

# Michigan

# 2007 ANNUAL REPORT

## Tracking Work-Related Asthma





# Michigan

## 2007 Annual Report:

### Tracking Work-Related Asthma

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#### MANUFACTURING:

*Mold line using isocyanates.*

Website: [www.oem.msu.edu](http://www.oem.msu.edu)

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

# Tracking Work-Related Asthma

## SUMMARY

This is the 17th annual report on Work-Related Asthma (WRA) in Michigan.

- ✓ There have been seven Michigan WRA deaths:

### ACUTE ATTACK AT WORK—

- 2003** 43 year old male, truck bed liner applicator, isocyanates
- 2004** 19 year old female, bar waitress, second hand smoke
- 2004** 75 year old female, dairy farmer, sodium hypochlorite/sodium hydroxide mixture
- 2005** 50 year old male, adhesive manufacturer, isocyanates
- 2007** 54 year old female, laundry worker, bleach

### DIED AT HOME—

- 2004** 29 year old male, plastic manufacturer, styrene
- 2006** 77 year old female, car seat manufacturer, isocyanates

- ✓ On average, 144 new cases of WRA are reported to MDLEG each year.
- ✓ From 1988-2007, 2,676 WRA cases have been identified through the Michigan Tracking System.
- ✓ We estimate there are 65,000 – 97,000 people in Michigan with WRA.
- ✓ 90% of the Michigan WRA patients have new onset asthma; 10% have pre-existing asthma aggravated by an exposure at work.
- ✓ MIOSHA enforcement inspections at the workplaces of these individuals reveal a large number of fellow workers with asthma or respiratory symptoms compatible with asthma.
- ✓ Isocyanates and metal working fluids are the most commonly reported exposure.
- ✓ About 1% of Michigan workers are employed in manufacturing, where isocyanates are used.
- ✓ The average incidence rate of WRA among African Americans is 2.0 times greater than Caucasians.

## ACRONYMS

### OA

Occupational Asthma

### AA

Work-Aggravated Asthma

### POA

Possible Occupational Asthma

### RADS

Reactive Airways Dysfunction Syndrome

### MDLEG

MI Department of Labor & Economic Growth

### MIOSHA

MI Occupational Safety & Health Administration

### NAICS

North American Industrial Classification System

### NIOSH

National Institute for Occupational Safety & Health

### OD

Occupational Disease

### PEL

Permissible Exposure Limit

### REL

Recommended Exposure Limit

### WRA

Work-Related Asthma

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](http://www.oem.msu.edu).

## 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/MDLEG and Michigan State University. 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.

## WRA TRACKING PROCEDURES:

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

### SOURCES TO IDENTIFY PATIENTS

- ✓ **Health Care Providers**
  - Private practice
  - Working for industry
- ✓ **Hospitals requested once each year**
  - ICD-9 506.0-.9
  - ICD-9 493 with workers' compensation as payer
- ✓ **Workers' Compensation Agency**
- ✓ **Poison Control Centers**
- ✓ **Reports from Co-workers confirmed by a health care provider**
- ✓ **Reports from MIOSHA field staff**
- ✓ **Death Certificates**

## 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 (1).

#### Exacerbation

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

## WRA Tracking Procedures in Michigan

### Identify Patients

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

### Interview

- **Telephone Interview**  
-Medical and Work History
- **Obtain Medical Records**  
-Breathing Test Results
- **Physician Review**

### Workplace Inspection

- **Inspection Referral**  
-MIOASHA Reviews to determine type of inspection
- **On-Site Inspection**  
-Assess Exposures/  
Monitor  
-I & I Log/Interview  
Co- Workers (MSU)  
-Evaluate Medical Program
- **Off-Site Inspection**  
-Company Addresses  
Issues  
-MSU Interviews  
Co-workers  
-Report to Company  
and MIOASHA

### Follow Up

- **Inspection Results to**  
-Company, Workers,  
and Reporting Physician
- **Letters to Co-Workers**  
-See Doctor if Breathing Problems
- **Analyze Data**  
-Annual Report  
-Other Outreach &  
Educational Materials



# Tracking Work-Related Asthma

**TABLE 1**

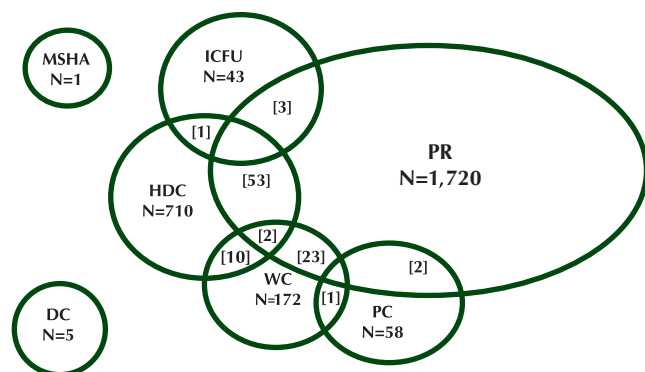
Number of Confirmed Patients with WRA by Year and Type

YEAR	DISEASE STATUS				TOTAL
	OA	POA	AA	RADS	
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	38	73	21	21	153
2006	31	59	26	14	130 <sup>a</sup>
2007	11	33	14	14	72 <sup>a</sup>
<b>Total</b>	<b>980</b>	<b>1,022</b>	<b>370</b>	<b>304</b>	<b>2,676</b>

<sup>a</sup>Reports are still being processed for calendar years 2006 and 2007; an increase in these totals will be reflected in next year's annual report.

**FIGURE 1**

Overlap of Reporting Sources for 2,604 Confirmed Work-Related Asthma Patients: 1988-2006<sup>a</sup>



<sup>a</sup>N's represent the total number for that source. Numbers in [ ] represent the overlap of reporting sources. There was an overlap of PC-HDC for 8 individuals.

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

## WORKPLACE INSPECTIONS

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 suspected allergen.
- ✓ Air monitoring for any suspected allergens is conducted.
- ✓ The company's health and safety program is reviewed.

After the investigation is complete, a report of air sampling results and any recommendations is sent to the company and made available to workers. A copy of the report is also sent to the reporting physician.

