	Styrene, Epichlorohydrin
	PVS Nolwood Chemicals	Formaldehyde
	PVS Technologies	Chlorine
	S & F Foods	Ammonia
	Santemp	Ammonia
	South Huron Valley Waste Water Treatment Plant	Chlorine
	SYSCO Food Services of Detroit	Ammonia
	Tanner Industries	Ammonia
	Trenton City of, Waste Water Treatment Plant	Chlorine
	Unistrut-Wayne Manufacturing	Ammonia
	Wolverine Packing Company	Ammonia
	Woodworth Incorporated	Ammonia
	Wyandotte City of, Municipal Power Plant	Chlorine
Wexford	AAR Mobility Systems	Formaldehyde
	Airgas Great Lakes—Cadillac	Chlorine
	Fiber-Tech Industries—Cadillac Plant	Styrene
	Four Winns, Cruiser & Sport Division	Styrene

[a]Source: Michigan Department of Environmental Quality (DEQ). Michigan Facilities' Guide to SARA Title III, Emergency Planning and Release Reporting, December 2007, 6th edition. The chemicals listed in this table are subject to reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) section 313, which is triggered by threshold amounts of 25,000 pounds manufactured or processed or 10,000 pounds otherwise used at facilities in Michigan. The companies listed in this table were current as of a report generated by the Michigan DEQ on December 16, 2011.

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. The combined estimates from these consensus statements suggest that 36.5% of all adult asthma is work-related. This percentage is not too far off from self reports from a random sample of adult asthma patients who responded that their asthma was caused or made worse by work[1]. The data by age, gender, race, income, education and year of survey are shown in Table 16. The same questions were asked in Michigan, Minnesota and Oregon and similar results were found (Figure 4). This same study also reported that among those individuals who responded their asthma was caused or made worse by work, only 21.5% had a discussion about work's effect on their asthma with their health care provider (Figure 5)[1]. At minimum, the data suggest that providers are not addressing concerns of their patients and probably missing the identification of WRA triggers. Data for this same study showed that the individuals with concerns about work-related asthma triggers had more health care usage (Figure 6)[1] and were more symptomatic (Figure 7)[1].

On average, 147 new people each year are reported to the Michigan Department of Licensing and Regulatory Affairs (MDLARA) with confirmed WRA. One hundred twenty-three reports were confirmed in 2007, the most recent year with complete data. Although the total number of WRA cases has not varied significantly (115-176), 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.[5] Using capture-recapture analysis, we estimate 228—801 adults in Michigan develop WRA each year.[7]

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 2.1 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 allergens, 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 either the use of alternative substances or improvements in controls when these agents are used. 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).

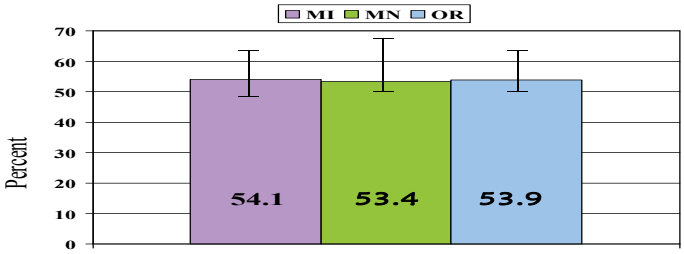
Table 16. Prevalence of Work-Related Asthma Using 3 Definitions, Among Adults with Current Asthma Michigan Asthma Call-Back Survey, 2005-2009 Combined			
	Asthma Caused or Aggravated by Current or Previous Job[a]	**Ever Told or Told By Doctor That Asthma Was Work-Related[b]**	**Any Indication of Work-Related Asthma[c]**
Total	51.0 (47.8-54.2)	15.9 (13.8-18.2)	52.6 (49.4-55.8)
Age in years			
18-34	43.5 (36.1-51.2)	12.2 (8.0-18.1)	45.7 (38.2-53.4)
35-64	57.1 (53.8-60.3)	19.3 (16.9-22.0)	58.3 (55.1-61.5)
≥ 65	45.9 (41.0-50.9)	11.7 (9.0-15.2)	47.3 (42.3-52.2)
Gender			
Male	51.8 (45.5-58.0)	16.8 (13.0-21.3)	54.2 (47.8-60.4)
Female	50.6 (47.0-54.1)	15.4 (13.1-18.1)	51.7 (48.1-55.3)
Race			
White	49.3 (45.8-52.8)	14.8 (12.8-17.2)	51.0 (47.6-54.5)
Black	60.7 (50.7-69.9)	21.1 (13.3-31.8)	60.7 (50.7-69.9)
Household income			
< $20,000	58.4 (51.3-65.1)	18.9 (14.8-23.9)	59.3 (52.2-66.0)
$20,000-34,999	59.2 (52.0-66.1)	21.3 (15.5-28.5)	60.2 (53.0-67.0)
$35,000-49,999	54.2 (45.7-62.4)	13.0 (8.5-19.3)	54.7 (46.2-62.9)
$50,000-74,999	45.3 (37.6-53.2)	14.2 (10.2-19.3)	47.4 (39.6-55.5)
≥ $75,000	43.8 (37.7-50.0)	12.1 (8.9-16.2)	45.7 (39.6-51.9)
Education			
< HS graduate	51.2 (38.1-64.1)	22.0 (12.9-35.0)	51.2 (38.1-64.1)
HS graduate	54.8 (48.8-60.6)	15.7 (12.3-19.7)	56.3 (50.3-62.0)
Some college	54.2 (48.3-60.1)	15.7 (12.2-20.1)	55.6 (49.6-61.5)
College graduate	43.6 (38.6-48.8)	14.6 (11.4-18.6)	45.9 (40.8-51.2)
Year of survey			
2005	52.9 (47.7-58.0)	12.1 (9.2-15.7)	54.1 (48.9-59.2)
2006	52.6 (45.5-59.6)	17.7 (13.6-22.8)	54.5 (47.3-61.4)
2007	49.6 (41.8-57.5)	16.3 (11.2-23.1)	50.5 (42.6-58.3)
2008	47.9 (40.2-55.8)	15.4 (11.2-20.9)	49.9 (42.0-57.8)
2009	52.1 (44.8-59.3)	17.9 (13.0-24.0)	54.2 (46.8-61.4)

[a]Responded "yes" to one or more of the following 4 questions: "Was your asthma caused by chemicals, smoke, fumes, or dust in your current job?" "Is your asthma made worse by chemicals, smoke, fumes, or dust in your current job?" "Was your asthma caused by chemicals, smoke, fumes, or dust in any previous job you ever had?" "Was your asthma made worse by chemicals, smoke, fumes, or dust in any previous job you ever had?"

