JANUARY 11TH 2011

2009 ANNUAL REPORT

TRACKING WORK-RELATED ASTHMA IN MICHIGAN

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Work-Related Asthma Surveillance Program

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Thanks to 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

MDELEG MI Department of Energy, Labor & Economic Growth

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 19th 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.

Summary, continued...

There are over 400 known asthma-causing agents used in the workplace. Thousands more substances have not been evaluated for their asthma-causing potential.

- On average, 147 new cases of WRA are reported to MDELEG each year.
- From 1988-2009, 2,920 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 (DELEG) 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.

Part 56 of the Michigan Public Health Code requires the reporting of all known or suspected occupational illnesses or work-aggravated health conditions to the Michigan Department of Energy, Labor & Economic Growth *within 10 days of discovery*.

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 MDELEG
- **Known or Suspected**
  -Work-Related Asthma
- **Letter to Patient**

INTERVIEW PATIENTS

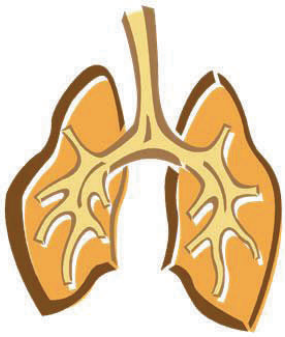
- **Telephone Interview**
  -Medical and work history
- **Obtain Medical Records**
  -Breathing test results
- **Physician Review**

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

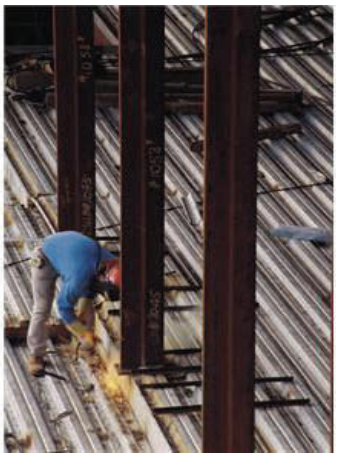
1) Occupational Asthma (OA) if A), B), and C) are met.
2) Possible WRA (POA) if only A) and B) are met.
3) Reactive Airways Dysfunction Syndrome (RADS) if symptoms develop after an acute exposure.[2]

Exacerbation

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

A new 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

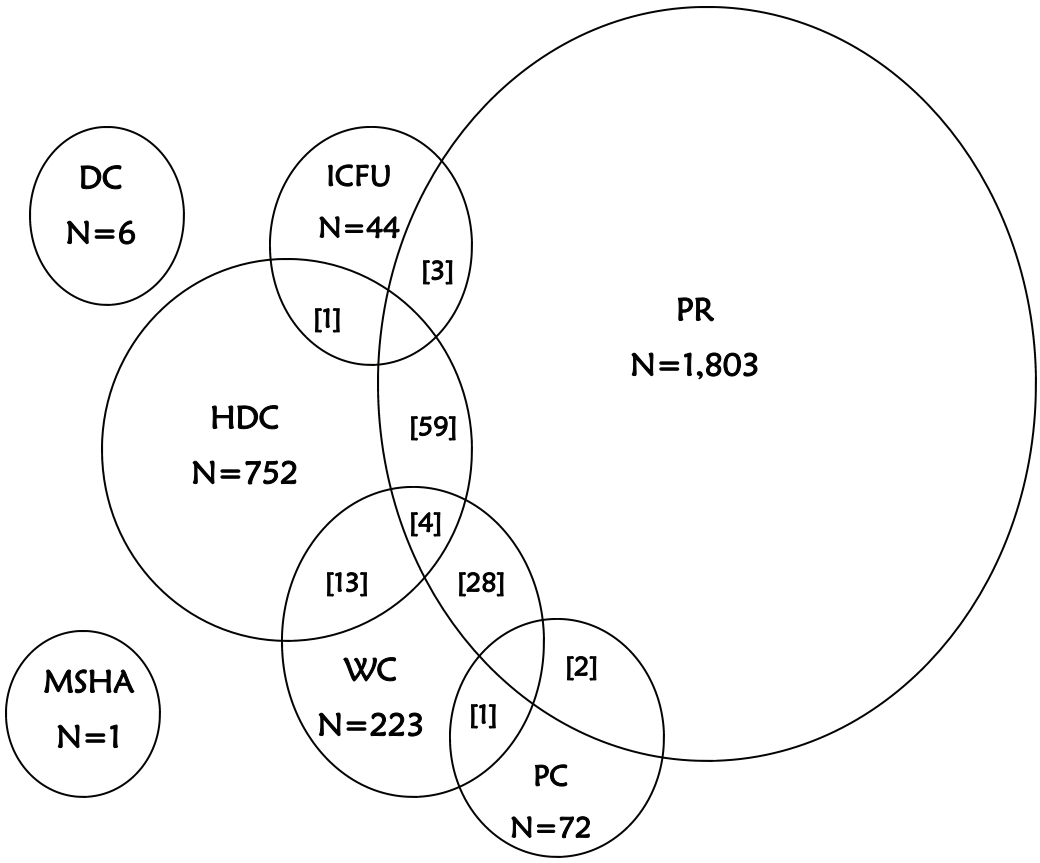
Table 1 shows that 2,920 people were confirmed with WRA between 1988—2009. The reports are divided into: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA) and Reactive Airways Dysfunction Syndrome (RADS). One hundred fifty-five additional patients have been confirmed since last year's report. Figure 1 shows the overlap of the patients by reporting sources, for 1988—2008.

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[a]
2008	15	51	23	16	105[a]
2009	17	35	22	6	80[a]
Total	1,032	1,051	392	319	2,920

[a]Reports are still being processed for calendar years 2007, 2008 and 2009; an increase in these totals will be reflected in next year's annual report.

FIGURE 1
Overlap of Reporting Sources for 2,840 Confirmed Work-Related Asthma Patients: 1988-2008[a]



[a] Ns represent the total number for that source.
Numbers in [ ] represent the overlap of reporting sources.
There was an overlap of PC-HDC for 12 individuals and of PR-ICFU and PR-DC for one individual each.
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.

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 1,546, 53%
- Men 1,374, 48%

YEAR OF BIRTH

- Range 1905—1989
- Average 1956

RACE

- Caucasian 2,190, 77%
- African American 539, 19%
- Hispanic 57, 2%
- Alaskan/American Ind. 23, 1%
- Asian 12, <1%
- Other 32, 1%
- Unknown 67

ANNUAL INCIDENCE RATE

- African American 5.3
- 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 (12.3 cases per 100,000), Luce (11.7 cases per 100,000), Osceola (7.9 cases per 100,000), Branch (7.0 cases per 100,000), Sanilac (6.8 cases per 100,000) and Cheboygan (6.7 cases per 100,000).

TABLE 2
Average Annual Incidence Rates of Work-Related Asthma Among Michigan Workers by County of Exposure: 1989-2007

County	# EE's[a]	Avg Annual Inc Rate[b]	Cases 1989-2007	County	# EE's[a]	Avg Annual Inc Rate[b]	Cases 1989-2007
Alcona- Iosco	11,775	1.8	4	Isabella	26,325	3.2	16
Alpena	13,600	3.1	8	Jackson	60,500	3.6	41
Antrim	5,750	1.8	2	Kalamazoo-Calhoun-Van Buren	208,900	1.9	76
Arenac	4,650	4.5	4	Kent-Ottawa-Muskegon-Allegan	550,100	1.4	144
Baraga	3,750	4.2	3	Lake	1,650	6.4	2
Barry	12,075	1.3	3	Luce	2,700	11.7	6
Berrien	70,900	1.8	24	Mackinac	5,400	1.0	1
Branch	14,225	7.0	19	Manistee	7,625	1.4	2
Cass	10,500	2.0	4	Marquette	28,000	3.2	17
Charlevoix	10,975	1.9	4	Mason	10,500	1.5	3
Cheboygan	7,800	6.7	10	Mecosta	13,075	0.8	2
Chippewa	15,425	1.0	3	Menominee	9,450	0.6	1
Clare	7,675	12.3	18	Montcalm	18,825	3.9	14
Clinton-Eaton-Ingham	232,200	2.5	111	Montmorency	2,250	4.7	2
Crawford	4,525	5.8	5	Newaygo	10,325	4.1	8
Delta	15,525	1.7	5	Oceana	6,750	2.3	3
Dickinson	14,325	3.7	10	Ogemaw	6,450	4.1	5
Emmet	15,900	1.7	5	Osceola	8,000	7.9	12
Genesee	178,600	6.3	215	Otsego	11,225	4.2	9
Gladwin	5,125	2.1	2	Roscommon	6,500	4.9	6
Gogebic	6,525	1.6	2	Sanilac	13,125	6.8	17
Grand Traverse-Benzie-Kalkaska-Leelanau	60,575	2.3	26	Schoolcraft	2,900	1.8	1
				Shiawassee	19,525	1.6	6
Gratiot	14,150	4.1	11	St. Joseph	25,150	1.5	7
Hillsdale	15,525	3.4	10	Tuscola	14,275	5.5	15
Houghton-Keweenaw	15,225	2.4	7	Washtenaw-Lenawee-Livingston	266,200	4.0	202
Huron	13,875	5.7	15	Wexford-Missaukee	17,325	1.8	6
Ionia	15,975	3.3	10	Saginaw-Bay-Midland	177,800	4.1	138
Iron	4,200	3.8	3	Detroit, MSA[c]	2,077,000	3.4	1,334
				All Michigan Counties[d]	**4,448,000**	**3.1**	**2,639**

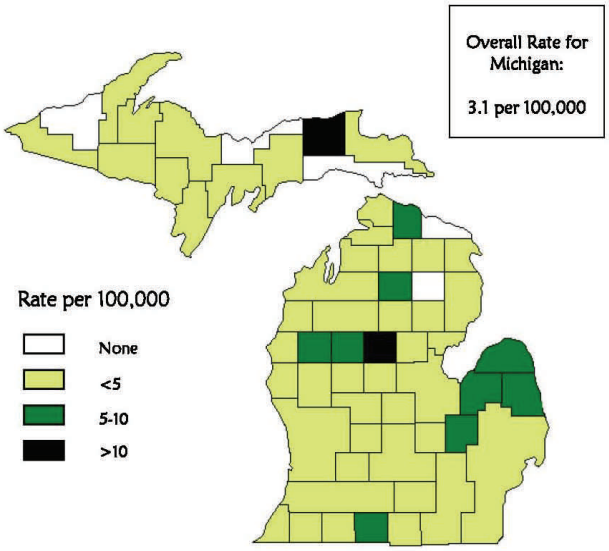
[a] Source: MDCD/Employment Service Agency 1997 Annual Average Labor Statistics for Employment by Place of Work. Some employee population data is only at a multi-county level, as indicated (i.e., not available at a single county level). Therefore, some data is presented with grouped counties.

[b] Rates are based on the average number of cases per year from 1989-2007, per 100,000 Michigan workers.

[c] MSA=Metropolitan Statistical Area and includes Lapeer (27 cases), Macomb (239 cases), Monroe (25 cases), Oakland (350 cases), St. Clair (46 cases) and Wayne (647 cases) counties.

[d] Forty-four cases had an out-of-state exposure and 21 had an unknown county of exposure, for the 1989-2007 reporting period.

FIGURE 2
Average Annual Incidence Rate of WRA by County of Exposure: 1989-2007



Type of Industry

Table 3 shows the Michigan industries by NAICS codes, where the exposures to occupational allergens occurred from 1988 to 2009. The predominant industries were in manufacturing (61%) and health care and social assistance (11%).