## OTHER FOLLOW-UP ACTIVITIES

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

## RESULTS:

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

## REPORTS

Table 1 shows that 2,676 people were confirmed with work-related asthma between 1988 - 2007. The reports are divided into four categories: occupational asthma (OA), possible occupational asthma (POA), aggravated asthma (AA), and Reactive Airways Dysfunction Syndrome (RADS). One hundred thirty additional patients have been confirmed since last year's report. Figure 1 shows the overlap of the 2,604 patients by reporting sources for 1988-2006.

**GENDER**

<b>Women</b>	1,398 (52.2%)
<b>Men</b>	1,278 (47.8%)

**RACE**

<b>Caucasian</b>	2,007 (76.7%)
<b>African American</b>	496 (18.9%)
<b>Hispanic</b>	50 (1.9%)
<b>Alaskan/Am Indian</b>	23 (0.9%)
<b>Asian</b>	11 (0.4%)
<b>Other</b>	31 (1.2%)
<b>Unknown</b>	58

**ANNUAL INCIDENCE RATE:**

<b>African American</b>	5.0/100,000
<b>Caucasian</b>	2.5/100,000

**YEAR OF BIRTH**

<b>Range</b>	1905-1989
<b>Average</b>	1956

**LOCATION IN STATE**

Figure 2 shows the county of employment where the patient developed work-related asthma. The main locations are:

<b>Wayne</b>	645 cases (24.7%)
<b>Oakland</b>	343 cases (13.1%)
<b>Macomb</b>	240 cases (9.2%)
<b>Unknown County</b>	64 cases

**FIGURE 2**

Confirmed WRA Cases by County of Exposure:  
1988-2007

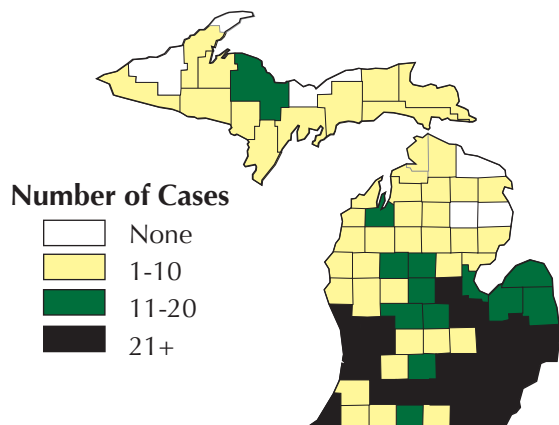
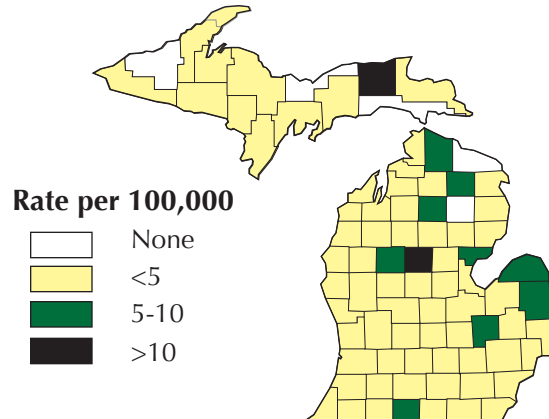


Figure 3 and Table 2 show the annual average incidence rates of WRA among the general working population in each county. The highest rates per 100,000 workers were in:

<b>Luce</b>	13.1
<b>Clare</b>	12.3
<b>Osceola</b>	8.1
<b>Cheboygan</b>	7.5

**FIGURE 3**

Average Annual Incidence Rates of WRA by  
County of Exposure:  
1989-2005

**GRAIN STORAGE FACILITY**

with potential exposures to grain dust,  
mold and pesticides.



# Tracking Work-Related Asthma

**TABLE 2**

Average Annual Incidence Rates of Work-Related Asthma  
Among Michigan Workers by County of Exposure: 1989-2005

COUNTY	# EMPLOYEES <sup>a</sup>	AVG ANN INC RATE <sup>b</sup>	TOTAL CASES 1989-2005	COUNTY	# EMPLOYEES <sup>a</sup>	AVG ANN INC RATE <sup>b</sup>	TOTAL CASES 1989-2005
Alcona- Iosco	11,775	1.0	2	Isabella	26,325	2.7	12
Alpena	13,600	3.0	7	Jackson	60,500	3.7	38
Antrim	5,750	2.0	2	Kalamazoo-Calhoun-VanBuren	208,900	1.9	66
Arenac	4,650	5.1	4	Kent-Ottawa-Muskegon-Allegan	550,100	1.3	124
Baraga	3,750	4.7	3	Lake	1,650	3.6	1
Barry	12,075	1.0	2	Luce	<b>2,700</b>	<b>13.1</b>	<b>6</b>
Berrien	70,900	1.7	21	Manistee	7,625	1.5	2
Branch	14,225	6.2	15	Marquette	28,000	3.2	15
Cass	10,500	2.2	4	Mason	10,500	1.7	3
Charlevoix	10,975	2.1	4	Mecosta	13,075	0.9	2
<b>Cheboygan</b>	<b>7,800</b>	<b>7.5</b>	<b>10</b>	Menominee	9,450	0.6	1
Chippewa	15,425	1.1	3	Montcalm	18,825	3.7	12
<b>Clare</b>	<b>7,675</b>	<b>12.3</b>	<b>16</b>	Montmorency	2,250	5.2	2
Clinton-Eaton-Ingham	232,200	2.6	102	Newaygo	10,325	4.0	7
Crawford	4,525	6.5	5	Oceana	6,750	1.7	2
Delta	15,525	1.5	4	Ogemaw	6,450	0.9	1
Dickinson	14,325	4.1	10	<b>Osceola</b>	<b>8,000</b>	<b>8.1</b>	<b>11</b>
Emmet	15,900	1.5	4	Otsego	11,225	4.7	9
Genesee	178,600	6.6	201	Roscommon	6,500	3.6	4
Gladwin	5,125	2.3	2	Saginaw-Bay-Midland	177,800	4.1	125
Gogebic	6,525	1.8	2	Sanilac	13,125	6.3	14
Gd Traverse-Benzie-Kalkaska-Leelanau	60,575	2.5	26	Schoolcraft	2,900	2.0	1
Gratiot	14,150	3.7	9	Shiawassee	19,525	1.8	6
Hillsdale	15,525	3.8	10	St. Joseph	25,150	1.4	6
Houghton-Keweenaw	15,225	1.5	4	Tuscola	14,275	4.5	11
Huron	13,875	5.1	12	Washtenaw-Lenawee-Livingston	266,200	4.2	190
Ionia	15,975	3.3	9	Wexford-Missaukee	17,325	1.7	5
Iron	4,200	4.2	3	<b>Detroit, MSA<sup>c</sup></b>	<b>2,077,000</b>	<b>3.4</b>	<b>1,210</b>
				<b>All Michigan Counties<sup>d</sup></b>	<b>4,448,000</b>	<b>3.2</b>	<b>2,382</b>