[b]Responded "yes" to one or more of the following 2 questions: "Were you ever told by a doctor or other health professional that your asthma was related to any job you ever had?" "Did you ever tell a doctor or other health professional that your asthma was related to any job you ever had?"

[c]Responded "yes" to at least one of the above 6 questions (a and b).

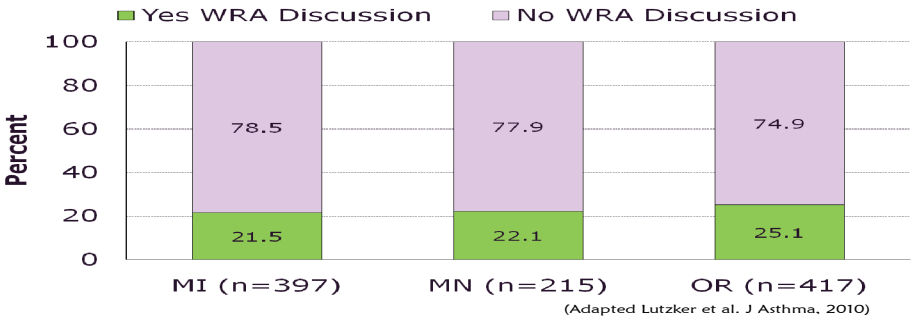
Figure 4. Estimates of Current Asthma Attributable to Work*: Michigan (MI), Minnesota (MN), & Oregon (OR)



*Asthma caused or aggravated by any job, either self-reported or ever told by health professional.

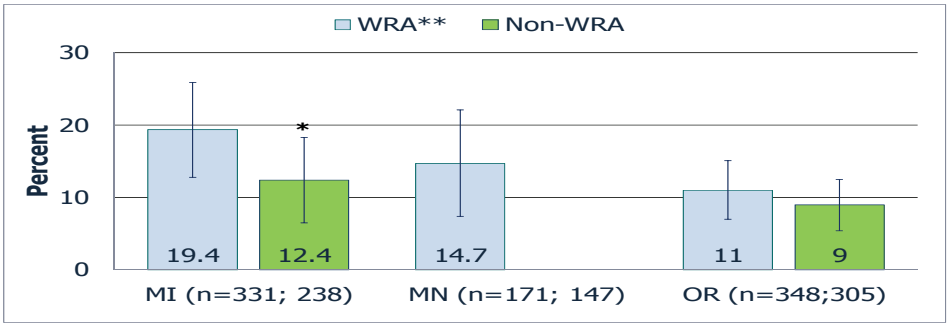
(Adapted Lutzker et al. J Asthma, 2010)

Figure 5. Lifetime Adult Asthmatics with Self-Reported Work-Related Symptoms by whether their Health Care Provider Discussed Work-Relatedness: Michigan (MI), Minnesota (MN), & Oregon (OR)



(Adapted Lutzker et al. J Asthma, 2010)

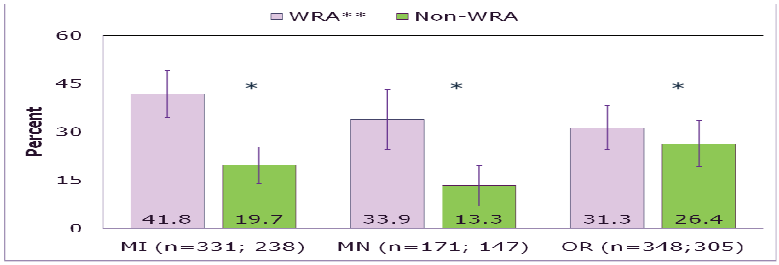
Figure 6. Prevalence of ≥1 Asthma ED/UC Visit (1 year) by Work-Relatedness, Adults (≥18 Years) with Current Asthma: Michigan (MI), Minnesota (MN), & Oregon (OR)



*p<0.0001
**Yes to at least one of the 6 questions
Data suppressed due to estimate stability.

(Lutzer etal. J Asthma,

Figure 7. Prevalence of Having Nighttime Awakenings (30 days) by Work-Relatedness, Adults (≥18 Years) with Current Asthma: Michigan (MI), Minnesota (MN), & Oregon (OR)



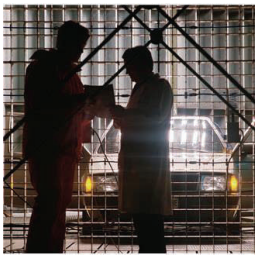
*p<0.001
**Yes to at least one of the 6 questions

(Lutzker et al. J Asthma, 2010)

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, <0.1-6.3% of the work force is employed in facilities where isocyanates are used: Sanilac (6.3%), Eaton (5.3%) and Luce (4.7%). 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.[8] On the average, among the 1,957 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



Employees can have exposure to more than one sensitizing agent. In an auto factory, isocyanates, metal-working fluids and welding fume are all possible exposures.

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

much is related to the physician not recommending that the individual leave the exposure.

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. In addition there is a concern that current standards are not sufficiently low to protect against the development of WRA. Revisions to the current standards and exposure limits are under consideration.

We identified 1,527 fellow workers with symptoms compatible with WRA (Table 13). Five hundred seventy-seven 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.[8]

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.[7] 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.

Molten metal is a burn hazard and inhalational hazard.

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An excellent resource on the management of WRA, available through the British Occupational Health Research Foundation can be found at:

www.bohrf.org.uk

APPENDIX

2010 PATIENT NARRATIVES BY TYPE OF INDUSTRY & EXPOSURE

Abbreviations:

POA = Possible Occupational Asthma
OA = Occupational Asthma with a Known Sensitizer
AA = Aggravated Asthma (Pre-Existing Asthma Exacerbated at Work)
RADS = Reactive Airways Dysfunction Syndrome

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

MANUFACTURING

EXPOSURE TO METAL WORKING FLUIDS

POA Case #3019 A man developed asthma in his 50s after working for a couple years at an auto parts manufacturer at his job grinding metal parts. He was exposed to metal dust and metal working fluids. He was prescribed Asmanex. He was reassigned to a new job away from these exposures and since that time his asthma has improved although he still requires the same amount of asthma medication. He is a lifelong non-smoker.

EXPOSURE TO ISOCYANATES

OA Case #3038 A woman developed asthma in her 30s after working for about three years at an automotive parts manufacturing plant that used recycled rubber from pulverized tires. She was exposed to an isocyanate compound mixed with the recycled rubber to make automotive parts. She was also exposed to a polyol-type product used to clean out the machines between shifts. She went to the ED and was subsequently hospitalized for her asthma. She was prescribed inhalers and Prednisone. She was moved to a different building but continues to experience asthma symptoms and require asthma medication. She currently smokes half a pack of cigarettes a day, and has done so since her 20s.