The incidence rate of WRA by industry type ranges from <0.1 cases per 100,000 in utilities to a high of 10.9 cases per 100,000 in manufacturing. Industries with the next highest annual average incidence rates were: mining with 6.2 cases per 100,000 workers and health care and social assistance with 3.2 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: 1988-2009

2002 North American Industry Classification System		WRA Cases 1988-2009		Number of Employees[a]	Ann. Average Incidence Rate[b]	
		#	%		Rate	# Cases
11	Agriculture, Forestry, Fishing, & Hunting	16	0.5	81,664	1.0	16
21	Mining	11	0.4	9,300	6.2	11
22	Utilities	11	0.4	861,200	<0.1	8
23	Construction	75	2.6	206,100	1.7	68
31-33	Manufacturing	1,790	61.3	823,100	10.9	1,698
42	Wholesale Trade	36	1.2	180,400	1.0	35
44-45	Retail Trade	73	2.5	548,800	0.6	63
48-49	Transportation & Warehousing	55	1.9	132,000	2.0	49
51	Information	18	0.6	76,000	1.2	17
52	Finance & Insurance	21	0.7	154,800	0.7	20
53	Real Estate & Rental & Leasing	13	0.4	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	42	1.4	267,000	0.7	37
61	Educational Services	126	4.3	423,300	1.4	112
62	Health Care & Social Assistance	333	11.4	482,700	3.2	297
71	Arts, Entertainment & Recreation	18	0.6	61,500	1.4	16
72	Accommodation & Food Services	79	2.7	332,700	1.1	68
81	Other Services (except Public Administration)	61	2.1	176,900	1.5	52
92	Public Administration	103	3.5	685,000	0.7	88
00	Unknown	12	0.4	--	--	10
Total		2,920		4,645,864	3.1	2,704

[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 1989-2007 per 100,000 adult workers in each industrial category.

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

TABLE 4
1,698 Work-Related Asthma Cases from Manufacturing Industries: 1989-2007

	2002 North American Industry Classification System	WRA Cases #	Ann Avg Rate[a]	# Employees[b]
311	Food Mfg	48	7.2	35,300
323	Printing & Related Support Activities	18	4.2	21,900
325	Chemical Mfg	89	13.5	34,600
326	Plastics & Rubber Products Mfg	89	10.2	45,800
327	Nonmetallic Mineral Product Mfg	15	4.3	18,500
331	Primary Metal Mfg	61	10.2	31,400
332	Fabricated Metal Product Mfg	92	5.4	89,000
333	Machinery Mfg	126	7.4	89,600
334	Computer & Electronic Product Mfg	12	2.7	23,700
336	Transportation Equipment Mfg	1,032	17.1	317,000
337	Furniture & Related Product Mfg	10	1.4	36,900
	Miscellaneous Mfg (*includes NAICS: 312-16,321-322,324,335,339)	106	7.0	79,400

[a]Average annual incidence rate, total number of cases for 1989-2007 (the years with complete case reporting results). Rates are based on average number of cases from 1989-2007 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 382 (13.1%) of the WRA case exposures and cleaning products, associated with 307 (10.5%) of Michigan's WRA patients. Metal working fluids (coolants) accounted for 305 (10.4%) of Michigan worker exposures.

There has been increased awareness and interest in the past few years of 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.

The Michigan WRA Tracking Program is working with other states to identify these agents, provide case-based evidence of the potential harm these substances can cause, and offer suggestions for alternative cleaning agents with less potential for harm.

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: 1988-2009

Exposure Agent	#	%
Isocyanates	382	13.1
Cleaning Solutions	307	10.5
Metal Working Fluids	305	10.4
Unknown (Mfg.)	217	7.4
Unknown (Office)	183	6.3
Exhaust/Smoke/Fumes	156	5.3
Welding Fume-Stainless & Other	128	4.4
Solvents	102	3.5
Paint Fumes	72	2.5
Epoxy	64	2.2
Formaldehyde	59	2.0
Latex/Rubber	59	2.0
Acids	53	1.8
Fungus	51	1.7
Plastic Fumes	42	1.4
Chlorine	41	1.4
Acrylates	38	1.3
Fire	34	1.2
Cobalt	30	1.0
Chemicals Used in Construction	27	0.9
Wood Dust	25	0.9
Ammonia	23	0.8
Styrene	23	0.8
Flour	22	0.8
Cigarette Smoke	20	0.7
Animal Dander	19	0.7
Fragrances	19	0.7
Herbicide/Pesticide	17	0.6
Glutaraldehyde	16	0.5
Fiberglass	15	0.5
Chromium	14	0.5
Amines	12	0.4
Caustics	12	0.4
Grain Dust	12	0.4
Printing Inks	12	0.4
Cement Dust	11	0.4
Plants/Organic Matter	11	0.4
Anhydrides	10	0.3
Cosmetology Chemicals	10	0.3
Rust Inhibitor	10	0.3
Asphalt	8	0.3
Insecticides	8	0.3
Meat Wrapper's Asthma	7	0.2
Other[a]	234	8.0
Total	**2,920**	**99.9**

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

There were 5 cases each w/exposure to: 1,1,1 Trichloroethane, Enzymes, Solder Fume, Textile Lint.

There were 4 cases each w/ exposure to: Asbestos, Freon, Medications, Photo Developing Fluids, Polyurethane, Rose Hips, Sulfonate, Sulfur Dioxide, Trichloroethylene, X-Ray Developing Fluids.

There were 3 cases each w/exposure to: Cadmium Solder, Coal Dust, Colophony, Drywall Dust, Hydraulic Oil, Lime Dust, Mold Release Spray, Natural Gas, Nickel, Psyllium, Sand, Sewage, Sludge, Tar Fume, Zinc Oxide.

There were 2 cases each w/exposure to: Acetates, Cellulose, Concrete Sealer, Copier Toner, Copper Oxide, Dimethyl Benzyl Ammonium Chloride, Exercise, Fireproofing Chemicals, Gas and Oil Refinery Exposures, Glaze, Kerosene, Ozone, Pepper Gas, Perchloroethylene, Phosgene, Polyester, Polyethylene, 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, Ammonium Chloride, Anesthesia, Benzoate Esters, Blood, Blue Prints, Car Window Sealant, Ceramic Powder, Cold Air, Cooking Oil, Cyanide, Ethylene Oxide, Explosion, Fertilizer, Flares, Flux, Gortex, Iodine, Isopropyl Alcohol, Methamphetamine Lab, Methanol, Mica, Monoammonium Phosphate, Ninhydrin, Nylon-polyhexamethylene Adipamide, Odor, Phenol, Pigment, Plating Chemicals, Platinum, Potassium Aluminum Fluoride, Soda Ash, Soot, Stress, Swimming Pool Shock, Talcum Powder, Tuberculosis Vaccine, White Lithium, World Trade Center Exposure, Zinc Borate.

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).

Twenty-five percent of the asthma patients had a personal history of allergies or asthma (Table 7). Six hundred eighty-seven (26%) had a history of allergies but not 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 2,832[a] Confirmed WRA Patients: 1988-2009

	Smoking Status						
	Current		Ex-Smoker		Non-Smoker		TOTAL
	#	%	#	%	#	%	
OA	211	20.9	395	39.2	402	39.9	1,008
POA	168	15.5	453	41.7	466	42.9	1,087
AA	92	22.5	116	28.4	201	49.1	409
RADS	92	28.0	123	37.5	113	34.5	328
All	563	19.9	1,087	38.4	1,182	41.7	2,832

[a]Missing data on 88 patients.

TABLE 7
Personal History of Allergies or Asthma Among 2,652[a] Confirmed WRA Patients: 1988-2009

	Personal History of...					
	Asthma only		Allergies but not Asthma		No Allergies or Asthma	
	#	%	#	%	#	%
OA	97	10.2	276	29.0	578	60.8
POA	121	12.1	338	33.7	547	54.5
AA	394	94.3	9	2.1	15	3.6
RADS	48	17.3	64	23.1	165	59.6
All	660	24.9	687	25.9	1305	49.2

[a]Missing data on 268 patients.

TABLE 8
Health Care Usage Among Confirmed WRA Patients: 1988-2009

Lifetime History of Health Care Usage			
ER Visit[a]		Hospitalized[b]	
Yes	No	Yes	No
# (%)	# (%)	# (%)	# (%)
1,744 (65)	944 (35)	911 (36)	1,651 (64)
Range		Range	
1-300 visits		1-200 hospitalizations	
AVG 5.8 ±15.6		AVG 3.8±10.5	

[a]Missing data on 232 patients.
[b]Missing data on 358 patients.

SYMPTOMS

Two thousand three hundred ninety-two 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 54%
- 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 49%
- Received benefits 35%
- Denied benefits 16%

TABLE 9
Persistence of Symptoms and Medication Use in 2,678 Confirmed WRA Patients: 1988-2009

Still Exposed?	Total	Breathing Problems Still Present? Yes #	Yes %	Less #	Less %	Still Taking Asthma Medications? Yes #	Yes %	Less #	Less %
Yes	784	756	96.4	240	30.6	674	86.0	145	18.5
No	1,894	1,636	86.4	921	48.6	1,503	79.4	541	28.6
Total	2,678[a]	2,392		1,161		2,177		686	

[a]Information missing on 242 individuals.

TABLE 10
Status of Facilities Where Confirmed WRA Patients Were Exposed to Allergens: 1988-2009

Inspection Status	# Patients Represented	Companies #	Companies %
Inspected	1,165	733[a]	35.0
No Follow-up Planned	1,546	1,171	55.8
Scheduled for Inspection	16	15	0.7
Out of Business	68	60	2.9
No Longer Use Occupational Allergen	26	25[b]	1.2
Sent Company Letter to Check Exposures[d]	99	93	4.4
Total	2,920	2,097[c]	100.0

[a]733 inspections were conducted in 627 different inspections.
[b]Eight companies that no longer use the allergen were previously inspected.
[c]Represents 1,991 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.

INDUSTRIAL HYGIENE

A total of 733 workplace inspections have been conducted since 1988 (Table 10); 106 of those facilities had been inspected more than once. Twenty-seven inspections have been completed since last year's report.

Air sampling for allergens was conducted during 523 inspections (Table 11); 24 (4.6%) of the 523 facilities with a MIOSHA standard for the allergen were above the enforceable permissible exposure limit.

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

TABLE 11
Air Monitoring Results from 733 Workplace Inspections: 1988-2009

Air Sampling – NIOSH Standard	#	%
Above NIOSH Standard	64	8.7
Below NIOSH Standard	440	60.0
No NIOSH Standard	20	2.7
Unknown (no report yet)	8	1.1
Did Not Sample for an Allergen	26	3.5
Did Not Sample	175	23.9
Total	733	99.9[a]

Air Sampling – MIOSHA Standard	#	%
Above MIOSHA Standard	24	3.3
Below MIOSHA Standard	496	67.7
No MIOSHA Standard	3	0.4
Unknown (no report yet)	8	1.1
Did Not Sample for an Allergen	27	3.7
Did Not Sample	175	23.9
Total	733	100.1[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 1988-2009

	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 562 of the 733 inspections. They reported daily or weekly breathing symptoms or new onset asthma since beginning to work at 370 of the 562 (66%) companies. The average percentage of co-workers with symptoms in these 370 companies was 20.6%. All 1,482 co-workers from the remaining 192 companies reported no breathing symptoms. One thousand five hundred twenty-one of the 9,678 (15.7%) co-workers interviewed had symptoms consistent with work-related asthma (Table 13).

The MIOSHA Injury and Illness Logs (Form 300) kept by employers listed 574 workers from 130 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 2,086 symptomatic workers were identified during the 733 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 2,920 Confirmed WRA Patients

Symptoms	Disease Status of the Index Patient									
	ALL		OA		POA		AA		RADS	
	#	%	#	%	#	%	#	%	#	%
Daily or Weekly SOB, Wheezing or Chest Tightness	1,521	15.7	1,065	16.1	415	15.0	4	16.0	37	12.9
Workers Interviewed	9,678		6,602		2,765		25		286	
OSHA Log	574	17.7	398	20.8	163	13.4	2	9.1	11	15.4
# Companies w/Employee on Log	130		89		36		1		4	
# Companies Inspected	733		427		269		11		26	
Total[a]	2,095		1,463		578		6		48	

[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 reported in calendar year 2009, and no deaths reported in calendar year 2010 as of the date of this publication.