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

<sup>b</sup> Rates are based on the average number of cases per year from 1989-2005, per 100,000 Michigan workers.

<sup>c</sup> MSA=Metropolitan Statistical Area and includes Lapeer (26 cases), Macomb (226 cases), Monroe (22 cases), Oakland (317 cases), St. Clair (35 cases) and Wayne (584 cases) counties.

<sup>d</sup> Forty-one cases had an out-of-state exposure and 20 had an unknown county of exposure, for the 1989-2005 reporting period.

## TYPE OF INDUSTRY

Table 3 shows the Michigan industries by NAICS codes, where the exposures to occupational allergens occurred from 1988 to 2007.

The predominant industries were:

Manufacturing	63.9%
Health Care	10.7%

The incidence rate of WRA by industry type ranges from <0.1 cases per 100,000 in utilities, to a high of 11.4 cases per 100,000 in manufacturing. Industries with the next highest annual average incidence rates were: mining with 6.3 cases per 100,000 workers and health care with 3.2 cases per 100,000 workers.

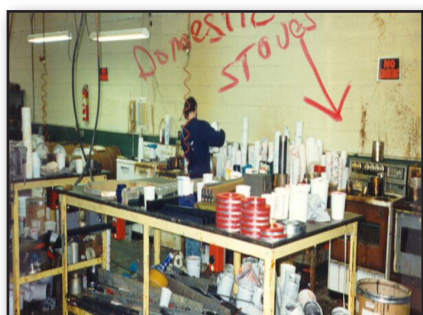
**TABLE 3**

Primary Industrial Exposure for Confirmed WRA Cases: 1988 - 2007

2002 NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM		WRA CASES 1988-2007		NUMBER OF EMPLOYEES <sup>a</sup>	ANN AVERAGE INCIDENCE RATE 1989-2005 <sup>b</sup>	
		#	%		Rate	# Cases
11	Agriculture, Forestry, Fishing, & Hunting	13	0.5	81,664	0.9	12
21	<b>Mining</b>	11	0.4	9,300	<b>6.3</b>	10
22	Utilities	6	0.2	861,200	<0.1	5
23	Construction	67	2.5	206,100	1.8	62
31-33	<b>Manufacturing</b>	1,709	63.9	823,100	<b>11.4</b>	1,589
42	Wholesale Trade	36	1.3	180,400	1.1	33
44-45	Retail Trade	60	2.2	548,800	0.6	54
48-49	Transportation & Warehousing	46	1.7	132,000	1.5	33
51	Information	17	0.6	76,000	1.2	16
52	Finance & Insurance	19	0.7	154,800	0.6	17
53	Real Estate & Rental & Leasing	12	0.4	55,500	1.3	12
54	Professional, Scientific & Technical Services	25	0.9	268,000	0.5	24
55	Management of Companies & Enterprises	1	<0.1	69,100	0.1	1
56	Administrative & Support & Waste Management & Remediation Svcs	34	1.3	267,000	0.7	30
61	Educational Services	111	4.1	423,300	1.3	92
62	<b>Health Care &amp; Social Assistance</b>	287	10.7	482,700	<b>3.2</b>	263
71	Arts, Entertainment & Recreation	16	0.6	61,500	1.2	13
72	Accommodation & Food Services	61	2.3	332,700	1.0	54
81	Other Services (except Public Admin)	50	1.9	176,900	1.5	44
92	Public Administration	87	3.3	685,000	0.6	72
00	Unknown	8	0.3			7
<b>TOTAL</b>		<b>2,676</b>		<b>4,645,864</b>	<b>3.1</b>	<b>2,443</b>

<sup>a</sup>Source: for all industry classifications except Agriculture: MDLEG Bureau of Labor Market Information & Strategic Initiatives: Michigan Current Employment Statistics 2001. For Agriculture: 2002 U.S. Census of Agriculture-State Data. Selected Operator Characteristics by Race: 2002 [www.nass.usda.gov/census02/volume1/mi/st26\\_1\\_052\\_052.pdf](http://www.nass.usda.gov/census02/volume1/mi/st26_1_052_052.pdf). 2001 U.S. Census Bureau Statistics: Agriculture, Forestry, Fishing & Hunting-MI [www.census.gov/epcd/susb/2001/mi/MI11.htm](http://www.census.gov/epcd/susb/2001/mi/MI11.htm).

<sup>b</sup>Average annual incidence rate, total number of cases for 1989-2005 (the years with complete case reporting results). Rates are based on average number of cases from 1989-2005 per 100,000 adult workers in each industrial category.



Poor housekeeping practices and lack of local exhaust ventilation at a company using **domestic stoves** to heat isocyanates.



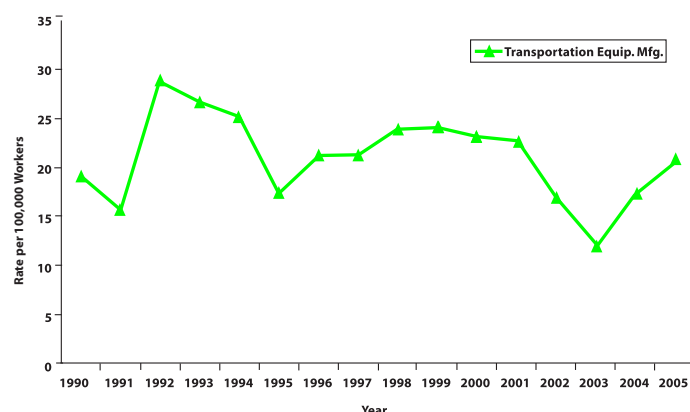
**Domestic fan** used as ventilation at a bar that allows cigarette smoking.