EXPOSURE TO WELDING FUME

RADS Case #3117 A woman developed RADS in her 40s when she was welding on stainless steel that was lined with a product containing alumina. She had been welding in a semi-enclosed space when she noticed a different smell than she was used to and almost immediately experienced wheezing, coughing and shortness of breath that did not resolve. She was treated in a hospital and prescribed Prednisone and Albuterol. She has smoked a pack of cigarettes a day for approximately 30 years.

AA Case #3136 A woman in her 40s experienced an exacerbation of her pre-existing asthma at her job as a press operator in an auto parts manufacturing facility when she was working near an automatic welding cell. The welding cell had been recently installed and initially the ventilation was poor. However, the company updated the ventilation for the cell, and since then she has not experienced any asthma flare ups at work. She formerly smoked a pack of cigarettes a day

for over 10 years, but had quit in her 30s.

POA Case #3039 A woman developed asthma in her 20s while working at an automotive manufacturing plant. She worked at the plant for five years before she developed a cough, chest tightness and shortness of breath. She was exposed to welding fume. She noted an increase in her symptoms as the work day progressed, and an improvement while off work on weekends. She was prescribed Qvar and Albuterol. She was placed on sick leave and since that time her asthma has improved although she still requires the same amount of asthma medication. She had smoked approximately 15 cigarettes a day for ten years but quit smoking in her 20s.

POA Case #3054 A man developed asthma in his 40s after working for over 10 years as a welder on galvanized steel at an automotive manufacturing plant. He developed chest tightness and shortness of breath and was prescribed a rescue inhaler. Initially, he only experienced these asthma symptoms when welding on galvanized steel. However, six months later he noted that his symptoms were then triggered by other exposures at work, such as dust and fumes in the air. He was reassigned to a welding cell that did not weld on galvanized steel. Since being reassigned, his symptoms have remained unchanged, but he stopped taking his rescue inhaler. He smokes a few cigarettes a day, and has done so for over 20 years.

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

POA Case #3037 A man developed asthma in his 50s while working as a forklift driver at an automotive stamping company. He was exposed to welding fume from robotic welding. The welded parts had residual oil on them from the stamping process. He worked for five years before he experienced wheezing, cough, chest tightness and shortness of breath. He was prescribed an inhaler and given a nebulizer. He continues to work at this company since he was diagnosed and his asthma has become worse. He formerly smoked half a pack of cigarettes a day for 40 years but quit about five years before he developed asthma.

AA Case #3045 A woman in her 30s experienced an exacerbation of her pre-existing asthma at her job at an automotive assembly plant. Fume and dust from welding in her work area triggered her asthma. She is a lifelong non-smoker. She continues to work at the plant in the same job, with frequent trips to the company medical department for treatment of her asthma.

Exposure to Cleaning Products

OA Case #3026 A woman developed asthma in her 50s from exposure to quaternary amine-based disinfectants. She had worked for a couple years as a janitor at an automotive manufacturing plant before she developed shortness of breath from disinfectants used to clean the bathrooms. She was prescribed a bronchodilator and Combivent. After her asthma developed, she continued to do this job for several months until she was placed on sick leave. Several months later, she has had no improvement in her asthma and requires the same amount of asthma medication. She smokes about five cigarettes a day, and has done so since her 20s.

Exposure to Paint Fume

OA Case #3033 A man in his 50s developed asthma after working over 30 years at a company making dental and industrial castings. He was exposed to epoxy paint fumes. He developed wheezing, chest tightness, shortness of breath and a cough and was prescribed steroids, an inhaler and Ventolin. He went to the ED and was subsequently admitted to the hospital for his breathing difficulties. He continues to work at this company and tries to limit his exposure to the epoxy paint. His asthma has worsened since he was initially diagnosed,

although he reports taking less asthma medication. He never smoked cigarettes.

Exposure to Formaldehyde

OA Case #3151 A man developed asthma in his 50s from exposure to formaldehyde at his job at a plastics product manufacturing facility. He had worked for this company for over 25 years. He described heating up the plastic mold machines at a temperature above manufacturer specifications at start up each day. He developed wheezing, cough and shortness of breath and was hospitalized for his symptoms. He was prescribed Combivent. He left this job because of his asthma and has not found new employment almost a year later. He formerly smoked over half a pack of cigarettes a day for 20 years, but quit when he developed asthma.

Exposure to Flour

OA Case #3056 A man developed bakers' asthma in his 30s, after working for approximately five years at a production bakery. He was exposed to flour dust in his job as a production support specialist, setting up and monitoring production lines and equipment. His asthma began as a cough for several years, and then his symptoms expanded to include shortness of breath. He was prescribed a rescue inhaler. He was fired from his job and has since found new employment. Since being out of the flour exposure, his asthma has improved and he continues to use his rescue inhaler as needed. He formerly smoked cigarettes for almost 20 years but quit a couple years before his asthma developed.

Commercial bakeries can expose employees to flour dust in operations such as mixing, weighing and cleanup.

Exposure to Plastic Fume

OA Case #2918 A man developed asthma in his 30s shortly after beginning to work at a plastic swimming pool liner manufacturing plant. He operated a machine in a pit where PVC was heated up and applied to the pool liners. He was prescribed Advair and Albuterol. His main symptom was chest tightness. He has had three trips to the ED since his diagnosis. He was let go from this job because his employer could not accommodate his medical restrictions. Over two years after being fired from his job, he has been unable to find a new job. However, his asthma has improved over time and he no longer takes asthma medication. He is a lifelong non-smoker.

Multiple Exposures

POA Case #3167 A man developed asthma in his 60s while working at a steel casting factory. He was exposed to dust from the molding machines. He was prescribed Albuterol and Asmanex. He had smoked cigarettes for approximately eight years in his teens and early 20s. He continues to work at the factory. A physician recommended he wear "some kind of mask so this doesn't happen again" at his most recent hospital ED visit.

POA Case #3080 A man in his 30s developed asthma while working at a chemical manufacturing plant. He was exposed to fiberglass, dust and chemicals related to plastics manufacturing at this facility for almost 20 years before he developed wheezing, cough, shortness of breath and chest tightness. He was prescribed ProAir and Singulair and since being out of the exposure for approximately one year, his symptoms have improved and he requires less asthma medication. He has never smoked cigarettes.

OA Case #3108 A man developed asthma in his 30s, approximately one year after beginning to work at a chemical manufacturing plant. He was exposed to chlorinates, formaldehyde and other chemical mixtures in his job as a material handler/compounder. He worked at this facility for five years but left due to his poor health. He has since worked in other jobs as a truck driver and farmer. He has increased his use of asthma medication over the years, including an inhaler and a nebulizer. He notes that other substances now trigger his asthma, including mold and perfume. He formerly smoked cigarettes in his 20s and 30s,

Proper asthma control prevents visits to the Emergency Room and Hospital. Using controller asthma medications reduces the need for rescue inhalers.

about a quarter of a pack a day for approximately 10 years.