We have published articles on some of the work-related asthma deaths[3,4].

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.

The companies that reported the use of isocyanates in calendar year 2008 (the most recent year available) 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.

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	3,100	47,470	6.5	Haworth Inc. Johnson Controls Parker Hannifin
Barry	1,100	26,216	4.2	Bradford White
Berrien	830	67,730	1.2	Ancast Tyler Refrigeration Vail Rubberworks Vanguard
Calhoun	223	60,813	0.4	Bostik Cello-Foil Products Comcast Urethane
Charlevoix	500	11,766	4.2	East Jordan Iron Works
Clare	300	10,856	2.8	Renosol Seating
Clinton	10	33,578	<0.1	Innovative Polymers
Dickinson	580	12,649	4.6	Grede Foundry Louisiana-Pacific Sagola OSB
Eaton	2,726	52,149	5.2	Axson North America GM/Lansing Delta Township

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]
Genesee	1,000	168,914	0.6	ASI Packaging Co.[d] Delphi Energy & Chassis Flint East
Hillsdale	85	17,170	0.5	Dow Chemical Company
Ingham	1,182	134,280	0.9	GMVM Lansing Huntsman Advanced Materials Williamston Products
Isabella	550	35,302	1.6	Delfield
Jackson	1,200	66,162	1.8	ADCO Products[d] Milsco/MI Seat/Hurst & Brooklyn TAC Manufacturing
Kalamazoo	120	119,688	0.1	Azon USA Parker Hannifin Corp.
Kent	2,228	279,564	0.8	Conway Products/Emerald Spas Detroit Diesel Remanufacturing North Grand Rapids Foam Technologies HB Fuller Leon Plastics Purforms Richwood Industries Univar USA Inc. Venture[d] Wolverine World Wide
Lapeer	10	35,980	<0.1	ITW/TACC
Lenawee	415	40,669	1.0	Anderson Development Insulspan[d] Pilkington Clinton
Livingston	430	80,046	0.5	Atreum Howell[d] Package Design & Manufacturing
Luce	111	2,355	4.7	Louisiana-Pacific Corporation
Macomb	2,614	349,519	0.7	Cadence Innovation/Malyn[d] Daimler/Chrysler Sterling Heights Assembly DuPont Mount Clemens Plant Faurecia Automotive Seating International Casting Corporation Michigan Metal Technologies Rivas

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]
Macomb	Continued...			Romeo Rim US Farathane Wolverine Bronze
Mason	215	12,685	1.7	Great Lakes Castings
Mecosta	540	17,117	3.2	Wolverine World Wide
Midland	1,000	38,752	2.6	Dow Chemical
Monroe	175	64,001	0.3	Sunrise Windows
Montcalm	208	22,055	0.9	Kent Foundry Northland Corporation
Muskegon	130	74,972	0.2	Brunswick Bowling[d] MI Steel
Oakland	1,228	524,869	0.2	Armaly Sponge Behr America Cass Polymers of Michigan Eagle Industries Exotic Rubber & Plastics[d] Fanuc Robotics[d] ITW Devcon Futura Lymtal International Microposite Inc. Recticel Interiors North America Recticel UREPP North America
Ogemaw	75	8,329	0.9	Taylor Building Products
Ottawa	585	115,000	0.5	Eagle Packaging Izzy/Counterpoint Magna Donnelly Corporation
Saginaw	1,135	82,376	1.4	Delphi Saginaw Steering Systems Filtrona Porous Technologies Glastender Saginaw Metal Casting Operations
St. Joseph	35	24,611	0.1	Chenowith Roofing[d]
Sanilac	730	17,154	4.3	Grupo Antolin Marlette Midwest Rubber Co. Numatics

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]
Van Buren	182	34,956	0.5	BASF Construction Chemicals Special-Lite
Washtenaw	1,500	168,054	0.9	Automotive Components Holdings
Wayne	5,808	727,699	0.8	Alpha Resins Arvinmeritor Auto Alliance International[d] BASF Corporation, Livonia & Wyandotte Collins & Aikman[d] Daimler/Chrysler JNAP EFTEC North Americas EQ Detroit Lear Corporation Plastomer Corporation Poof-Slinky Progressive Distribtion[d] Recycled Polymeric Materials Univar USA Woodbridge Corporation
TOTAL	32,860	4,224,000	0.8	

[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 2008 (report April 4, 2010).

[d]Source: Michigan Department of Environmental Quality, FOIA Request for SARA Title III Emergency Planning and Release Reporting of select chemicals (isocyanates), received April 6th, 2010.

Michigan Workforce Exposed to Selected Causes of WRA

Another source to identify chemical exposures associated with WRA comes from the Michigan Department of Natural Resources and Environment (DNRE). 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 April 6, 2010, the date of the report generated by the Michigan DNRE.

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 Natural Resources and Environment (DNRE) 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	Munising City of (POTW)	Chlorine
	Neenah Paper—Michigan Inc.	Ammonia
Allegan	Birds Eye Foods	Ammonia, Chlorine
	Dr. Pepper/Seven Up Bottling	Ammonia
	Green Valley Agricultural	Ammonia
	Hamilton Farm Bureau Co-Op	Ammonia
	Hudsonville Creamery & Ice Cream	Ammonia
	Otsego City of, Waste Water Treatment Plant (WWTP)	Chlorine
	Otsego City of, Wells #3, #4, #5	Chlorine
	JBS Plainwell	Ammonia
	Plainwell City of, WWTP & Water Renewal	Chlorine
	Sherwin Williams Company	Ammonia
	Tiara Yachts—S2 Yachts	Styrene
Alpena	Airgas Great Lakes	Chlorine
	Alpena Supply Company	Chlorine
Antrim	Great Lakes Packing Company	Ammonia
	US Fish & Wildlife Svc—Jordan Riv Natural Fish Hatchery	Formaldehyde
Arenac	Saginaw-Midland Municipal Water—Whitestone Station	Chlorine
Barry	Caledonia Farmers Elevator	Ammonia
	Carbon Green BioEnergy	Ammonia
Bay	Airgas Great Lakes—Bay City	Chlorine
	Auburn Fertilizer	Ammonia
	Bay City of, Bay Metropolitan Water Treatment	Chlorine
	Carbone of America—Ultra Carbon Division	Chlorine
	Crop Production Services	Ammonia
	Essexville Waste Water Treatment	Chlorine
	Mammel Farm	Ammonia
	Quantum Composites, Inc.—Premix	Styrene
	West Bay County Regional Waste Water	Chlorine

Table 15, continued...

County	Company Name	Type of Exposure
Benzie	Frankfort Cold Storage	Ammonia
	Graceland Fruit	Ammonia
	MI DNR—Platte River St. Fish Hatchery	Formaldehyde
	Smeltzer Orchard Company	Ammonia
Berrien	Advanced Products	Ammonia
	Andrews University WWTP	Chlorine
	Benton Harbor Water Plant	Chlorine
	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 Waste Water Treatment Plant	Chlorine
	Niles Water Department—Iron Removal Plant	Chlorine
	Old Europe Cheese	Ammonia
	Saint Joseph Water Plant	Chlorine
	Sandvik Materials Technology	Ammonia
Branch	Alchem Aluminum—Aleris International	Chlorine
	Colwater Water Treatment Plant	Chlorine
	Quality Spring/Togo	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
	Eaton Corporation PSCO	Ammonia
	Guardian Fiberglass	Formaldehyde
	House of Raeford Farms	Ammonia
	Musashi Auto Parts	Ammonia
	Post Foods	Chlorine
	The Andersons Albion Ethanol	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Cass	Marcellus Agronomy	Ammonia
	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
	Georgia-Pacific Chemicals	Ammonia, Formaldehyde
	Grayling Generating Station	Chlorine
	Weyerhaeuser NR Company	Formaldehyde
Delta	Escanaba Paper Company—Newpage Corporation	Ammonia, Chlorine
Dickinson	Verso Paper Company—Quinnesec Mill	Chlorine
Eaton	Airgas Great Lakes—Lansing Plant	Ammonia, Chlorine
	Axson North America	Styrene
	Cass Polymers of Michigan	Styrene
	Citizens, Otto Rd. Plant	Ammonia
	Crop Production Services	Ammonia
	Lansing Board of Water & Light—River Intake	Chlorine
	Meijer Lansing Distribution	Ammonia
	Owens Brockway Glass	Ammonia
	S.P. Kish Industries	Ammonia
Emmett	Michigan DNR—Oden State Fish Hatchery	Formaldehyde
Genesee	Airgas Great Lakes—Flint	Chlorine
	Coca-Cola Enterprises—Flint	Ammonia
	Country Fresh	Ammonia
	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	Ammonia
	Koegel Meats	Ammonia
	Rogers Elevator Company	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Genesee	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
Hillsdale	Bob Evans Farms	Ammonia
	Conagra Foods	Ammonia
	Hillsdale Waste Water Treatment	Chlorine
	Michigan South Central Power Agency — Endicott	Chlorine
	Prattville Fertilizer & Grain	Ammonia
	The Andersons Litchfield Farm	Ammonia
Houghton	Michigan—American Water Company	Chlorine
	Peninsula Copper Inds.	Ammonia
	Vollwerth's	Ammonia
Huron	Bad Axe City of, Waste Water Treatment Plant	Chlorine
	Caseville Village of, Water Treatment Plant	Chlorine
	Co-Op Elevator Elkton NH3 Site	Ammonia
	Cooperative Elevator Company	Ammonia
	Crop Production Services	Ammonia
	Dow Agrosciences	Ammonia
	Farmers Co-Op Grain	Ammonia
	Harbor Beach Waste Water Treatment Plant	Chlorine
	Harbor Beach Water Works	Chlorine
	Thumb Tool & Engineering	Ammonia
Ingham	Airgas Great Lakes—Lansing Mint Road	Ammonia
	Aldi Inc., Webberville	Ammonia
	Alexander Chemical Corporation	Ammonia, Chlorine
	Arctic Glacier—Lansing Plant	Ammonia
	Aurora Specialty Chemistries	Epichlorohydrin
	East Lansing—Meridian Water & Sewer	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Ingham	Jorgensen Farm Elevator	Ammonia
	Lansing Board of Water & Light—Dye Water Cond. Plt.	Ammonia
	Leslie City of, WWTP	Chlorine
	Linde Gas	Ammonia
	Mason City of, POTW Plant	Chlorine
	MBI	Ammonia
	Melody Farms	Ammonia
	Nitrex—Michigan Operations	Ammonia
	Quality Dairy Company	Ammonia
	Symmetry Medical—Jet Engineering	Cobalt
	The Andersons Webberville	Ammonia
Ionia	Belding Tank Technologies	Styrene
	Cargill Kitchen Solutions	Ammonia
	Crop Production Services	Ammonia
	Herbruck Poultry Ranch	Ammonia
	Portland City of, Waste Water Treatment Plant	Chlorine
	TRW Automotive US	Ammonia
	Twin City Foods	Ammonia, Chlorine
Iosco	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
	Springport Elevator	Ammonia
	Summit Township—Coventry Pk, JCC, Kimmel Rd, Meadow Hts, Southview & West Chester	Chlorine
	Tenneco-Jackson Engineering	Ammonia
Kalamazoo	AGA Gas	Ammonia, Chlorine
	Cytec Industries	Epichlorohydrin, Formaldehyde
	Haviland Products	Formaldehyde
	Kal Blue Reprographics	Ammonia
	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

Table 15, continued...