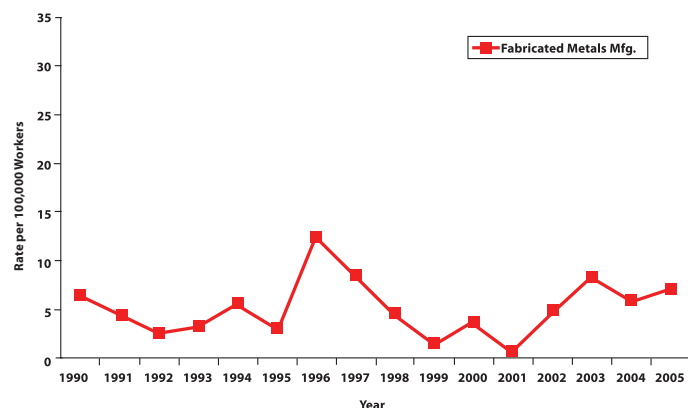
# Tracking Work-Related Asthma

Figures 4-10 show the average annual incidence rates of WRA from 1990 through 2005 for selected industries which had the largest number of reported WRA cases. The manufacturing of transportation equipment had the highest rates over this time period.

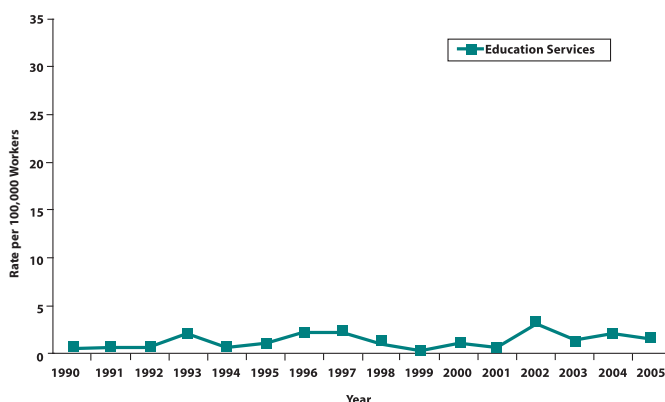
**FIGURE 4.** Annual Incidence of WRA in Transportation Equipment Manufacturing: MI 1990-2005



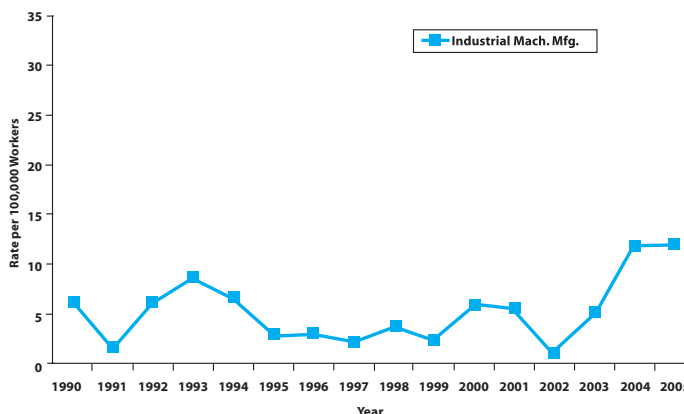
**FIGURE 5.** Annual Incidence of WRA in Fabricated Metals Manufacturing: MI 1990-2005



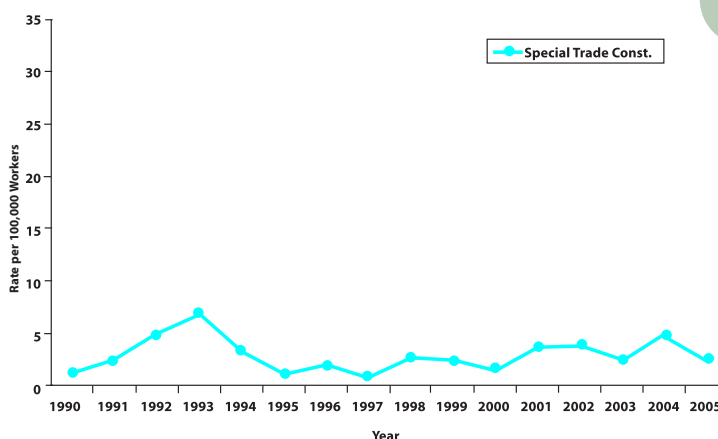
**FIGURE 6.** Annual Incidence of WRA in the Education Services Industry: MI 1990-2005



**FIGURE 7.** Annual Incidence of WRA in Industrial Machinery Manufacturing: MI 1990-2005

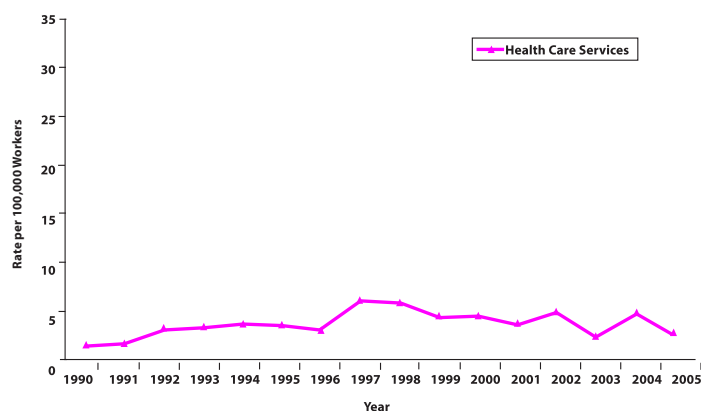


**FIGURE 8.** Annual Incidence of WRA in the Special Trade Construction Industry: MI 1990-2005

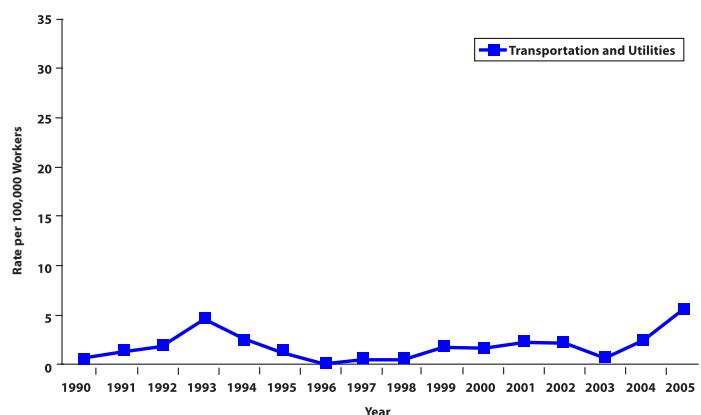


LEFT: Manufacturing operation using phthalic anhydride in an open air mold.