Health care workers are exposed to a wide variety of agents with the potential to cause asthma, including latex and disinfectants.

POA Case #2953 A woman developed asthma in her 30s after working for a plastic automotive parts manufacturer for over five years. Her job was to fill hoppers with a plastic resin, and also to clean out the hoppers periodically. She experienced cough, chest tightness and shortness of breath from exposure to chemicals being used in the area where she worked, including floor wax, bleach-based cleaning agents and paint. She was prescribed an inhaler and Prednisone. She had never smoked cigarettes. She left that job and has since begun working in a health care facility. In her new job, perfumes and cleaning supplies trigger her asthma.

POA Case #2957 A man developed asthma in his 30s after working at an automotive assembly plant for over seven years. He was exposed to polyurethane and transmission fluid. He developed a cough, wheezing, chest tightness and shortness of breath. He was prescribed Singulair, Zyrtec, Maxair and Spiriva. He continued to work in this environment for almost three more years before he was eventually moved to a climate-controlled room at the factory. Over the three years since his asthma developed, his asthma has worsened and he requires more asthma medication. After moving to the climate controlled location, his symptoms have improved. He has never smoked cigarettes.

AA Case #3051 A woman in her 40s experienced an exacerbation of her pre-existing asthma while working at an automotive assembly plant. She was exposed to an industrial soap-like substance used during engine inspections. She continues to work at this job and continues to experience exacerbations of her asthma from exposure to the chemical used for testing engines. She had formerly smoked cigarettes for several years in her teens.

POA Case #2990 A man developed asthma in his 50s after working for over 30 years at a steel mill. He was exposed to hydrochloric acid in his job as a material handler. He developed wheezing, cough, shortness of breath and chest tightness and was prescribed Singulair and Proventil. He had a positive methacholine challenge test. After he was diagnosed with asthma, his company was able to reassign him to a new location. Since that time, his asthma has improved although he still requires the same amount of asthma medication. He formerly smoked half a pack of cigarettes a day for over 30 years but quit a couple years after he was diagnosed with asthma.

Visit www.oem.msu.edu, for many resources available to monitor and understand asthma-causing agents in the work place.

HEALTH CARE SERVICES

EXPOSURE TO CLEANING PRODUCTS

RADS Case #2928 A woman in her 60s was diagnosed with RADS after an acute exposure to a spill of disinfectants used to sterilize equipment at the health care facility where she worked. She had worked at this facility for over 30 years before the spill occurred. She was prescribed Advair and Albuterol at the ED where she was treated for cough and shortness of breath when the disinfectants splashed on her. She continues to work at the facility and her symptoms have remained unchanged since the incident. She has never smoked cigarettes.

RADS Case #3063 A woman developed RADS in her 50s when she had an acute exposure to an oven cleaner at her job as an in-home aide for elderly shut-ins. The oven cleaner sprayed in her face when she was cleaning at a client's home. She went to the ED and was admitted to the hospital. She was prescribed Prednisone, inhalers, a nebulizer and put on oxygen. After this incident, she tried to go back to work but any exertion caused her to become short of breath, wheeze, and experience chest tightness. She continues to require asthma medication, her asthma has worsened and she is on oxygen 24 hours a day. She cannot work. She had previously smoked half a pack of cigarettes a day for over 30 years, but quit when her asthma developed. She has also been diagnosed with COPD.

RADS Case #3004 A woman developed RADS in her 30s when she was exposed to a mixture of drain cleaner and waste medications after a janitor tried to unclog the drain of the waste disposal sink at the hospital where she worked. She walked into the room shortly after the janitor put the drain cleaner in the drain and was overcome by fumes. Since this incident, the hospital has changed their policy on the use of this sink, limiting who has access and how items are disposed of. Since the incident, other chemicals including bleach products trigger her asthma. Her symptoms have increased as well as her use of asthma medication (Singulair and Albuterol) has increased. She continues to work at the hospital, but in an area where exposures to cleaning agents is limited. She has never smoked cigarettes.

POA Case #3110 A woman developed asthma in her 40s after having worked at a hospital for three years as a janitor. She developed wheezing, cough, chest tightness and shortness of breath and was prescribed an Albuterol inhaler, Prednisone and given some breathing treatments when she went to the hospital ED for treatment. She was exposed to sodium hydroxide, sodium metasilicate and sodium hypochlorite, which were ingredients in disinfecting wipes used throughout the hospital. Shortly after she went to the ED and was hospitalized for her asthma, she was fired from her job for being off work too long. She has since found new employment and she no longer requires asthma medication. She has never smoked cigarettes.

AA Case #3055 A woman in her 40s experienced an exacerbation of her pre-existing asthma at her job as a nurse in a kidney dialysis center. She was exposed to peracetic acid which was used to clean the dialysis machines. The dialysis center had switched procedures from buying pre-mixed peracetic acid solutions to mixing the solutions themselves as a cost-savings measure. This mixing was done in a small room with poor ventilation and no respirator. The first time the mixing procedure was demonstrated she went to the ED for treatment for an asthma attack. Since the ED visit, she has been on sick leave, and her asthma has improved although she now requires more asthma medication. She is a lifelong non-smoker.

AA Case #2964 A woman in her 50s experienced an exacerbation of her pre-existing asthma while working as a nurse. Her employer instituted a new policy for the cleaning of equipment, and it was exposure to the bleach-based disinfectant that triggered her asthma. One asthma attack was severe enough to require hospitalization. She continues to work at the same job, but uses a different cleaner for equipment. She smokes a pack of cigarettes a day, and has done so since her early 30s.

OA Case #2968 A woman developed asthma in her 40s after working over 15 years as a nurse at a hospital. She developed chest tightness and shortness of breath from exposure to a disinfectant. She noticed her breathing symptoms became worse during each shift she worked, and improved on weekends when she was away from work. She was prescribed Advair, Singulair and Albuterol. She continued to work at the hospital and had continued to be exposed to the disinfectant for another two years until she was assigned to a new work location free from the disinfectant exposure. Since that reassignment, her asthma has improved although she still requires the same amount of asthma medication. Since the development of her asthma, she has had to visit the ED four times and was hospitalized once. She has never smoked cigarettes.

OA Case #2961 A woman developed asthma in her 40s after 11 years of employment as a nurse at a hospital. She was exposed to floor strippers and floor wax. She developed wheezing and chest tightness and was prescribed Advair, Singulair, Rhinocort and Xopenex. She noted that her symptoms got worse during each shift she worked, were worse on her first day back to work and improved on her days off. She continues to work at this hospital and notes a worsening of her asthma although she does require less asthma medica-

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

tion. She is a lifetime non-smoker.