County	Company Name	Type of Exposure
Kent	AGA Gas	Ammonia
	Airgas Great Lakes—Grandville	Ammonia, Chlorine
	Allied Finishing	Formaldehyde
	Brenntag Great Lakes	Ammonia, Formaldehyde
	Butterball Farms	Ammonia
	Coca-Cola Bottling	Ammonia
	Cook Composites & Polymers	Phthalic Anhydride
	Country Fresh	Ammonia
	CPA: 14	Ammonia
	Earthgrains Baking Co.	Ammonia
	Electro-Chemical Finishing Company—44th St. Facility	Ammonia
	Electro-Chemical Finishing Company—Remico St. Facility	Formaldehyde
	Emerald Spas	Styrene
	Everfresh	Ammonia
	GM Components Holdings	Ammonia
	Gordon Food Service — Clay Ave & 50th St. Facilities	Ammonia
	IBP Foods	Ammonia
	Jack Brown Produce	Ammonia
	Jolly Roger Ice Arena	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
	Old Orchard Brands — Spark Facility	Ammonia
	Patterson Ice Center	Ammonia
	Ridgeking Apple Packing	Ammonia
	Sellner-Behr Corporation	Styrene
	Southside Ice Center	Ammonia
	Sparta Village of, Water Department	Chlorine
	Spartan Stores Distribution	Ammonia
	Specialty Heat Treating	Ammonia
	State Heat Treating	Ammonia
	Superior Seafood	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Kent	Superior Stone Products	Styrene
	SYSCO Food Services of Grand Rapids	Ammonia
	Univar—Grand Rapids	Formaldehyde
	Vi-Chem Corporation	Styrene
	Wolverine Leathers	Ammonia
	Wyoming Clean Water Plant	Chlorine
Keweenaw	Tootsie Roll Movers	Ammonia
	Susan's Big Dummy	Ammonia
	Susan's Farm	Ammonia
Lapeer	Airgas Great Lakes — Lapeer	Chlorine
	Deco' Plate Manufacturing—DOTT Industries	Formaldehyde
	Royster-Clark—Crop Production Services	Ammonia
Leelanau	Cherry Growers—Plant 2	Ammonia
	Leelanau Fruit Company	Ammonia
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
	Munson Agri-Services	Ammonia
	Tecumseh City of, Well House #3, #8-#12 & #14	Chlorine
	War-Ag Farms Services	Ammonia
Livingston	Alpha Technology Corporation	Styrene
	Chemco Products	Formaldehyde
	Gordon Food Service	Ammonia
	Howell City of, Waste Water Treatment Plant	Chlorine
	Howell City of, Water Plant	Chlorine
	Kelsey-Hayes Company, TRW Automotive	Chlorine
	May & Scofield	Styrene
	Pepsi Cola Metropolitan Bottling	Ammonia
Mackinac	Department of Public Works—WWTP	Chlorine
	Department of Public Works—Water Treatment Plant	Chlorine
Macomb	Ashland Distribution	Styrene
	Chemtech Finishing System	Epichlorohydrin, 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

Table 15, continued...

County	Company Name	Type of Exposure
Macomb	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
	Turri's Italian Foods	Ammonia
	Warren City of, Waste Water Treatment	Chlorine
Manistee	Bear Lake Storage	Ammonia
Marquette	Airgas North Central	Chlorine
	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
	Noron Composite Technologies	Styrene
Mecosta	Leprino Foods Company—Remus	Ammonia
	United States Marble	Styrene
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
	Midland City of, Waste Water Plant	Chlorine
	Midland City of, Water Treatment	Chlorine
	Midland Materials Research—Carbone of America	Chlorine
Monroe	Advanced Heat Treat	Ammonia
	Detroit Edison—Monroe Power	Ammonia
	Home City Ice Company	Ammonia
	Independent Dairy	Ammonia
	Maybee Farmers	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Monroe	Meijer Newport Distribution	Ammonia
	Ottawa Lake Co-Op Elevator	Ammonia
	Royster-Clark	Ammonia
Montcalm	Crop Production Services	Ammonia
Muskegon	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
	Muskegon Heights Filtration Plant	Chlorine
	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
	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
	Husky Injection Molding Systems	Ammonia
	John Lindell Ice Arena	Ammonia
	K.C. Jones Plating Company	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Oakland	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
	United Paint & Chemical Corporation	Ammonia
	US Foodservice	Ammonia
	Valley National Gases	Ammonia
	Waterford Township Iron Removal Plants	Chlorine
Oceana	Chase Farms	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
Ontonagon	Smurfit-Stone Container Enterprises	Chlorine
Osceola	Advanced Fibermolding	Styrene
	Liberty Dairy Company	Ammonia
	Ventra Evart	Formaldehyde
	Yoplait USA	Ammonia
Otsego	Airgas Great Lakes—Gaylord	Chlorine
Ottawa	Boar's Head Provisions	Ammonia
	Consumers Energy — JH Campbell Plant	Ammonia
	Crème Curls Bakery	Ammonia
	Edge Ice Arena	Ammonia
	Georgetown Ice Center	Ammonia
	Grand Haven Board of Light—JB Sims Generating Station	Chlorine
	Grand Haven, City of — NW Ottawa Water Treatment	Chlorine
	Interstate Warehousing	Ammonia
	Juana's Packing Company– Brady Farms	Ammonia
	Lake Welding Supply Company	Ammonia
	Lakeshore Filtration Plant—Grand Rapids	Chlorine

Table 15, continued...

County	Company Name	Type of Exposure
Ottawa	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
	Specialty Heat Treating of Holland	Ammonia
	Superior Sales	Ammonia
	Total Logistic Control	Ammonia
	Vertellus Specialties	Ammonia
Saginaw	Agriliance	Ammonia
	Agrium Advanced Technologies (US)	Ammonia
	Airgas Great Lakes—Saginaw Stoker Drive	Chlorine
	Bridgeport Waste Water Treatment Plant	Chlorine
	Buena Vista Waste Water Treatment Plant	Chlorine
	Dow Corning	Ammonia
	Eaton Corporation	Ammonia
	Frankenmuth City of, Waste Water Treatment Plant	Chlorine
	Hi-Tech Steel Treating	Ammonia
	Linear Motion	Ammonia
	Nash Finch (Super Foods)	Ammonia
	Nexteer Automotive	Ammonia
	Saginaw Charter Township Retention Basin	Chlorine
	Saginaw City of, Water Treatment Plant	Chlorine
	Saginaw City of, WWTP	Chlorine
	Star of the West Milling Company	Chlorine
	Winfield Solutions	Ammonia
Saint Clair	Airgas Great Lakes — Port Huron	Chlorine
	Dunn Paper	Chlorine
	Lake Huron Water Treatment Plant	Chlorine
	Marysville City of, WWTP	Chlorine
	Marysville Ethanol	Ammonia
Saint Joseph	Abbott Nutrition	Ammonia
	Crop Production Services—Mendon Unit	Ammonia
	Forest River—Vanguard	Formaldehyde
	Michigan Milk Producers	Ammonia
	Sturgis City of, Waste Water Treatment Plant	Chlorine
	Three Rivers Waste Water Treatment Plant	Chlorine

Table 15, continued...

County	Company Name	Type of Exposure
Sanilac	Crop Production Services	Ammonia
	Croswell Water Plant	Chlorine
	DGP	Styrene
Shiawassee	Crop Production Services	Ammonia
	Kondel Farms	Ammonia
	Machine Tool & Gear	Ammonia
	Taylor Farms	Ammonia
	V V Farms	Ammonia
	Vanderhoof Farms	Ammonia
	Wausaukee Composites	Styrene
Tuscola	Caro Village of, Waste Water Treatment Plant	Chlorine
	Cass City Village of, Waster Water Treatment Plant	Chlorine
	Co-Operative Elevator	Ammonia
	Dykhouse Pickle Company	Ammonia
	Precision Concepts	Styrene
Van Buren	Albemarle Corporation—South Haven	Ammonia
	Alloy Steel Treating	Ammonia
	Coca-Cola North America	Ammonia, Chlorine
	Crop Production Services	Ammonia
	Dole Packaged Foods—Decatur	Ammonia
	Fruit Belt Foods, Canning	Ammonia
	Hanson Logistics, Hartford Warehouse	Ammonia
	Knouse Foods—Paw Paw Plant	Ammonia
	Lawrence Freezer	Ammonia
	MBG Marketing—Grand Junction Facility	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
Washtenaw	Airgas Great Lakes—Ann Arbor	Ammonia, Chlorine
	Ann Arbor Ice Cube	Ammonia
	Arbor Hills Electric, Gas Recovery Systems	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

Table 15, continued...

County	Company Name	Type of Exposure
Wayne	A & R Packing	Ammonia
	Aldoa Company	Epichlorohydrin
	Arctic Cold Storage	Ammonia
	Arted Chrome Plating	Chlorine
	BASF Corporation	Ammonia, Epichlorohydrin, Styrene
	Bottling Group, LLC, Pepsi Bottling	Ammonia
	C.F. Burger Company	Ammonia
	Cardinal Health	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
	Farmer's Cold Storage	Ammonia
	Faygo Beverages	Ammonia
	Freezer & Dry Storage	Ammonia
	Freezer Services of MI	Ammonia
	Fritz Products	Chlorine
	Home City Ice Company	Ammonia
	Inland Waters Pollution Control	Styrene
	Interstate Chemical	Ammonia, Formaldehyde
	JCI Jones Chemicals	Chlorine
	KA Steel Chemicals	Chlorine
	Lincoln Distributing—Painters Supply & Equipment	Styrene
	Linde Gas—Canton	Ammonia
	Marathon Petroleum	Ammonia
	McGean-Rohco	Ammonia
	McLane Food Service—Plymouth	Ammonia
	Michigan Dairy—The Kroger Company	Ammonia
	Norquick Distributing Company	Ammonia
	Polychemie	Formaldehyde
	Polymer Concrete Corporation	Styrene
	Praxair Distribution	Ammonia

Table 15, continued...

County	Company Name	Type of Exposure
Wayne	Progressive Distribution Centers—Evans Distribution	Styrene, Epichlorohydrin
	PVS Nolwood Chemicals	Formaldehyde
	PVS Technologies	Chlorine
	Quaker Chemical	Formaldehyde
	S & F Foods	Ammonia
	Sherwood Food Distributers	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
	White Tower Industrial Laundry	Chlorine
	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
	Haring Township Water Supply	Chlorine
	TD Heat Treat	Ammonia

[a]Source: Michigan Department of Natural Resources and Environment (DNRE). 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 DNRE on April 5, 2010.

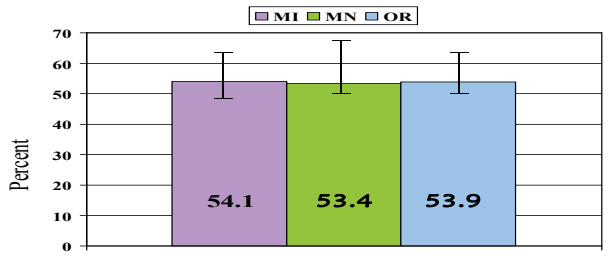
Discussion

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.[5]

Self-reports from patients suggest that work exposures have an even greater effect. In a study published in May 2010, 54.1% of a random sample of adults with asthma in Michigan responded that their asthma was caused or made worse by work (Figure 3)[1]. The same questions were asked in Michigan and Oregon and similar results were found. 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 4)[1]. At minimum, the data suggest that providers are not addressing concerns of their patients and probably missing the identification of work-related asthma triggers. Data for this same study showed that the individuals with concerns about work-related asthma triggers had more health care usage (Figure 5)[1] and were more symptomatic (Figure 6)[1].