**FIGURE 9.** Annual Incidence of WRA in the Health Care Services Industry: MI 1990-2005



**FIGURE 10.** Annual Incidence of WRA in Transportation and Utilities: MI 1990-2005



**BELOW:**

A worker directs the ladle to fill the mold with a phthalic anhydride-containing liquid.

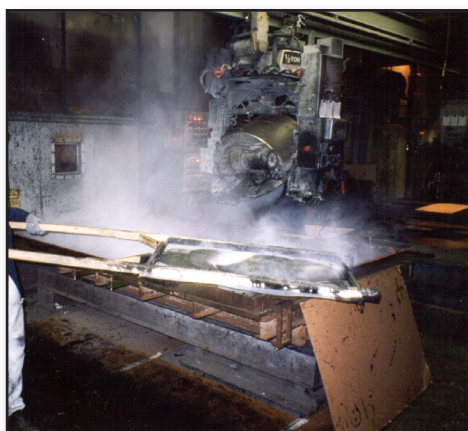


Table 4 shows the average annual incidence rates for work-related cases *within manufacturing*. The highest rates per 100,000 workers were in:

Transportation Equipment Mfg.	18.2
Chemical Mfg.	14.3
Primary Metal Mfg.	10.9
Plastics & Rubber Products Mfg.	10.1

**TABLE 4**

1,589 WRA Cases from Manufacturing Industries: 1989-2005

2002 NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM	WRA CASES <sup>a</sup>	ANN AVG RATE	EMPLOYEES <sup>b</sup>
	#		#
<b>311</b> Food Mfg	47	7.8	35,300
<b>323</b> Printing & Related Support Activities	18	4.8	21,900
<b>325</b> Chemical Mfg	84	14.3	34,600
<b>326</b> Plastics & Rubber Products Mfg	79	10.1	45,800
<b>327</b> Nonmetallic Mineral Product Mfg	14	4.5	18,500
<b>331</b> Primary Metal Mfg	58	10.9	31,400
<b>332</b> Fabricated Metal Product Mfg	84	5.6	89,000
<b>333</b> Machinery Mfg	111	7.3	89,600
<b>334</b> Computer & Electronic Product Mfg	12	3.0	23,700
<b>336</b> Transportation Equipment Mfg	980	18.2	317,000
<b>337</b> Furniture & Related Product Mfg	8	1.3	36,900
Miscellaneous Mfg (*includes NAICS: 312-316, 321-322, 324, 335, 339)	94	7.0	79,400

<sup>a</sup> Cases for 1989-2005 are the years with complete case reporting results. Rates are based on average number of cases from 1989-2005 per 100,000 adult workers in each industrial category.

<sup>b</sup> 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 in Michigan. The most frequent exposures were to:

Isocyanates	13.8%
Metal Working Fluids	11.0%
Cleaning Solutions	9.5%
Exhaust, Smoke and Fumes	5.6%
Welding Fumes	4.6%
Solvents	3.6%



# Tracking Work-Related Asthma

**TABLE 5**

Top Workplace Exposures Associated with  
Confirmed WRA Patients: 1988-2007

EXPOSURE	#	%
Isocyanates	370	13.8
Metal Working Fluids	294	11.0
Cleaning Solutions	255	9.5
Unknown (Mfg.)	207	7.7
Unknown (Office)	170	6.4
Exhaust/Smoke/Fumes	149	5.6
Welding Fumes	124	4.6
Solvents	96	3.6
Paint Fumes	65	2.4
Epoxy	61	2.3
Latex/Rubber	57	2.1
Formaldehyde	51	1.9
Acids	50	1.9
Fungus	40	1.5
Acrylates	38	1.4
Chlorine	37	1.4
Plastic Fumes	37	1.4
Cobalt	29	1.1
Fire	28	1.0
Ammonia	23	0.9
Styrene	22	0.8
Wood Dust	22	0.8
Flour	19	0.7
Animal Dander	18	0.7
Chemicals Used in Construction	18	0.7
Cigarette Smoke	18	0.7
Fragrances	16	0.6
Glutaraldehyde	16	0.6
Herbicide/Pesticide	16	0.6
Chromium	14	0.5
Fiberglass	13	0.5
Caustics	12	0.4
Printing Inks	12	0.4
Amines	11	0.4
Grain Dust	11	0.4
Cement Dust	10	0.4
Cosmetology Chemicals	9	0.3
Anhydrides	8	0.3
Asphalt	8	0.3
Meat Wrapper's Asthma	7	0.3
Plants/Organic Matter	7	0.3
Rust Inhibitor	7	0.3
Azodicarbonamide	6	0.2
Insecticide	6	0.2
Pickling Ingredients	6	0.2
Other <sup>a</sup>	183	6.8
<b>Total</b>	<b>2,676</b>	<b>99.9<sup>b</sup></b>

<sup>a</sup>There were five cases each w/exposure to: 1,1,1 Trichloroethane, Enzymes, Heat, Nitrogen, Paper Dust, Solder Fume.  
There were four cases each w/ exposure to: Asbestos, Ethyl Alcohol, Freon, Photo Developing Fluids, Rose Hips, Sulfonate, Sulfur Dioxide, Trichloroethylene.

There were three cases each w/exposure to: Cadmium Solder, Colophony, Drywall Dust, Lime Dust, Mold Release Spray, Psyllium, Sand, Sludge, Tar Fume, X-Ray Developing Fluids.