RADS Case #3058 A woman developed RADS in her 40s at her job in a hospital when she was exposed to floor wax. She had worked shifts when housekeeping staff had waxed the floors before, however this time she immediately developed wheezing, cough, chest tightness and shortness of breath. She was prescribed an inhaler, oral steroids, given breathing treatments and a rescue inhaler. The hospital attempted to schedule floor stripping and waxing on shifts when she was not working. However, other exposures began to trigger her asthma, so she was placed on medical disability. She is a lifetime non-smoker. Since her asthma was diagnosed, her symptoms have worsened and she requires a greater amount of asthma medication to control her symptoms.

POA Case #3028 A woman developed asthma in her 50s, after working for a year as a housekeeper at a hospital. She was exposed to a bleach-based spray disinfectant used to clean bathrooms. The bleach-based disinfectant was a new product brought in by the hospital; when she first began to use it, she developed a cough, shortness of breath, chest tightness and wheezing. These symptoms became worse as her work day progressed, were worse on Mondays after being off work over the weekend, and improved when she was away from work. She was prescribed Albuterol, a nebulizer, Flovent and a steroid taper. She took a leave of absence during which time her asthma improved and she now requires less asthma medication. She has never smoked cigarettes.

Exposure to Pharmaceutical Agents

OA Case #3115 A woman developed asthma in her 30s while working at an assisted living facility. She was mixing a psyllium-based laxative for a patient. She developed wheezing and shortness of breath and was treated at an ED for exposure to the dust from mixing the laxative. She was prescribed Prednisone and Albuterol and given an Epi-Pen. She has never smoked cigarettes.

Chemicals and dusts from construction activities can affect construction workers as well as individuals who work in areas where remodeling occurs.

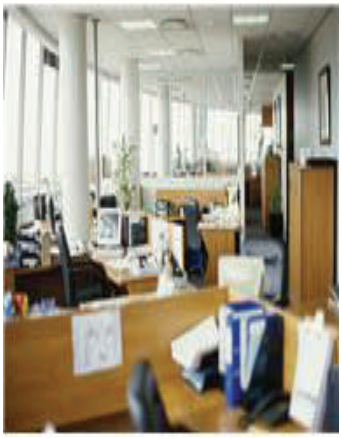
POA Case #3064 A woman developed asthma in her 30s while working at a drug store pharmacy. She was exposed to dust from the medication, especially when counting out hydrocodone pills. She developed cough, chest tightness and shortness of breath, and was prescribed Ventolin and Prednisone. She ended up quitting this job because of her breathing problems and was still looking for a new job half a year later. Since being out of the pharmacy, her asthma has improved and she requires less asthma medication. She has had two trips to the ED for her asthma since she was diagnosed. She formerly smoked approximately five cigarettes a day for three years but quit almost 20 years prior to the development of her asthma.

Exposure to Indoor Air Contaminants

AA Case #3103 A woman in her 20s experienced an exacerbation of her pre-existing asthma at the hospital where she works in the pharmacy department. She described her work environment as dusty with poor ventilation. She reported that strong perfumes were also a respiratory irritant for her. She has never smoked cigarettes.

POA Case #3107 A woman developed asthma in her 50s after working over 30 years in an office at a hospital. Her asthma developed during renovation activities on the floor above her. Cement dust and other construction particles coated a filmy layer of dust on everything in her office. She sought treatment in the hospital ED on four separate incidents related to these exposures. She was prescribed Singulair, Spiriva, Symbicort and Allegra. She had to leave this job due to her asthma. Since that time, her asthma has improved and she requires less asthma medication. She formerly smoked half a pack of cigarettes a day for over 30 years. She has not found a new job almost a year after leaving this job.

POA Case #3135 A woman developed asthma in her 50s after working about five years in a medical office. She developed wheezing, cough and chest tightness from exposure to photocopier toner dust. She was prescribed Albuterol and Advair. She ended up quitting her job because of her asthma since she was unable to be removed from the exposure. Since leaving this job, her asthma has improved and she no longer requires asthma medication. She formerly smoked a pack and a half of cigarettes a day for 20 years but quit in her 30s. She is currently looking for a new job.



RADS Case #3009 A woman developed RADS in her 20s from an undetermined chemical exposure at the health care office where she worked. She had worked at the facility for less than a year when she developed a cough and chest tightness. She went to the ED and was prescribed Prednisone and Benadryl. She left that job shortly after her asthma developed, and has since found new employment with a different health care facility. Since leaving that job, her asthma has improved although she still requires the same amount of asthma medication. She has never smoked cigarettes.

POA Case #2983 A woman developed asthma in her 50s after working in an office at a hospital for almost 10 years. She noted smells in the office that circulated throughout the ventilation system. She developed a cough, chest tightness and shortness of breath, was treated in the hospital ED, and prescribed Singulair and Symbicort. HEPA filters were installed in the office and since that time her asthma has improved although she requires a greater amount of asthma medication. She has never smoked cigarettes. She continues to work for the hospital.

AA Case #2972 A woman in her 50s experienced exacerbations of her pre-existing asthma at her job as a nurse at a hospital when she was exposed to a variety of things including perfumes, carpet cleaners, fresh flowers and paint fume. She continues to work at the hospital and over time her asthma has become worse and she requires a greater amount of asthma medication. She currently takes Advair, Combivent, DuoNeb and Singulair. She formerly smoked a half a pack of cigarettes a day for about 10 years but quit in her 40s.

AA Case #2955 A woman in her 50s experienced an exacerbation of her pre-existing asthma while at work. She worked in an office at a hospital, and had worked at this job for over 25 years. Her asthma was triggered at work when some water and sewer lines were being repaired under the building. Since the repairs were completed, she continues to experience asthma attacks at work, possibly related to the water damage to the building when the repairs were made. She is a lifelong non-smoker.

AA Case #2975 A woman in her 50s experienced an exacerbation of her pre-existing asthma when there was flooding at the hospital where she worked. Mold in the walls and carpet aggravated her symptoms. Since this exposure, the hospital has torn out the carpet and replaced it with linoleum. She is a lifelong non-smoker.

Indoor air in office buildings can contain many contaminants, including molds, copier toner dust, carpet, glues, intake ventilation contaminants from poorly positioned air intake vents near loading docks, insects and animals, and cleaners and disinfectants.

EDUCATIONAL SERVICES

EXPOSURE TO ANIMAL DANDER

OA Case #3040 A woman in her 30s developed asthma while caring for rats, mice and rabbits in her job as a veterinary technician. She worked at this job for about nine years before she developed wheezing, cough and shortness of breath. Skin testing confirmed her allergy to the lab animals. She was prescribed Albuterol and Symbicort. She had never smoked cigarettes. She continues to work in this job, wearing a NIOSH-approved respirator for exposure to animal dander. Since then her symptoms have improved and she has been able to discontinue the use of her asthma medication.