On average, 147 new people each year are reported to the Michigan Department of Energy, Labor and Economic Growth (DELEG) with confirmed WRA. One hundred twenty-three reports were confirmed in 2007,

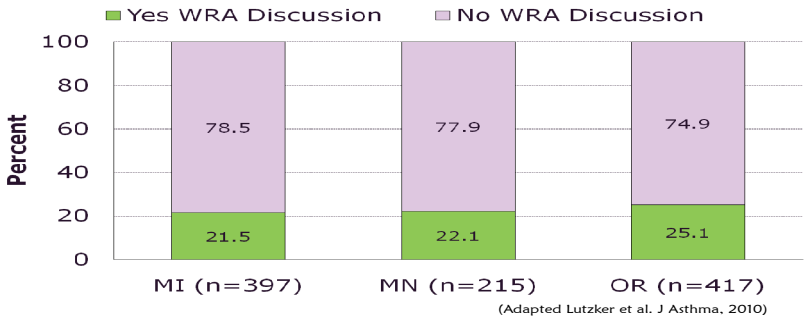
Figure 3. Estimates of Current Asthma Attributable to Work*: MI, MN, & OR



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

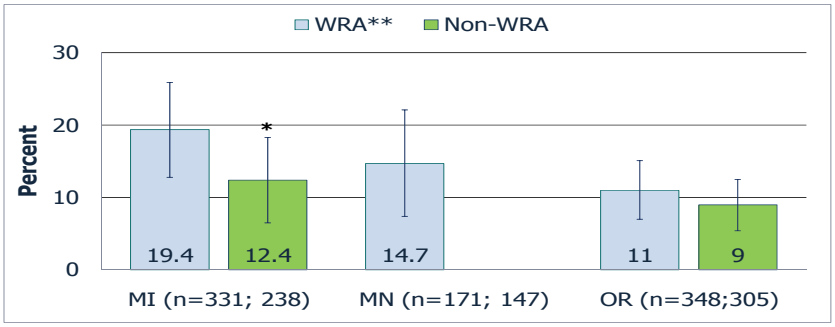
(Adapted Lutzker et al. J Asthma, 2010)

Figure 4. Lifetime Adult Asthmatics with Self-Reported Work-Related Symptoms by whether their Health Care Provider Discussed Work-Relatedness: MI, MN, & OR



(Adapted Lutzker et al. J Asthma, 2010)

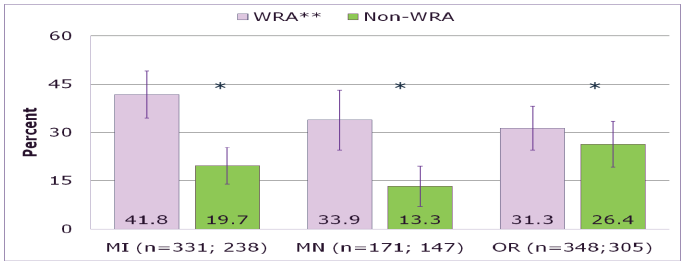
Figure 5. Prevalence of ≥1 Asthma ED/UC Visit (1 year) by Work-Relatedness, Adults (≥18 Years) with Current Asthma: MI, MN, & OR



*p<0.0001
**Yes to at least one of the 6 questions
Date suppressed due to estimate stability.
ED=Emergency Department; UC=Urgent Care

(Lutzker et al. J Asthma, 2010)

Figure 6. Prevalence of Having Nighttime Awakenings (30 days) by Work-Relatedness, Adults (≥18 Years) with Current Asthma: MI, MN, & OR



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

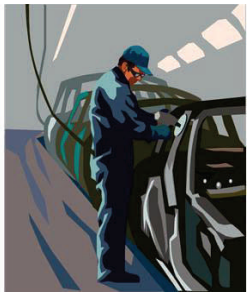
(Lutzker et al. J Asthma, 2010)

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.[6]

As in the previous annual reports on WRA in Michigan, the 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 find new ways to 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



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.

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 this year, metal working fluids have been the second most frequently reported exposure at work. 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, <0.1-6.5% of the work force is employed in facilities where isocyanates are used: Allegan (6.5%), Eaton (5.2%) 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.[7] On the average, among the 1,894 individuals no longer exposed, almost three years elapse from onset of respiratory symptoms at work to date last exposed. We do not have data on how much of this delay is secondary to the individual not seeking medical care and how much is related to the physician not recommending that the individual leave the exposure.

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 (Table 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. A proposal to lower the allowable air concentrations for the isocyanates has been written, gone through a public hearing and is in the final stages of promulgation. There is also an advisory committee to the Occupational Health Standards Commission that is reviewing the permissible exposure limits (PELs) with the intent of making recommendations to lower the PELs on 10-15 substances, including a number of well-known causes of WRA.

We identified 1,521 fellow workers with symptoms compatible with WRA (Table 13). Five hundred seventy-four 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.[7]

The percentages of individuals reported with WRA that this surveillance system documented with breathing tests performed in relation to work is 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.

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

www.bohrf.org.uk

By reporting any known or suspected work-related illness to the state, health professionals contribute to the greater understanding and prevention of work-related illness.

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APPENDIX

2009 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.

TABLE OF CONTENTS

MANUFACTURING

Exposure to Metal Working Fluids and other lubricants

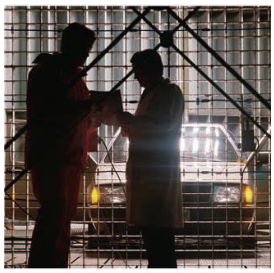
POA Case #2817 A factory worker developed asthma in his 40s after working for approximately one month at a heat-treat facility. He was exposed to fume from the furnace where oil- and rust-inhibitor-covered steel was heat-treated. He was given a paper mask for protection from the fume. He continued to work at this facility for over a year, while continuing to experience wheezing, cough, chest tightness and shortness of breath. He was prescribed Singulair and an inhaler. During this time, he visited the local emergency room once and was hospitalized one time for his breathing problems. He had smoked cigarettes for 30 years. His spirometry was abnormal with an FEV_1 of 56% of predicted, an FVC of 50% of predicted, and a 59% improvement in his FEV_1 post-bronchodilation. He continued to take his medications to control his symptoms after leaving the job.

OA Case #2950 A man developed asthma in his 40s after working over 10 years in an auto parts manufacturing facility. He worked as a tool and die maker, and described grinding activities using a coolant. The grinding machine had no ventilation. He developed wheezing, cough and shortness of breath and was prescribed Advair, Prednisone, and Albuterol. He had never smoked cigarettes.

POA Case #2867 A woman in her 60s with a 60 pack-year cigarette smoking history had worked in a metal stamping factory for over 20 years. She was exposed to both water- and oil-based coolants, as well as diesel fume. She developed asthma with symptoms of wheezing, cough, and shortness of breath. She was prescribed Pulmicort, Albuterol and Advair. She reported her symptoms progressed through the work week and improved when she was away from work.

OA Case #2940 A man developed asthma in his 40s, about a year after beginning to work at a metal stamping plant where he was exposed to metal working fluids. His job as a press operator exposed him to a mist of metal working fluid. He reported wearing a dust mask at work. He was prescribed Singulair, Albuterol, Advair and Spiriva to control his

asthma. He had smoked a pack a day of cigarettes for over 10 years, but quit in his 20s. He continued to work at the company for a couple of years, but left work due to his breathing problems. After being out of the metal working fluid mist, his symptoms improved and he required less asthma medication.



OA Case #2947 A woman developed asthma in her 40s while working for an automotive manufacturing company as a machine operator. She was exposed to metal working fluids, welding fume and boron nitride. She had worked for two years at the company before she developed wheezing, chest tightness, cough and shortness of breath. She was prescribed Advair and Xopenex. She left work at this facility about 10 years after her symptoms developed; about a year later her medication use decreased although her breathing problems had not improved. She quit her pack-a-day cigarette smoking habit after 30 years when she stopped working at the plant.

EXPOSURE TO INDOOR AIR CONTAMINANTS

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.

AA Case #2937 A woman in her 20s experienced an exacerbation of her asthma when she was exposed to mold at her work place in the automotive industry. She was taking Advair, Prednisone and an Albuterol MDI for her pre-existing asthma. She had recently (within less than a year) taken up smoking a pack of cigarettes a day. The company's health and safety personnel confirmed mold was found in the area where she worked. She was reassigned to a new work area and her symptoms improved. She continues to work at the company, avoiding areas where known mold exposures exist.

MULTIPLE EXPOSURES

POA Case #2872 A woman developed asthma in her 30s while working as a pickle brine operator where she was exposed to capsaicin and peppers. She developed wheezing, cough, and shortness of breath eight years after starting work at this facility. She was prescribed Advair and Albuterol. Twelve years after her symptoms started, she left her job on sick/disability leave. Her breathing problems continued and she was on the same amount of asthma medications. She had never smoked cigarettes.

OA Case #2844 A woman developed asthma in her 40s while working at an electronic coil manufacturer where she was exposed to anhydrides, styrene, oil mist, varnish and paints. She had worked at the company for about five years before she developed wheezing, chest tightness and shortness of breath. She was prescribed Advair, Spiriva, and Albuterol and had a nebulizer at home. She continued to work at the company for five more years, and then was put on medical leave for her asthma. She demonstrated an obstructive pattern on spirometry while she was working which improved after stopping work. After she left, she stopped taking asthma medicine. She had multiple doctor's office visits, one emergency room visit and one hospitalization due to her asthma.

POA Case #2963 A man developed asthma in his 30s from exposure to cement dust the year he began working at a cement manufacturing plant. His symptoms began with a cough, which then expanded to wheezing and shortness of breath, then chest tightness. He was prescribed Advair, ProAir and an Albuterol breathing treatment. He smoked a pack and a half of cigarettes for almost 20 years, and quit when his breathing symptoms first began. He continues to work at this company, and tries to avoid exposure to the dust.

POA Case #2966 A woman developed asthma in her 20s after working for about five years in an automotive parts manufacturing facility. Her asthma developed when the company started up a new department to make carpet for vehicles. The carpet contained formaldehyde and other glue-type chemicals. She was prescribed a nebulizer and Ventolin as needed, to control her wheeze, cough, chest tightness and shortness of breath. She continues to work at this facility, although her breathing symptoms are improved and she requires less asthma medicine. She had smoked a pack of cigarettes a day for almost 10 years but quit about five years before her asthma developed.

POA Case #2944 A woman developed asthma in her 30s after working for almost a year at an automotive assembly plant. She was exposed to fiberglass in the automotive carpets she installed, which triggered wheezing, cough, chest tightness and shortness of breath. She has continued to work in the same department for over 10 years, and continues to have breathing problems. Since her initial diagnosis, her symptoms have worsened and she requires increased asthma medication. She smoked less than a pack of cigarettes a day for approximately 20 years, but quit smoking for the past five years.

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

AA Case #2849 A man in his 40s developed aggravation of his pre-existing asthma while working in a construction products plant where he was exposed to multiple chemicals and solvents. He had worked for the company about 10 years before developing cough and shortness of breath after dumping chemicals. At that time, he was prescribed Albuterol. He left this job three months after exposure, and reported decreased symptoms though he continued to use Albuterol. He had never smoked cigarettes.

POA Case #2877 A woman developed asthma in her 40s while working in an automotive metal stamping plant where she was exposed to aerosolized paint, truck exhaust, welding fumes and soot. She initially developed wheezing, cough, chest tightness, and shortness of breath about one hour after vacuuming welding soot. She was seen in the ED and hospitalized, and was treated with Alvesco and Albuterol. Spirometry was normal. She then wore a dust mask while working but continued to have worsening breathing problems at work. She was taking more asthma medications than before. She smoked one pack/day for seven years but quit 30 years ago.

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

POA Case #2829 A woman developed asthma in her 50s while working as a production factory worker where she was exposed to detergent chemicals and solder fumes. Symptoms started after a drain pipe burst and she was soaked with fluid, including detergents. She developed wheezing, cough, chest tightness, and shortness of breath within 24-48 hours of exposure. Subsequently, she was admitted to a local hospital, where she was treated for a presumed pneumonia with steroids, Advair, Albuterol, and antibiotics. After this event, she was reassigned to a new location and was no longer exposed to substances causing breathing problems. Her symptoms persisted, but improved, and she was on fewer asthma medications. She smoked one pack of cigarettes per day for about 40 years, and quit smoking seven years ago.

POA Case #2838 A woman developed asthma in her 20s when working at an automotive manufacturer where she was exposed to paints, plastics, and tetrachloroethylene. Her symptoms of wheezing, cough, chest tightness, and shortness of breath developed within her first year of working at this facility. She was prescribed Ventolin. In addition, she had visited the ED once for breathing problems. She continued to work in the same area with the same

duties. She reported worsening symptoms, with breathlessness during daily activities. She had been diagnosed with emphysema. Spirometry was normal. She smoked three cigarettes per day for five years as a teenager.