There were two cases each w/exposure to: Acetates, Cellulose, Coal Dust, Concrete Sealer, Copier Toner, Copper Oxide, Exercise, Fire Extinguisher Powder, Fireproofing Chemicals, Gas and Oil Refinery Exposures, Hydraulic Oil, Kerosene, Medications, Natural Gas, Nickel, Ozone, Pepper Gas, Perchloroethylene, Phosgene, Polyester, Polyvinyl Butyrate, Rust Inhibitor, Sewage, Sulfite, Teflon, Textile Lint, Zinc, Zinc Oxide.

There was one case each w/exposure to: 1,3, Dichloro-2-Propanol, 1,3 Dichloro 5 5-Dimethyl Hydrantoin, Anesthesia, Blood, Blue Prints, Ceramic Powder, Cyanide, Ethylene Oxide, Explosion, Fertilizer, Flares, Flux, Glaze, Gortex, Iodine, Methamphetamine Lab, Methanol, Mica, Monoammonium Phosphate, Ninhydrin, Nylon-polyhexamethylene Adipamide, Odor, Pigment, Plating Chemicals, Platinum, Polyethylene, Polyurethane, Potassium Aluminum Fluoride, Soda Ash, Soot, Stress, Talcum Powder, Tuberculosis Vaccine, World Trade Center Exposure, Zinc Borate.

<sup>b</sup>Percentages do not add to 100 due to rounding.

## MEDICAL RESULTS

Table 6 shows patients' cigarette smoking status. Twenty percent of patients were smoking when their work-related asthma developed. This is a lower percentage than the state average and markedly lower than that found in blue collar working populations.

**TABLE 6**

Cigarette Smoking Status of 2,595<sup>a</sup>  
Confirmed WRA Patients: 1988-2007

### SMOKING STATUS

Disease Status	Current Smoker		Ex-Smoker		Non-Smoker	
	#	%	#	%	#	%
OA	203	21.1	380	39.6	377	39.3
POA	153	15.3	414	41.5	430	43.1
AA	79	23.0	98	28.5	167	48.5
RADS	88	29.9	110	37.4	96	32.7
<b>All</b>	<b>523</b>	<b>20.2</b>	<b>1,002</b>	<b>38.6</b>	<b>1,070</b>	<b>41.2</b>

<sup>a</sup>Missing data on 81 patients.

Forty-four percent of the WRA patients had a family history of allergies (Table 7).

**TABLE 7**

Family History of Allergies Among 2,320<sup>a</sup>  
Confirmed WRA Patients: 1988-2007

### FAMILY HISTORY OF ALLERGIES

Disease Status	Yes		No	
	#	%	#	%
OA	354	39.7	537	60.3
POA	393	43.2	517	56.8
AA	171	61.1	109	38.9
RADS	92	38.5	147	61.5
<b>All</b>	<b>1,010</b>	<b>43.5</b>	<b>1,310</b>	<b>56.5</b>

<sup>a</sup>Missing data on 356 patients.

Forty-eight percent of the asthma patients had a personal history of allergies or asthma (Table 8). Five hundred eighty-four (47.3%) of the 1,235 patients with a personal history of allergies or asthma previously had asthma.

**TABLE 8**

Personal History of Allergies or Asthma  
Among 2,602<sup>a</sup> Confirmed WRA Patients: 1988-2007

### PERSONAL HISTORY

Disease Status	Yes		No	
	#	%	#	%
OA	363	38.0	593	62.0
POA	431	43.4	563	56.6
AA	340	95.5	16	4.5
RADS	101	34.1	195	65.9
<b>All</b>	<b>1,235</b>	<b>47.5</b>	<b>1,367</b>	<b>52.5</b>

<sup>a</sup>Missing data on 74 patients.

Two thousand one hundred eighty-eight of the patients identified 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.

**TABLE 9**

Persistence of Symptoms and Medication Use of 2,452<sup>a</sup> Confirmed WRA Patients: 1988-2007

	EXPOSURE STATUS			
	Still Exposed		No Longer Exposed	
Total	711		1,741	
Breathing Problems Still Present?	#	%	#	%
Yes	685	96.3	1,503	86.3
Less	216	30.4	840	48.2
Still Taking Asthma Medication?				
Yes	612	86.1	1,362	78.2
Less	129	18.1	484	27.8

\*Missing data on 224 patients.

### OBJECTIVE MEDICAL TESTING

Very few of the WRA cases had objective pulmonary function testing performed to determine the relationship of their asthma to workplace exposures.

Methacholine challenge	14.6%
Pre-post-bronchoprovocation	40.1%
Specific antigen	0.4%
Peak flow monitoring	2.6%
Pre-post-work shift	2.4%

### WORKERS' COMPENSATION

Only half of the WRA cases applied for workers' compensation benefits; only a third of those individuals had been awarded compensation for their breathing problems:

Applied for benefits	1,161	48.9%
Pending approval	573	49.4%
Denied benefits	188	16.2%
Received benefits	400	34.5%

### INDUSTRIAL HYGIENE

A total of 695 workplace inspections have been conducted since 1988 (Table 10); 105 of those facilities were inspected more than once. Thirty-five inspections were completed since last year's report. Table 10 shows the inspection status of companies where the confirmed WRA patients were exposed to agents that caused or triggered their asthma.

**TABLE 10**

Status of Facilities Where Confirmed WRA Patients Were Exposed to Allergens: 1988-2007

INSPECTION STATUS	# PATIENTS	COMPANIES	
		#	%
Inspected	1,119	695 <sup>a</sup>	36.6
No Follow-up Planned	1,363	1,028	54.1
Scheduled for Inspection	4	4	0.2
Out of Business	67	58	3.1
No Longer Use Occupational Allergen	26	25 <sup>b</sup>	1.3
Sent Company an Indoor Air Letter <sup>d</sup>	48	42	2.2
Sent Company Letter to Check Exposures <sup>e</sup>	49	49	2.6
Total	2,676	1,901 <sup>c</sup>	100.1 <sup>f</sup>

<sup>a</sup> 695 inspections were conducted at 590 different facilities.

<sup>b</sup> Eight companies that no longer use the allergen were previously inspected.

<sup>c</sup> Represents 1,796 different facilities.