The US EPA has useful information to understand indoor air problems:

http://www.epa.gov/iaq/pubs/careforyourair.html

Exposure to Cleaning Products

RADS Case #3118 A man developed RADS in his 50s after working as a custodian for a school for over 20 years. He was exposed to an unintended mixture of bleach and a product used to clean toilets. Another employee had mixed bleach and a toilet bowl cleaner and left the mixture over the weekend; when the patient flushed the toilet the fumes were released and he immediately experienced breathing difficulties. He was prescribed Albuterol and Asmanex and still requires the same amount of asthma medication for symptom control. The school system has since substituted out the original cleaning products with new peroxide-based cleaners. He had formerly smoked a pack of cigarettes a day for almost 30 years, but had quit 10 years prior to this incident.

AA Case #3122 A man in his 40s experienced an exacerbation of his pre-existing asthma while working as a custodian at a school. The floor stripper he was using caused his asthma to flare up. Since the incident, he opens windows in his work area when stripping the floors to help increase fresh air. He currently smokes a pack of cigarettes a day, and has been doing so since his mid-teenage years.

POA Case #2986 A man developed asthma in his 30s shortly after beginning to work for a school janitorial cleaning service company. He was exposed to cleaning agents, including heavy duty spray cleaners. He was treated for asthma in the ED and prescribed a nebulizer and an inhaler. He continues to work for the cleaning service, and since his asthma began he reports a greater use of asthma medication along with an improvement of his symptoms. He is a lifelong non-smoker.

Exposure to Indoor Air Contaminants

POA Case #3120 A woman developed asthma in her 40s while working as a teacher's aide at a school. She had worked for the school system for 15 years before she began to experience a cough and chest tightness. Gradually, her symptoms expanded to wheezing and shortness of breath. She was prescribed a nebulizer, an Albuterol inhaler and steroids. She described the school as a "sick building" with renovations after a fire generating dusts and also salvaged materials from the fire triggering her asthma. Her symptoms have improved and she requires less asthma medication since being out of the school environment over the summer. She has never smoked cigarettes.

POA Case #2941 A woman developed asthma in her 40s after working for four years as a teacher at a public school. She was exposed to mold and poor indoor air quality from water infiltration in her classroom. She developed a cough, chest tightness, and shortness of breath, which would worsen as the day progressed. She was prescribed Singulair. The school sealed off and completely renovated her classroom. Her symptoms have improved and she requires less asthma medication since she has been off work and her classroom has been cleaned up. She is a lifelong non-smoker.

POA Case #2929 A woman developed asthma in her 30s shortly after beginning to work as a teacher at a school. She developed chest tightness and shortness of breath. She was prescribed Advair and Albuterol. Her asthma started when she began working in a newly-renovated classroom and she noted her symptoms were worse when she opened the door to her classroom first thing in the morning. She was moved to a different classroom and since that time her asthma has improved although she still requires the same amount of asthma medication. She has never smoked cigarettes.

POA Case #2965 A man developed asthma in his 30s after working as a teacher at a public school for over five years. His symptoms began when there was a leaky roof in the building where he taught. He experienced a cough, chest tightness and shortness of breath

and took over-the-counter allergy medication for seven years until he eventually saw a doctor and was prescribed an inhaler. Since his diagnosis and treatment, he has been moved to a new location in the building and reports an improvement in his symptoms although he now requires more asthma medication. He formerly smoked two packs of cigarettes a week for several weeks in his teens.

POA Case #3002 A woman developed asthma in her 30s after having worked a couple years in an office in the educational services sector. She was exposed to sewage, along with poor ventilation in her basement office. There had been flooding and sewage back-up that was never properly remediated several months before her asthma developed. She developed wheezing, chest tightness and shortness of breath and was prescribed Asmanex and Maxair. She was placed on disability leave and since that time her asthma has improved although she still requires the same amount of asthma medication. She has never smoked cigarettes.

Multiple Exposures

POA Case #3091 A woman developed asthma in her 50s after working as a bus driver for over 10 years. She was exposed to diesel fume and chemicals in a car wash solution used to wash the busses. She was prescribed Combivent and Albuterol for her wheezing, cough, chest tightness and shortness of breath. Her symptoms have remained the same and she requires the same amount of asthma medication originally prescribed. She has smoked approximately 5 cigarettes a day for over 20 years. She continues to drive busses.

POA Case #3144 A man developed asthma in his 40s about one year after working with clay while making pottery. He was exposed to clay, silica dust and glazes. He developed wheezing and a cough initially, and then several years later his symptoms expanded to include chest tightness and shortness of breath. He continues to make pottery and since his diagnosis he requires a greater amount of asthma medication. He now wears a NIOSH-approved respirator when making pottery. He formerly smoked a pack of cigarettes a day for over 20 years but quit a couple of years before his asthma developed.

Water incursion from leaking roofs can lead to indoor air quality problems and respiratory difficulties.

OFFICE

Exposure to Indoor Air Contaminants

POA Case #3113 A woman developed asthma in her 30s after working for about a year in a call center. She was exposed to unknown contaminants in the office area where she worked. She continued to work in this environment for another five years, but had to quit due to her worsening wheezing, chest tightness, cough and shortness of breath. She had smoked a pack a day of cigarettes for approximately 15 years, but had quit about five years before she took the call center job. Since leaving that job, she has been unable to find new employment. She currently takes Ventolin, Albuterol and Symbicort.

AA Case #2982 A woman in her 40s experienced an exacerbation of her pre-existing asthma at her office job from an unknown exposure at her work place. She noted that shredded paper dust was the likely trigger for her asthma. She continues to work at this office. She formerly smoked a half a pack of cigarettes a day for 20 years, but quit in her early 40s.

POA case #2984 A woman developed asthma in her 50s after having worked in an office setting for over 30 years. There was a roof leak in her building. About four years after the leak, she developed a cough, wheezing, chest tightness and shortness of breath. She was prescribed Albuterol, and an inhaler. She noticed her breathing symptoms became worse as her work day progressed, got worse as the work week progressed, and

got better on weekends when she was off work. She went on sick leave and her asthma has improved although she requires a greater amount of asthma medication. She has not returned to work four months after she went on medical leave. She formerly smoked a pack of cigarettes a day for approximately five years in her early 20s.

AA Case #2951 A woman in her 40s experienced an exacerbation of her pre-existing asthma while working as a sales assistant in an office. The building where she worked had mold in the heating ducts. Exposure to the mold triggered her asthma, and she was hospitalized for an asthma attack because of this. She eventually left this job about a year after the mold was discovered. Since that time, her asthma symptoms have improved although she requires a greater amount of asthma medication. She has never smoked cigarettes.