Automotive seat manufacturers have potential exposure to diisocyanates, glues, leather and components of fabrics used in seat production.

OA Case #2890 A woman in her 30s developed asthma while working as a meat packager where she was exposed to carbon monoxide, glue, and the breakdown products of polyvinyl chloride, including formaldehyde and anhydrides. Her job duty was to wrap meat in a plastic sealer. She began experiencing wheezing, cough, chest tightness, and shortness of breath that worsened at work about two years after starting this job. She was seen in the ED two times and hospitalized once for breathing problems. She was prescribed Pulmicort and Albuterol. Spirometry was normal. She quit her job on doctor's advice one year later, and reported an improvement in her breathing symptoms. However, she was on more asthma medications than previously. She had never smoked.

EA Case #2833 A man in his 30s developed aggravation of pre-existing asthma while working in an automotive manufacturing plant where he was exposed to fumes, smoke and dust. He developed worsening of his wheezing, cough, chest tightness, and shortness of breath when he began working at this job. His duties entailed running a die-cast machine. He had been seen in the ED on two occasions and was prescribed Serevent and an inhaled steroid. On spirometry, he had signs of obstructive airways disease with hyperinflation with TLC 132%, RV/TLC 137% of predicted, and increased airways resistance. There was no significant post-bronchodilator improvement. He continued to work in the same job and did not wear a respirator or mask. His asthma symptoms worsened, and he was on Xolair, Accolate, and Advair. He had never smoked.

Exposure to wood dust

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

AA Case #2836 A man in his experienced an aggravation of his pre-existing asthma in his 60s while working in a paper mill where he was exposed to wood and cement dust. He developed worsening of his wheezing, chest tightness, and shortness of breath. He was started on inhalers after being off them for over 10 years. Spirometry was normal. He continued to work in the same job. With wearing a protective mask, he reported that exposure to substances causing breathing problems occurred less frequently. His breathing problems improved, and he was not on any asthma medications. He smoked a pack and a half of cigarettes per day for 18 years, but quit in his 30s.

Exposure to flour

OA Case #2871 A man in his 20s who was exposed to flour dust developed asthma two years after beginning to work for a large commercial bakery. After his asthma developed, he continued to work as a mixer operator for three years, until the company went out of business. On spirometry, he demonstrated a severe obstructive pattern. He was prescribed Primatene, Albuterol, Ipratropium, and Singulair. After no longer working as a baker, he continued to have wheezing and shortness of breath, which limited his activity. He had smoked a pack of cigarettes a day for almost 20 years, and quit about 10 years after working as a baker. In the 20 years since his asthma developed, he has had 90 emergency room visits as well as multiple hospitalizations due to exacerbation of his symptoms.

OA Case #2859 A man developed asthma in his 40s while working in a bakery where he was exposed to flour dust. He had been working at this company for 13 years and in a bakery for 30 years before developing wheezing, cough, chest tightness, and shortness of breath. He was prescribed Albuterol and Symbicort. He was seen in the ED on two occasions for breathing problems. He resigned from his position six months after developing symptoms. However, his breathing problems persist and he continues on the same asthma medications. He smoked a half pack of cigarettes per day for 12 years but quit nearly 30 years ago.

Exposure to Isocyanates

OA Case #2854 A man developed asthma in his 40s while working at a motor vehicle parts manufacturer where he was exposed to isocyanates. He developed wheezing, chest tightness, and shortness of breath after exposure to chemicals, including methylene diisocyanate (MDI). He was prescribed Foradil and Asmanex. Baseline spirometry was normal with positive response to bronchodilators. He continued to work in the same job with the same exposures. His breathing problems persisted and he was on the same amount of asthma medications.

OA Case #3027 A man developed isocyanate-induced asthma in his 50s after having worked for about seven years at an automotive parts manufacturing facility. He developed wheezing and shortness of breath. Pulmonary function testing showed a slight small airways obstruction, with FVC 91% of predicted and FEV_1 at 88% of predicted. He was prescribed Pulmicort. Since his diagnosis, he has continued to work at the facility and he reported that his breathing problems have worsened. He has smoked almost a pack of cigarettes a day since his teenage years.

OA Case #2932 A woman developed asthma in her 30s while working as an assembler for an automotive manufacturer where she was exposed to isocyanates. After working at the facility for four years, she developed shortness of breath and chest tightness. She had a positive methacholine challenge and was told that she had environmental asthma. She was off work for two months. When returning to work, she continued to have breathing problems when injection molding machines were purged. She also had acute exposure to isocyanates after a spill at work, after which she developed coughing. She sought medical care and was started on Advair and Xopenex. Spirometry at that time demonstrated air trapping, borderline low FVC and FEV_1, decreased diffusing capacity of 77% and lack of response to bronchodilators. She went on sick/disability leave two months later, and symptoms improved. She had never smoked cigarettes.

OA Case #2898 A woman developed asthma in her 40s while working for an automotive seat manufacturer. She worked at the company for about five years before her exposure to methylene diisocyanate (MDI) caused her to develop wheezing, chest tightness and shortness of breath. She was prescribed Xopenex and Qvar. She had one emergency room visit when her symptoms began, from a failure of the ventilation system. She continues to work at the company, and is required to wear a respirator. She has smoked half a pack of cigarettes a day for over 10 years.

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.

OA Case #2910 A man in his 40s with no prior health problems developed asthma after working a short while on a high-volume production operation spraying MDI-based foam insulation at a factory. This was a temporary assignment at this company. He developed wheezing, cough, chest tightness and shortness of breath and sought medical treatment at an occupational medicine clinic; he was told he had bronchitis. He later sought treatment with his own physician. He was prescribed an Albuterol inhaler. Since that job assignment, he has not been able to find work in a setting with no chemical exposures. His symptoms have improved and he continues to use his inhaler. He has smoked cigarettes for approximately 30 years, about a pack a week.

OA Case #2855 A man developed asthma in his 30s while working at an automotive door manufacturer where he was exposed to methylene diisocyanate (MDI). He worked at the company for eight years before developing cough, chest tightness, and shortness of breath. He was hospitalized once for breathing problems. Baseline spirometry was normal with positive methacholine challenge. He continued to work in same environment for 15 more years with persistent breathing problems. Upon resignation, his symptoms resolved. He has smoked three cigarettes per day for 20 years.

EXPOSURE TO CLEANING PRODUCTS

RADS Case #2926 An engineer developed RADS in his 50s from a leak of chlorine gas at his work place. The leak occurred during the delivery of chlorine from a truck during start up operations at the manufacturing plant where he was helping set up a new process. He developed chest tightness and shortness of breath within 48 hours. He was sent to a local hospital emergency department, and later prescribed Singulair, Albuterol, Advair and Prednisone. After being off work for several months, his breathing improved and he was taking fewer prescribed asthma medications. He had never smoked cigarettes.

In auto manufacturing, diisocyanate-containing paints can cause work-related asthma.

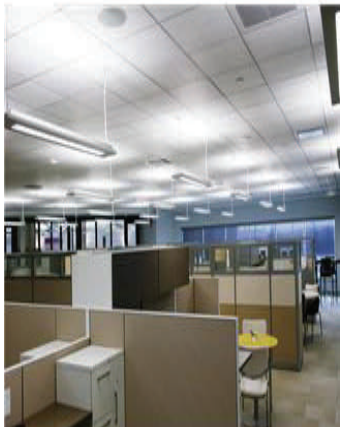
EXPOSURE TO SEALANT

POA Case #2865 A man in his 40s developed asthma while working as a welder at an automotive manufacturer where he was exposed to a sealant containing phthalic acid and zinc oxide. He was working in this job for seven years before developing symptoms of wheezing and shortness of breath. He was prescribed Advair, Xopenex, and Combivent. Spirometry showed FVC 88% of predicted and FEV_1 63% of predicted and a positive bronchodilator challenge. Allergy skin testing was negative. He was hospitalized three times for breathing problems. After he left his job on sick/disability leave, his symptoms persisted though he was on fewer asthma medications. He had never smoked.

EXPOSURE TO COBALT CARBIDE

OA Case #2839 A man developed asthma in his 20s while working in maintenance for a carbide products manufacturer where he was exposed to carbide and cobalt dust. At the same time he started this job, he developed wheezing, cough, chest tightness, and shortness of breath. These symptoms initially bothered him more at work, and just being in the workplace was a trigger. He wore a half mask when working with furnaces. However, over time, his symptoms began to bother him throughout the day regardless of location. He was

admitted to the hospital approximately three times for work-related breathing problems. Eight months later, he left his job on sick/disability leave and had improvement in his symptoms. He was on more asthma medications than previously, including Proventil, ProAir, Prednisone, Albuterol, Allegra, and Singular. Spirometry was abnormal, demonstrating moderately severe airway obstruction and diffusion defect was present. He previously smoked a pack of cigarettes per day for 15 years but quit about five years ago.



OFFICE

EXPOSURE TO CLEANING PRODUCTS

POA Case #2903 A woman developed asthma in her 40s while working as a receptionist in a medical office where she was exposed to an air sanitizer/deodorizer. She was exposed to this product upon hire, but did not develop wheezing, cough, chest tightness and shortness of breath until one year later. She was seen in the ER on two occasions and hospitalized once for breathing problems. Medications included Prednisone, Flovent, Symbicort, and a nebulizer. Spirometry was normal. She quit her job on doctor's advice and was no longer exposed to the air sanitizer. Her breathing problems were reduced though she was maintained on the same medications. She previously smoked two cigarettes per day for six years.

RADS Case #3003 A man in his 40s developed Reactive Airways Dysfunction Syndrome while working as a janitor. He experienced wheezing, cough and shortness of breath within 24 hours of being exposed to floor stripper chemicals. He was prescribed Prednisone, Advair, Combivent and Flonase. He was a 30 pack-year cigarette smoker. He continues to work as a janitor.

RADS Case #2902 A woman in her 50s developed RADS while working as a librarian where she was exposed to chewing gum remover containing liquid petroleum gas. She developed cough and chest tightness immediately after the exposure to gum remover. After seeking medical attention, she was prescribed Prednisone, ProAir, and Asmanex. She continued to work in same job, but kept away from any exposure to the gum remover. Her symptoms improved and she was on less of asthma medications. She smoked for 12 years previously, but quit 35 years ago.

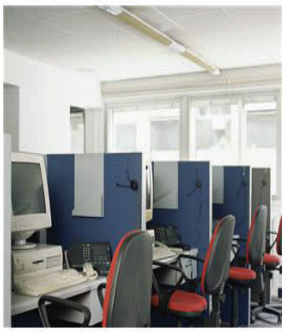
EXPOSURE TO INDOOR AIR CONTAMINANTS

POA Case#2842 A woman with a history of asthma developed breathing problems in her 40s while working as a liability examiner where she was exposed to indoor air contaminants and dust. She developed wheezing, cough, chest tightness, and shortness of breath four years after beginning work in this location. She was admitted to the hospital on two occasions for asthma exacerbations, and was prescribed ProAir, Singulair, Asmanex, and a nebulizer. She continued to work in the same environment with worse symptoms and required more asthma medications. She has smoked 10 cigarettes per day for 22 years.

AA Case #2893 A woman in her 40s developed aggravation of her pre-existing asthma

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.

while working in an office where she was exposed to mold. She was working at this location for one month when she began having worsening of her wheezing, cough, chest tightness, and shortness of breath. Symptoms were the worst while in the workplace, and this was attributed to mold growing under the carpet of her office. She sought medical care and was prescribed Advair and an antibiotic. Her symptoms resolved three months later after her employer sealed windows, removed mold, and replaced carpeting. She was on fewer asthma medications. She had never smoked.