<sup>d</sup> The company was sent information on how to address issues related to indoor air quality and respiratory health.

<sup>e</sup> The company was sent information on how to address potential exposures in their workplace that may be causing respiratory health problems.

<sup>f</sup> Percentages do not add to 100 due to rounding.

Air sampling for allergens was conducted during 493 of the inspections. Fifty-five of the 473 (11.6%) facilities with a NIOSH recommended exposure limit (REL) for the allergen were above the NIOSH REL. Twenty-three (4.7%) of the 488 facilities with a MIOSHA standard for the allergen were above the enforceable MIOSHA permissible exposure limit (PEL) (Table 11).

**TABLE 11**

Air Monitoring Results from 695 Workplace Inspections: 1988-2007

#### AIR MONITORING RESULTS

AIR SAMPLING – NIOSH STANDARD	#	%
Above NIOSH Standard	55	7.9
Below NIOSH Standard	418	60.1
No NIOSH Standard	20	2.9
Unknown (no report yet)	2	0.3
Did Not Sample for an Allergen	22	3.2
Did Not Sample	178	25.6
Total	695	100.0

AIR SAMPLING – MIOSHA STANDARD	#	%
Above MIOSHA Standard	23	3.3
Below MIOSHA Standard	465	66.9
No MIOSHA Standard	4	0.6
Unknown (no report yet)	2	0.3
Did Not Sample for an Allergen	23	3.3
Did Not Sample	178	25.6
Total	695	100.0



# Tracking Work-Related Asthma

Table 12 shows the allergens that were above the NIOSH and/or MIOSHA limits. One exposure was above the MIOSHA PEL and NIOSH REL for phthalic anhydride during an inspection this past year. The top three allergens found to be above the NIOSH REL were:

<b>Formaldehyde</b>	40.4%
<b>Styrene</b>	11.5%
<b>Metal Working Fluids</b>	9.6%

The top three allergens found to be above the MIO-SHA enforceable PEL were:

<b>Welding Fume</b>	22.7%
<b>Styrene</b>	18.2%
<b>Glutaraldehyde</b>	13.6%

**TABLE 12**

Allergens Above the MIOSHA Permissible Exposure Limit (PEL) and/or NIOSH Recommended Exposure Limit (REL):  
Michigan 1988-2007

ASTHMA- CAUSING AGENTS	ABOVE NIOSH REL		ABOVE MIOSHA PEL	
	#	%	#	%
Formaldehyde	21	40.4	1	4.5
Styrene	6	11.5	4	18.2
Metal-Working Fluids	5	9.6	1	4.5
Glutaraldehyde	4	7.7	3	13.6
HDI	4	7.7	No PEL	--
Cobalt	3	5.8	2	9.1
MDI	3	5.8	0	--
Wood Dust	2	3.8	2	9.1
Chromic Acid	1	1.9	1	4.5
Ethylene Oxide	1	1.9	0	--
Phthalic Anhydride	1	1.9	1	4.5
Starch	1	1.9	0	--
Welding Fume (Total Particulate)	No REL	--	5	22.7
Flour Dust	No REL	--	2	9.1
<b>Total</b>	<b>52</b>	<b>99.9<sup>a</sup></b>	<b>22</b>	<b>99.8<sup>a</sup></b>

<sup>a</sup>Percentages do not add to 100 due to rounding.

Co-workers were interviewed at 535 of the 695 inspections. They reported daily or weekly breathing symptoms or new asthma since beginning to work at 359 of the 535 (67.1%) companies. The average percentage of co-workers with symptoms in these 359 companies was 20.5%. All 1,359 co-workers from the remaining 176 companies reported no breathing symptoms. One thousand four hundred eighty-five of the 9,310 (16.0%) co-workers interviewed had symptoms consistent with work-related asthma (Table 13).

The MIOSHA Injury and Illness Logs kept by employers listed 564 workers from 124 companies with asthma or asthma-like symptoms. Only nine workers identified in the interviews with daily or weekly breathing symptoms were also listed on the MIOSHA Log. A total of 2,040 symptomatic workers were identified during the 695 inspections.



**TABLE 13**

Breathing Symptoms Among Co-Workers of the 2,676 Confirmed WRA Patients

## DISEASE STATUS OF THE INDEX PATIENT

SYMPTOMS	ALL		OA		POA		AA		RADS	
	#	%	#	%	#	%	#	%	#	%
<b>Daily or Weekly SOB, Wheezing or Chest Tightness</b>	1,485	16.0	1,065	16.4	384	15.0	4	16.0	32	13.2
<b>Workers Interviewed</b>	9,310		6,478		2,565		25		242	
<b>OSHA Log</b>	564	17.8	399	21.6	154	13.0	2	9.1	9	8.7
<b>Companies w/Employee on Log</b>	124		88		33		1		2	
<b>Companies Inspected</b>	695		408		253		11		23	
<b>Total<sup>a</sup></b>	<b>2,049</b>		<b>1,464</b>		<b>538</b>		<b>6</b>		<b>41</b>	

<sup>a</sup>Nine individuals were identified both on the co-worker questionnaire and the OSHA Log.

## 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 workers such as auto body paint shop employees since the EPA database does not include non-manufacturing establishments. Conversely, it over-counts manufacturing employees since 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 2006 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.



## MICHIGAN WORKFORCE EXPOSED TO SELECTED CAUSES OF WRA

Another source to identify chemical exposures that are associated with WRA comes from the Michigan Department of Environmental Quality (DEQ). The chemicals listed in the Michigan Facilities' Guide to SARA Title III, Emergency Planning and Release Reporting (December 2007, 6th edition) are subject to reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) section 313, which is 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 in Table 15 are current as of June 26, 2008, the date of the report generated by the Michigan DEQ.

The chemicals shown can be categorized in two ways; those that are known to cause asthma and those that are irritants and capable of causing reactive airways dysfunction syndrome. Those that can cause asthma are: Bisphenol A, Cobalt, Epichlorohydrin, Formaldehyde, Methyl Acrylate, Phthalic Anhydride and Styrene. Ammonia and Chlorine are classified as irritants. Water treatment facilities and waste water treatment facilities often use chlorine to treat the water supplies.