POA Case #2943 A man developed asthma in his 30s while working in an office setting. The building where he worked had poor air quality, including improperly located exhaust and air intake ventilation, and mold incursions. He first developed chest tightness, then a couple years later experienced a cough and shortness of breath, and a year after that developed wheezing. He was prescribed Combivent, Zyrtec, Advair, Singulair and Asmanex. After working in this environment for approximately seven years, he went on medical leave. He had a positive fungal titer. Since that time he has had an improvement in his asthma symptoms, although he requires a greater amount of asthma medication. He has never smoked cigarettes.

AA Case #3065 A man experienced an exacerbation of his pre-existing asthma. Mold was identified after water leaked into the basement of the building where he worked. Within 24 hours of this exposure, he experienced wheezing, chest tightness, shortness of breath and cough. A professional cleaning crew was hired for remediating the mold problem. Other than this one-time exposure, his asthma is not triggered by exposures at work. He is a lifetime non-smoker.

POA Case #3042 A woman developed asthma in her 30s after working for about four years in a government office. While most of her time was spent in an office, her job also involved visits to client homes. She associated the poor indoor office air as being the cause of her asthma. She developed wheezing, cough and shortness of breath and was prescribed Advair, Albuterol and Singulair. She worked in this setting for an additional four years, but was eventually placed on sick leave. Since being out of the office environment, her asthma has improved although she continues to take the same amount of asthma medication. She smoked a pack of cigarettes a day since her teenage years, but quit smoking when she was diagnosed with asthma.

MISCELLANEOUS SERVICES & INDUSTRIES

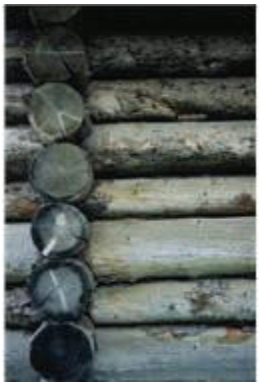
EXPOSURE TO CLEANING PRODUCTS

AA Case #3116 A man in his 20s experienced an exacerbation of his pre-existing asthma from exposure to a mixture of cleaning agents, including a toilet bowl cleaner and bleach. He was working at a county fair. He was treated in the ED. He smokes a pack of cigarettes a day, and has done so for the past 5 years.

RADS Case #3085 A man in his 50s developed RADS when he was exposed to mold and cleaning agents at a house he was cleaning out in preparation for it to be rented. He developed a cough, chest tightness, shortness of breath and wheezing and was treated in the ED. He was prescribed an inhaler and steroids. One year later he still has not gone back to work because of his breathing difficulties. He had formerly smoked a pack of cigarettes a day for 30 years, but quit smoking about 15 years before the incident when he developed

RADS.

POA Case #2987 A woman developed asthma in her 60s after having worked for 10 years for a building cleaning service. She was exposed to fume from floor strippers and grout cleaner. She developed wheezing, a cough, chest tightness and shortness of breath and was prescribed a nebulizer and an Albuterol inhaler. She was treated in the ED the first time she experienced these symptoms. Since her diagnosis, she no longer is present when floors are stripped and waxed. Her asthma has improved although she still requires the same amount of asthma medication. She has smoked half a pack of cigarettes a day for almost 50 years.



RADS Case #3157 A woman developed RADS in her 40s from an incident where acid and bleach-based cleaners were inadvertently mixed. She worked as a housekeeper at a camp, and was responsible for cleaning and disinfecting the campers' cabins. She developed wheezing, cough, shortness of breath and chest tightness. She was prescribed ProAir, Asmanex and a nebulizer. She had worked at this job over five years before the incident. After the mixture of cleaning agents caused her initial breathing problems, being exposed to any of the cleaners separately caused her asthma to flare up. She was laid off not long after the incident and since that time her symptoms have remained about the same but she has been able to reduce her asthma medication. She currently smokes a half a pack of cigarettes a day, and has done so for the past 20 years.

RADS Case #3102 A woman in her 40s developed RADS when an ammonia and a bleach –based chemical were mixed while she was cleaning at the gas station where she worked. She described a cloud of smoke that formed when the chemicals interacted, and she immediately experienced wheezing, cough, shortness of breath and chest tightness. She was prescribed an inhaler which she uses as needed. The company where she works substituted out the cleaners for "eco-friendly" products. Since the initial exposure, her symptoms have improved and she requires less asthma medication. She had smoked approximately half a pack of cigarettes a day for 20 years, but quit when the cleaning agent exposure incident occurred. She continues to work at the gas station.

AA Case #3072 A woman in her 50s experienced an exacerbation of her pre-existing asthma at her job as a cook at a restaurant when she was exposed to a mixture of a cleaning agent and a degreaser. With this exposure, she was assessed in the ED and admitted to a local hospital for overnight observation. She currently smokes a half a pack of cigarettes a day and has done so for over 30 years. Her current medication includes ProAir, Ventolin and a steroid.

Exposure to Animal Dander

AA Case #2977 A woman in her 30s experienced an exacerbation of her pre-existing asthma while working for an employment agency. She was exposed to cat and dog dander in a client's home, which triggered her asthma symptoms. Her usual job was office-based and did not involve client visits. Other than this incident, her work environment did not usually trigger her asthma. She formerly smoked a pack of cigarettes a day for over 10 years but quit in her 30s.

Multiple Exposures

AA Case #3149 A woman in her 40s experienced an exacerbation of her pre-existing asthma at her job at a day care facility. She was exposed to disinfectants, pesticides, perfumes and dust. Her employer has changed their cleaning products to organic, natural products, to help prevent further asthma exacerbations. Since switching to these products, she notes that her symptoms have decreased and she requires less asthma medication. She

has never smoked cigarettes.

POA Case #3046 A woman developed asthma in her 20s while working as a summer camp counselor. She developed wheezing, cough, shortness of breath and chest tightness from exposure to camp fire smoke, grass and tree pollen. She went to the ED for treatment four times during the summer, and was prescribed an Albuterol inhaler, steroids and Symbicort. Since being out of the exposures at the summer camp, her symptoms have not resolved and she continues to require the same amount of asthma medication. She has had several more visits to the ED and one hospitalization for her asthma. She has never smoked cigarettes.

POA Case #3021 A woman developed asthma in her 20s while working through a temporary agency at a job scanning books. She was exposed to dust and developed a cough, chest tightness and shortness of breath. She was treated at a local ED and prescribed Albuterol and Prednisone. She was fired from this job and since being off work her asthma has improved and she requires less asthma medication. She has been unable to find new employment more than one year later. She has never smoked cigarettes.