POA Case #2858 A woman developed asthma in her 40s working as a clerical assistant where she was exposed to indoor air, humidity, and perfume. She developed wheezing, cough, and shortness of breath two years after starting this job. She was prescribed Combivent, Tilade, and Singulair. She was seen in the ED once for breathing problems. Baseline spirometry was normal though she had a 14% change in FEV_1 after administration of bronchodilator. She continued to work in the same environment and required more asthma medications, including Symbicort and Albuterol. She had never smoked cigarettes.

POA Case #2901 A woman developed asthma in her 30s working as an office assistant where she was exposed to dust and mold. Six months after hire, she developed head congestion, rash and sore throat that were treated with Singular and Astelin. Five months later, she developed shortness of breath when a dry wall project was started in her office. She was prescribed Prednisone and ProAir and stopped working secondary to breathing problems. Spirometry was normal. She was then reassigned to a new environment and had fewer symptoms. However, she was on more asthma medications than previously, including Qvar, Spiriva, ProAir, Advair, Clarinex and Singulair. She had never smoked.

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

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

POA Case #2894 A man developed asthma in his 50s while working as a manager where he was exposed to indoor air during a construction project taking place in his building. He developed wheezing, cough, chest tightness, and shortness of breath at the time of the construction project. He moved to a new location three months later and was no longer exposed to substances causing breathing problems. However, three months after the project ended, he was seen in the ED for breathing problems. He was prescribed Prednisone and an inhaler. He continued to have breathing problems and was started on more asthma medications. He smoked ½ pack per day for 30 years but quit smoking 10 years ago.

POA Case #2837 An office worker developed asthma in her 30s after a construction project began near her work area where she was employed at a social service agency. She had worked in her office for about two years before she developed wheezing, chest tightness and shortness of breath. Her desk was close to a fresh air supply vent; when construction began she noticed musty and moldy odors coming through the vent. In addition, she noticed mice droppings in her work area. She was prescribed Asmanex and a rescue inhaler and was moved to a different work area. After this, her symptoms improved and she required less asthma medication. She had never smoked cigarettes.

AA Case #2883 A woman developed aggravation of her pre-existing asthma in her 40s while working as a purchasing agent where she was exposed to latex contained in her office's paint, carpet, balloons, and signs. She developed wheezing, cough, chest tightness, and shortness of breath when exposed to latex-containing products. She had been seen in the ER over 20 times, and had been hospitalized six times for breathing problems. Initial

medications included Symbicort, Albuterol, Benadryl, and Prednisone. She continued to have exposure to latex at home and at work, and her breathing problems worsened. She was then on more asthma medications. She previously smoked five cigarettes per day for 27 years but quit two years ago.

AA Case #2939 A woman in her 40s experienced aggravation of her pre-existing asthma at her work place when she was exposed to paint fumes during office renovation activities. She was evaluated at the local hospital's emergency department, and discharged with a prescription for a Prednisone taper. She reported that her work place tried to keep her from exposures that trigger her asthma. She had never smoked cigarettes.

POA Case #2850 A man in his 30s developed asthma two years after working as an engineer where he was exposed to indoor air in his office building. He developed wheezing, cough, chest tightness, and shortness of breath after exposure to mold, dust, and possibly chemicals at his workplace. Symptoms were worst in the afternoon and at the end of the week. He was prescribed Proventil and Singulair. Spirometry was normal. His symptoms resolved five months later and he was no longer taking asthma medications. He had never smoked.

Disinfectants can contain asthma-causing agents such as quaternary amines, that are unnecessarily needed for some cleaning applications.

POA Case #2853 A man in his 30s with a history of seasonal allergies developed asthma while working as an engineer where he was exposed to indoor air and textiles. He developed a cough after moving to a new building with dry, hot air and a previous water leak. He also had significant exposure to textiles at this location. His cough worsened while at work. He was prescribed Singulair, Astepro, Proventil, and antibiotics. On spirometry, he demonstrated minimal airway obstruction and response to bronchodilators. His symptoms resolved and he was on fewer medications when he moved to a new worksite four months later. He had never smoked.

POA Case #2952 A woman developed asthma about five years after she began working at a government office. She described exposures to asbestos and fiberglass. She was prescribed Prednisone, Proventil, Advair, ProAir and a nebulizer. She continued to work in this environment for another 10 years. Upon leaving this job, she reported an improvement in her asthma symptoms and required less asthma medicine. She had smoked one and a half packs of cigarettes a day for over 40 years, but quit smoking when she left her job.

AA Case #2869 A computer analyst developed asthma in her 40s after working 15 years in state government. She developed wheezing, cough, chest tightness and shortness of breath, and was prescribed Qvar, Pro-Air, Flonase and given allergy shots. About 10 years later she was exposed to fumes from an electrical fire in her office, which exacerbated her asthma. She was moved to a new office and her symptoms improved although she continued to require asthma medication. She had smoked cigarettes for over 30 years but recently quit.

Exposure to Animal Dander

OA Case #3018 An office manager in her 50s moved to a new office location that had a cat on the premises. She developed asthma and was prescribed Qvar. Pulmonary function testing showed mild decreased vital capacity with 82% of predicted, and a normal expira-

tory air flow. Post bronchodilators suggested reactive small airways. She had never smoked cigarettes. She ended up having to leave this jobs as more cats were brought into the work place. Since that time, her breathing symptoms have improved and she requires less asthma medication. She had not found new employment almost three years after leaving this job.

EDUCATIONAL SERVICES

EXPOSURE TO INDOOR AIR CONTAMINANTS

POA Case #2816 A woman in her 30s developed asthma working as a school administrator where she was exposed to welding fumes, tile glue, diesel fumes, and construction dust. Four months after starting this job, she developed wheezing, cough, chest tightness, and shortness of breath. Her symptoms worsened when she was in her building and improved when she was away. Three months later, she was seen in the ED and hospitalized for work-related breathing problems. She was prescribed Prednisone, Ventolin, Asmanex, Zyflo, and Ranitidine. Spirometry was normal. She then quit her job due to lung problems. She continued to have breathing problems, and was on more medications. She had never smoked.

Exposures to asthma-causing agents in schools can affect kids, teachers, and other support staff.

POA Case #2891 A woman developed asthma in her 20s after working two years in a public high school as a speech pathologist. After working in a damp room with visible mold on the walls for about two years, she started to feel short of breath. Five years later she started to have a dry cough and chest tightness. She used Asmanex for a few months then stopped. She continued to work in the same environment but noted her shortness of breath and chest tightness decreased even without her medication. She did report the persistence of a cough at work. She had never smoked cigarettes. Spirometry testing was normal.

AA Case #2924 A woman in her 40s experienced an aggravation of her pre-existing asthma at the school where she worked when she was exposed to smoke from a fire. Exposure to smoke from the fire triggered wheezing and shortness of breath. She was prescribed Albuterol, Advair and a steroid pill. She had smoked a pack of cigarettes a day for over 20 years, but had not smoked for over five years.

POA Case #2949 A woman developed asthma in her 30s after she had been working as a teacher for 15 years. She described an incident where water flooded some classrooms and mold grew in those rooms as a result of the flooding. She was prescribed ProAir and Alvesco. Despite clean-up efforts to remove the mold from the rooms, the teacher still experiences wheezing, chest tightness and shortness of breath, although her symptoms are not as severe. She had never smoked cigarettes.

HEALTH CARE SERVICES

EXPOSURE TO WAX AND FLOOR STRIPPERS

AA Case #2831 A woman in her 40s developed aggravation of her pre-existing asthma while working as a nurse where she was exposed to floor strippers and finishers. She noted wheezing, cough, chest tightness and shortness of breath that worsened while at work. In

total, she was admitted to the hospital fifteen times for breathing problems. She was prescribed Prednisone, Advair, DuoNebs, Uniphyl and Zyrtec. Spirometry demonstrated FVC 84% of predicted and FEV_1 69% of predicted. Bronchodilator challenge was negative. She continued to be exposed to these substances and her symptoms persisted. She was on the same amount of asthma medication as previously. She had never smoked cigarettes.

AA Case #2962 A woman in her 40s experienced an exacerbation of her pre-existing asthma at work in a hospital. Her breathing became worse when she was exposed to fume from floor stripper. This type of exposure had occurred several times in the past as well. She was treated at the hospital and able to return to work after that. In general, she tries to avoid being in areas when the floors are stripped. She had never smoked cigarettes.

EXPOSURE TO CLEANING PRODUCTS

OA Case #2832 A man developed asthma in his 20s while working as a maintenance and grounds worker at a hospital where he was exposed to formaldehyde and bleach. He was exposed to a formaldehyde spill and developed wheezing, cough, chest tightness, and shortness of breath within 24 hours of exposure despite using a respirator. After evaluation in the ER, he was prescribed Albuterol. He was still exposed to the substances causing breathing problems after this event but had fewer breathing problems. He was on less asthma medications. He had never smoked cigarettes.

Hospitals use many asthma-causing agents in the disinfecting of hospital equipment.

AA Case #3015 A health care worker experienced an aggravation of her preexisting asthma while working at a health care facility where she was exposed to ammonia, bleach and other cleaners that were inappropriately mixed together. She was prescribed bronchodilators and steroids after this incident.

POA Case #2880 A woman developed asthma in her 30s while working as a medical research assistant where she was exposed to cleaning supplies, perfumes and deodorants. She developed wheezing, cough, chest tightness, and shortness of breath that worsened at work when she was exposed to cleaners and fragrances. She was prescribed inhalers and prednisone. She had visited the ED four times for breathing problems. About 10 years after her symptoms began, she was fired from her job and her symptoms improved. She was then on fewer asthma medications. Spirometry was normal. She previously smoked three cigarettes per day for 20 years, but quit 10 years ago.

AA Case #2922 A woman in her 40s experienced a worsening of her preexisting asthma at the hospital where she worked. She was exposed to disinfectants while cleaning emergency department equipment using sanitizing wipes. She experienced wheezing, cough, chest tightness and shortness of breath and was prescribed Advair. She was prescribed additional medicines as her breathing problems continued, including Atrovent, Brethine, Prednisone and Advair. She had never smoked cigarettes.

MULTIPLE EXPOSURES

RADS Case #2888 A woman with a history of asthma developed RADS in her 30s while working as a hospital pharmacy technician where she was exposed to chemotherapy

NIOSH has a resource page for Health Care Workers that addresses asthma and other health and safety issues encountered by this employment group: http://www.cdc.gov/niosh/topics/healthcare/

medications, coolant, and fire retardant. She developed wheezing, cough, chest tightness and shortness of breath immediately after exposure to a gas-like substance while cleaning up a spill after a sprinkler system was damaged. She was wearing a mask, paper gown, gloves, and bonnet at the time of the spill. She was seen in the ED where she was treated with Prednisone, Advair, and Combivent. On spirometry, she demonstrated FVC 100% of predicted, FEV_1 69% of predicted, and lack of response to bronchodilators. She continued to experience chest tightness and shortness of breath, but symptoms were overall improved and she was on less asthma medication. She had never smoked.

POA Case #2878 A woman in her 50s developed breathing problems while working as a dental technician where she was exposed to silica, dust, and glazes. She developed cough, chest tightness, and shortness of breath after working at this job for thirteen years. She was seen in the ED one time and hospitalized six times for treatment of breathing problems. She was prescribed Uniphyl, Singulair, Xopenex, and Advair. Spirometry was normal. She continued to work with exposure to the same substances and symptoms persisted. She was on the same amount of asthma medications. She smoked 3 cigarettes per day for 33 years, but quit when her asthma symptoms began.

POA Case #3008 A nurse developed asthma in her 30s about a year after starting work at a hospital. She was prescribed Flovent and Albuterol. She described exposure to carpet removing chemicals, dust and mold. Since her initial diagnosis, she has continued to work at the hospital and requires greater amounts of her medications. She had smoked a half a pack of cigarettes a day for over 15 years, but quit in her 30s. Pulmonary function testing showed normal spirometry, with an FEV_1 93% of predicted, FVC 91% of predicted and FEF25-75 104% of predicted. She continues to work at the hospital.