POA Case #3022 A man developed asthma in his 50s while working on the cleanup crew for a crude oil spill. He had only worked for a couple months for this environmental remediation company before he helped clean up the very large spill. He developed a cough, chest tightness and shortness of breath and was prescribed oral and inhaled steroids during an ED visit. Since the cleanup ended, he has been off work and since that time his asthma has improved and he requires less asthma medication. He formerly smoked almost a pack of cigarettes a day for over 30 years, but quit when he was diagnosed with asthma.

Environmental Exposures

POA Case #3086 A man developed asthma in his 60s after having worked for over 20 years as an auto body repairman. His shop was located near a large environmental oil spill, and his asthma began after the spill occurred. He developed wheezing, shortness of breath, cough and chest tightness and was prescribed a nebulizer, steroids and an inhaler. He moved the location of his business and has had an improvement in his asthma and requires less asthma medication. However, since the spill, he now notices that other chemicals cause his asthma to flare. He has never smoked cigarettes.

JUSTICE, PUBLIC ORDER, & SAFETY

Exposure to Indoor Air Contaminants

RADS Case #3061 A man in his 20s was diagnosed with RADS shortly after he began working in law enforcement. While on patrol, he was exposed to chemicals from a meth lab. He developed wheezing, chest tightness, shortness of breath and a cough. He was prescribed a Proventil inhaler. Since the initial exposure, his symptoms have remained unchanged, but he no longer uses asthma medication. He has never smoked cigarettes.

AA Case #2956 A woman in her 40s with pre-existing asthma since childhood experienced an exacerbation of her asthma while working in a government office. She was exposed to a cleaning product that contained ammonium chloride. Shortly after this exposure, her work place substituted a new cleaning product for the one that caused her asthma to flare up. With this chemical substitution, her asthma has improved and she takes less asthma medication. She has never smoked cigarettes.

RADS Case #3111 A volunteer fire fighter in his 60s was diagnosed with RADS after he helped put out a fire in a trailer house. After he was done helping put out the fire, he developed shortness of breath and was hospitalized. He was prescribed an inhaler. Since

the fire, his asthma has improved and he requires less asthma medication. He formerly smoked one cigarette a day for approximately 20 years, but had quit smoking about 20 years before he developed RADS. He has been a volunteer fire fighter for over 30 years.

POA Case #2921 A woman who worked at a jail developed asthma in her 50s was exposed to mold and construction dust during renovations at the building where she worked. During renovations, she developed wheezing, cough and shortness of breath. About one year later she developed chest tightness. She had positive mold titers. She was prescribed Spiriva, Singulair and given breathing treatments. She was given medical leave and since being off work her asthma has improved although she does require more asthma medication. She formerly smoked half a pack of cigarettes a day for over 30 years but quit several years after her asthma developed.

AA Case #3161 A firefighter in his 30s experienced an exacerbation of his pre-existing asthma while fighting a fire. He reported being exposed to a small amount of smoke at a house fire. He was treated in the ED for wheezing and shortness of breath. He was given Albuterol and Atrovent. He is a lifetime non-smoker.

POA Case #2973 A woman developed asthma in her 30s after having worked as an auditor in a government office for four years. She was exposed to an unknown chemical in a factory she was auditing, was sent to a local hospital ED and subsequently hospitalized for asthma, with cough, chest tightness and shortness of breath. She was prescribed asthma medication including Advair. She had never smoked cigarettes. She is on medical leave and since being off work her asthma has remained the same but she requires less medication.

RETAIL SERVICES

Exposure to Miscellaneous Chemicals

RADS Case #3109 A woman developed RADS from an acute exposure to a spill of photo developing chemicals in the store where she had worked for five years prior to this incident. On the day of her exposure to the chemicals, she developed wheezing, chest tightness and a cough and was treated in the ED for her symptoms. She was prescribed Albuterol. She has smoked about a half a pack a day of cigarettes for over five years. Since the spill, her asthma has improved and she requires less asthma medication. She continues to work at the store.

AA Case #3146 A store cashier in her 20s experienced an aggravation of her pre-existing asthma when she was exposed to dust from fire extinguisher powder. She also reported that dust and mold from cleaning up at the store triggers her asthma. She has never smoked cigarettes. Since the fire extinguisher exposure, she requires more asthma medication and her breathing problems have become worse. She continues to work at the store, but wears a dust mask when performing cleaning activities.

Exposure to Cleaning Products

AA Case #3106 A woman experienced an exacerbation of her pre-existing asthma when she used a floor cleaning product at the store where she worked. She was treated in an ED for her asthma flare up. She smokes approximately half a pack of cigarettes a day.

OA Case #3041 A woman developed asthma in her 40s after having worked approximately five years at a retail store. She was exposed to disinfectants used to treat aquariums and ponds at the store where she worked. She developed wheezing, cough, chest tightness and shortness of breath and was prescribed Advair. She ended up quitting this job for health reasons, and since that time her asthma symptoms have remained the same although she no longer takes asthma medication. She recently quit smoking cigarettes

due to the development of her asthma; she had previously smoked a few cigarettes a day for over 20 years. She has not found new employment half a year after leaving this job.

Exposure to Indoor Air Contaminants

POA Case #2974 A woman developed asthma in her 30s while working for a retail store where mold was identified. She had worked at the store for a couple years before her asthma developed. She experienced wheezing, cough, shortness of breath and chest tightness and was prescribed Albuterol, a nebulizer and Advair. The store closed shortly after she was diagnosed with asthma and since that time, being out of the exposure, her asthma has improved and she was able to discontinue use of her asthma medication. She has smoked half a pack of cigarettes a day since her late teens. Over three months after the store closed, she has been unable to find new employment.

AGRICULTURAL SERVICES

Exposure to Cleaning Products

POA Case #3129 A man in his 50s developed asthma after working for less than a year at a fruit processing company. He was exposed to bleach used to process the fruit. He developed a cough, chest tightness and shortness of breath, and was prescribed an Albuterol inhaler. His asthma symptoms worsen at night after work, and worsen as the work week progresses. He continues to do this job, and his asthma has remained unchanged although he requires less asthma medication. He has smoked a pack of cigarettes a day for over 35 years.

AA Case #2989 A woman in her 40s experienced an exacerbation of her pre-existing asthma at her dairy farm. She was exposed to a chlorine-acid solution in the sink of the milking parlor, which she normally does not visit. She is a lifelong non-smoker. Typically she avoids any farm activities.

MINING

Multiple Exposures

POA Case #3007 A man developed asthma in his 40s while working for a mining company doing maintenance and repair work on machinery at the mine's processing plant. He developed wheezing, cough and chest tightness from exposure to dust and chemicals at the plant. He was prescribed Advair and Singulair. He has never smoked cigarettes. He was reassigned to a different location and since that time his asthma has improved. However, upon occasion when he visits the other plant, he experiences a flare up of his asthma.