Exposure to indoor air contaminants

OA Case #2818 A woman worked as a medical assistant when she developed asthma in her 50s from exposure to x-ray processing developers and fixers. She had worked in health care for over 15 years where she was exposed to the x-ray developing chemicals before she developed wheezing, chest tightness and a dry cough. She was prescribed Albuterol, Proventil and Advair. She continued to work in the medical office for a year and a half after she developed her asthma, and then was terminated because she refused to continue to process x-rays because of her breathing symptoms. Spirometry results were normal, and she had never smoked cigarettes. Almost a year later she had not found a new job.

POA Case #2845 A woman in her 30s developed breathing problems while working as a medical assistant. One month after moving to a new office building, she developed wheezing, cough, chest tightness and shortness of breath. Her new workplace was in a basement with water damage. She was seen in the ED on two occasions and hospitalized once for breathing problems shortly after moving to the new location. She was treated with Advair, Albuterol, Singulair, Flonase, steroids, and antibiotics. Further evaluation included peak flows suggesting that her asthma was aggravated by work and spirometry demonstrating a mild obstructive process. She continued to work in same environment and breathing problems persisted, however she was on less asthma medications. She had never smoked.

POA Case #2895 A nurse in her 50s with a history of hay fever developed breathing prob-

lems after exposure to mold spores in the clinic where she worked. She had acute worsening in wheezing, cough, chest tightness, and shortness of breath on two separate occasions after her workplace flooded with sewage. She also developed laryngitis. She was treated with Flovent and Flonase. Workplace air testing demonstrated Alternaria and other mold spores even after environmental remediation. Spirometry was normal. She went on sick leave six months later with improvement in her symptoms. She had never smoked, but lived at home with smokers.

AA Case #2900 A woman with a history of asthma had an asthma attack while working at a hospital. She did not feel that her exacerbation was related to work, and therefore further history could not be obtained from this subject.

POA Case #2981 A woman developed asthma in her 40s after working for over 20 years as a paramedic. Her cough, wheeze, shortness of breath and chest tightness developed after repeated exposures to the cleaning agents used to disinfect the ambulances after each ambulance run. She was prescribed Proventil, and no longer helped clean the ambulances. Since her diagnosis, she reported a worsening of her breathing problems and requires more asthma medicine to control her symptoms, despite avoiding the exposure associated with her asthma. She was a lifetime non-smoker.

AA Case #2866 A woman in her 50s developed an aggravation of her pre-existing asthma while working as a nurse where she was exposed to styrene and betadine found in IV kits. She had been working as an IV nurse for 10 years before developing wheezing, chest tightness, and shortness of breath that began when she would open an IV kit. She was seen in the ED two times for breathing problems and was prescribed Advair, Albuterol, and oral steroids. Baseline spirometry was normal with positive methacholine challenge. Her symptoms improved when she went on sick/disability leave one month later. She had never smoked.

A useful website with information on peak flow monitoring of patients with asthma can be found at:

http://www.occupationalasthma.com/

FOOD AND BEVERAGE SERVICES

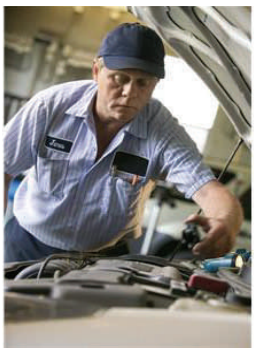
MULTIPLE EXPOSURES

AA Case#2909 A woman in her 20s developed aggravation of her pre-existing asthma while she was working at a fast food restaurant where she was exposed to Vicks rub worn by a co-worker. She developed worsening of her cough, chest tightness, and shortness of breath on two occasions when near the other employee wearing Vicks. She sought care in the ED and was prescribed Xopenex and inhaled steroids. Her workplace banned the use of Vicks. However, she continued with the same amount of symptoms despite removal from exposure. She was on the same amount of asthma medications as well. She had never smoked cigarettes.

EXPOSURE TO CLEANING PRODUCTS

RADS Case #2749 A woman in her 20s developed RADS while working in a restaurant where she was exposed to bleach. She developed wheezing, cough, and shortness of breath

within 24 hours of exposure to bleach used while cleaning walls. She was seen in the ED after the exposure. Spirometry one month later showed FVC 101% of predicted, FEV_1 64% of predicted and a 31% change in FEV_1 post-bronchodilator. Eight months after this event, she was prescribed Proventil and Symbicort. She continued on these medications though her symptoms improved. She had never smoked.



MISCELLANEOUS SERVICES & OTHER INDUSTRIES

EXPOSURE TO INDOOR AIR CONTAMINANTS

AA Case #2884 A woman in her 40s with a history of asthma developed an aggravation of her symptoms while working as a social worker. Her workplace had frequent sewage back-ups and mold and windows that did not open. She developed worsening of her wheezing, cough, chest tightness, and shortness of breath one year after moving to this building. She was seen in urgent care two times for breathing problems and was prescribed Nasacort and MaxAir. Spirometry was normal. She continued to have symptoms and was on the same amount of medication. She smoked one pack/day for 15 years, but quit about 10 years ago.

Workers at any age and with any length of employment are at risk for the development of work-related asthma.

RADS Case #2848 A man developed RADS in his 50s while working in maintenance where he was exposed to fire extinguisher powder. He developed cough and shortness of breath immediately after exposure to the powder while working above a false ceiling. He was prescribed Advair, Spiriva, and Albuterol. After leaving his job on sick/disability leave, he was no longer exposed to the substance causing breathing problems. However, his breathing problems persisted and he continued on the same amount of medications. Spirometry demonstrated FVC 86% of predicted and FEV_1 72% of predicted with a positive methacholine challenge. He previously smoked for 20 years but does not smoke currently.

MULTIPLE EXPOSURES

OA Case #2843 A man in his 40s developed asthma while working in an auto repair shop, exposed to natural gas fumes, bonds, spray paints, carbon monoxide, and black mold. He worked in this facility for seven years before developing cough, chest tightness, and shortness of breath. His symptoms were worse at work and improved while away. He was seen in the ED on five occasions and admitted to the hospital three times for breathing problems. He was prescribed ProAir. Despite continuing at this same job, his symptoms improved as he wore a respirator at all times. Spirometry was normal though he demonstrated a diffusion defect consistent with pulmonary vascular process. He had never smoked.

POA Case #2897 A man in his 30s developed asthma while working to direct traffic and collect fees where he was exposed to automobile exhaust and burning wood fumes. He developed wheezing, chest tightness, and shortness of breath nine years after starting this job. He was seen in the ED about 10 times for breathing problems. Medications started included Singular, Allegra, Asmacort, and Pulmicort. Spirometry was normal. He wore a dust mask while at work. He continued at the same job with same exposures and his breathing problems worsened. He was on more asthma medications. He had never smoked but was exposed to tobacco smoke while at work.

AA Case #2967 A hair stylist in her 30s experienced an exacerbation of her pre-existing asthma from the hair color products in her work place. She described ammonia and developer solutions, as well as permanent hair coloring products as being associated with a worsening of her asthma symptoms. She takes Albuterol for her symptoms, and reported requiring a decreased amount of medication in recent years. She continues to work in this environment, and wears a face mask. She was an occasional cigarette smoker for about 10 years, smoking a cigarette a day, but quit in her 30s.

ANIMAL EXPOSURES

AA Case #2887 A woman in her 20s with pre-existing asthma experienced an exacerbation of her symptoms while working at a zoo for a summer job. She was a nonsmoker with a history of asthma and seasonal allergies since age 12. She worked in the tourism office and her tasks included talking to guests and being on her feet all day. She had an emergency room visit while working there due to her symptoms. When she left the job at the end of the summer she felt better although she continued to use her rescue inhaler as needed.

Cosmetology chemicals may contain ammonia-based products as well as formaldehyde and persulphates.

EXPOSURE TO ISOCYANATES

OA Case #2914 A man developed asthma in his 40s while working in auto body repair where he was exposed to paint, epoxy, and isocyanates. He worked at the company for about 10 years before developing wheezing, cough, and shortness of breath. He was prescribed Advair and Ventolin. During this time, he was hospitalized once for breathing problems. On spirometry, he demonstrated moderate airway obstruction consistent with small airways disease. He continued to work at the company with exposure to substances causing breathing problems and reported worsening symptoms. He has smoked one pack of cigarettes per day for 22 years, but quit smoking many years ago.

EXPOSURE TO DUST AND LINT

POA Case #3006 A man in his 40s developed asthma while doing a side job as a home repair contractor. He was exposed to carpet fibers and dust that had settled over time in the carpet he was paid to rip out. He developed wheezing, cough, shortness of breath and chest tightness and was prescribed a nebulizer and Advair. Once the job ended, his breathing symptoms improved although he still requires asthma medicine. He had smoked half a pack of cigarettes a day for over 20 years.

EXPOSURE TO CLEANING PRODUCTS

POA Case #2919 A custodian developed asthma in her 50s when she was exposed to tile floor stripper and cleaners. She developed wheezing, cough, chest tightness and shortness of breath when a co-worker was using tile floor stripper. She was admitted to the hospital once and was seen in the ED three times for breathing problems. Spirometry demonstrated FVC 71% of predicted, FEV_1 44% of predicted, and ratio of 50% predicted. Diffusing capacity was reduced. She was treated with breathing treatments, Prednisone, inhalers, and home oxygen. She reported improved symptoms when she was no longer exposed to the substances. She was also on less asthma medication. She previously smoked ½ pack per day for 27 years but quit the same year as her breathing problems began.

AA Case #2998 A woman with asthma since she was a teen experienced an exacerbation of her asthma while working for an airline agency. Carpet cleaning chemicals were associated with her wheezing, cough, chest tightness and shortness of breath. In response, her employer moved her to a location where carpet cleaning chemicals were not used. She had been smoking 15 cigarettes a day for the past 10 years.

AA Case #2911 A woman in her 60s developed aggravation of her pre-existing asthma while working at a retail clothing store after using a disinfectant in a confined, poorly ventilated area. She had worked at the store for several years before developing wheezing, cough, and chest tightness. She used the cleaning product at work previously, but symptoms did not begin until using it while cleaning fitting rooms. She was prescribed Prednisone, Cephalexin, Hydroxyzine, and Mometasone. She quit working on doctor's advice four months later. After this, her symptoms improved and she used only a rescue inhaler as needed. She had never smoked.

AA Case #2823 A man in his 30s developed aggravation of his pre-existing asthma while working as a church custodian where he was exposed to chlorine gas from mixing cleaning products. He developed wheezing, cough, and chest tightness immediately after mixing bleach and ammonia in a bucket. He was hospitalized after exposure and treated with Albuterol and steroids. His symptoms subsequently improved. He had a 14 year smoking history but quit 10 years ago.

Construction-related exposures include wood dust, epoxies, paints, diisocyanates, chemicals used in grout, and welding fume.

CONSTRUCTION

EXPOSURE TO DUST AND FUMES

POA Case #2913 A man developed asthma in his 30s working in construction where he was exposed to welding, cutting, and grinding fumes, asbestos, trichloroethylene, PVC cleaner and glue, solder, lead and burning paint fumes. He experienced wheezing, cough, chest tightness, and shortness of breath that improved while away from work. He worked as a welder, plumber, pipefitter, and laborer. His symptoms were worst after inhalation of welding, cutting and grinding fumes. He was prescribed Singulair and a rescue inhaler. Spirometry demonstrated a mild obstructive defect and diffusing capacity was reduced. His breathing problems were still present and he was on more asthma medications than previously. He smoked one pack of cigarettes a day for 10 years.

TRANSPORTATION

EXPOSURE TO DIESEL FUMES

POA Case #3023 A man in his 20s developed asthma from exposure to diesel fume in his job as a hi-lo driver. He had visited the local emergency department because of the diesel fume exposure, where he was given a breathing treatment and prescription for asthma medication and released. He was prescribed Prednisone and an Albuterol metered dose inhaler. He was trying to quit smoking. He continues to work at this job, and reports his symptoms have improved although he still requires the same amount of asthma medication.