Ammonia is often used by food production plants.

# Tracking Work-Related Asthma

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

COUNTY	# WORKERS EMPLOYED <sup>a</sup> BY ISOCYANATE-USING FACILITIES	TOTAL # WORKERS IN THE COUNTY <sup>b</sup>	% WORKERS POTENTIALLY EXPOSED TO ISOCYANATES	COMPANY NAME <sup>c</sup>
Allegan	2,475	52,085	4.8	GPM Industries Inc. Haworth Inc. Johnson Controls Interiors LLC
Barry	1,100	29,314	3.8	Bradford White Corp.
Berrien	1,345	71,590	1.9	Ancast Inc. Leco Corp. Tyler Refrigeration
Calhoun	243	65,826	0.4	Bostik, Inc. Cello-foil Products Inc. Comcast Urethane
Charlevoix	500	12,744	3.9	East Jordan Iron Works Inc.
Clare	300	12,075	2.5	Renosol Seating LLC
Clinton	10	14,448	0.1	Innovative Polymers, Inc.
Dickinson	580	13,700	4.2	Grede Foundries Inc. Louisiana-Pacific Sagola OSB
Eaton	30	55,979	0.1	Axson North America Inc.
Genesee	1,000	191,799	0.5	Delphi Energy & Chassis Flint East
Hillsdale	160	20,179	0.8	Dow Chemical Co.
Ingham	1,690	143,867	1.2	Collins & Aikman Plastics GMVM Lansing Huntsman Advanced Materials
Isabella	550	35,976	1.5	Delfield Co.
Jackson	1,250	71,302	1.8	ADCO Products Inc. <sup>d</sup> Milsco/MI Seat/Hurst & Brooklyn TAC Manufacturing Inc.
Kalamazoo	260	125,304	0.2	Azon USA Inc. Premier Products <sup>d</sup>
Kent	3,434	303,024	1.1	Detroit Diesel Remig North Grand Rapids Foam Technologies HB Fuller Co. Knape & Vogt Manufacturing Co. Purforms, Inc. Steelcase Inc. Wolverine World Wide Inc.
Lapeer	26	40,931	0.1	ITW TACC
Lenawee	355	45,672	0.8	Anderson Development Company Pilkington Clinton
Livingston	1,040	88,122	1.2	Atreum Brighton Atreum Howell Pkg. Design & Manufacturing Inc.
Luce	129	2,632	4.9	Louisiana-Pacific Corporation
Macomb	5,689	386,464	1.5	Auto Components/Chesterfield Auto Components/Shelby Twp. Daimler Chrysler/Sterling Hts. Assy. Du Pont/Mt. Clemens Plant Faurecia Automotive Seating International Casting Corp. Magna Closures Rivas Inc. Romeo Rim Inc. US Farathane Wolverine Bronze Co.
Mason	220	12,817	1.7	Great Lakes Castings LLC
Mecosta	1,000	18,697	5.3	Wolverine World Wide Inc.
Monroe	175	72,226	0.2	Sunrise Windows Ltd.
Montcalm	172	24,295	0.7	Kent Foundry Northland Corp.



COUNTY	# WORKERS EMPLOYED <sup>a</sup> BY ISOCYANATE-USING FACILITIES	TOTAL # WORKERS IN THE COUNTY <sup>b</sup>	% WORKERS POTENTIALLY EXPOSED TO ISOCYANATES	COMPANY NAME <sup>c</sup>
Muskegon	410	82,593	0.5	Brunswick Bowling MI Steel Inc.
Oakland	766	587,086	0.1	Armaly Sponge Co. Behr America Inc. Cass Polymers of Michigan Inc. Eagle Industries Inc. ITW Devcon Futura Recticel Interiors North America LLC Recticel UREPP North America Inc.
Ogemaw	150	8,741	1.7	Taylor Building Products Inc.
Ottawa	585	129,291	0.5	Eagle Packaging Inc. Izzy/Counter Point Magna Donnelly Corp.
Saginaw	2,233	90,190	2.5	Glastender Inc. GM Power Train Saginaw Malleable Lendell Manufacturing Inc. Saginaw Metal Casting Operations
St. Clair	450	76,471	0.6	Collins & Aikman Lear Corp.
Sanilac	635	20,208	3.1	Midwest Rubber Co. Numatics Inc. Trelleburg YSH Inc.
Shiawassee	70	33,564	0.2	Tegant Diversified Brands
Van Buren	182	37,901	0.5	BASF Construction Chemicals LLC Special-Lite Inc.
Washtenaw	1,600	180,378	0.9	Automotive Components Holdings Kalitta Charters, LLC <sup>d</sup> (Not mfg.)
Wayne	7,752	813,663	1.0	Alpha Resins Inc. BASF Corp., Livonia BASF Corp., Wyandotte Daimler Chrysler JNAP EFTEC North Americas LLC EQ Detroit Inc. Feblo International LLC General Motors Hamtramck Lear Corp. Poof-Slinky Inc. Recycled Polymeric Materials Inc. SprayTek, Inc. <sup>d</sup> Wayne Disposal Inc.
Wexford	800	13,580	5.9	Genmar Cadillac Four Winns
<b>Total</b>	<b>39,116</b>	<b>4,206,900</b>	<b>0.9</b>	

<sup>a</sup>Source: Michigan Manufacturer's Directory 2008, and www.acinet.org accessed June 10, 2008.

<sup>b</sup>Source: Michigan Labor Market Information, Data Explorer, www.milmi.org accessed July 4, 2007 and June 12, 2008.

<sup>c</sup>Source: U. S. Environmental Protection Agency. Toxics Release Inventory, Michigan Companies Using Isocyanates in 2006 (report June 5, 2008).

<sup>d</sup>Source: Michigan Department of Environmental Quality, FOIA Request for SARA TITLE III Emergency Planning and Release Reporting of select chemicals (isocyanates), received June 26, 2008.

# Tracking Work-Related Asthma

**TABLE 15**

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

✓ Substances Capable of Causing Asthma—Bisphenol A, Cobalt, Epichlorohydrin, Formaldehyde, Methyl Acrylate, Phthalic Anhydride, and Styrene

✓ Irritants Capable of Causing Reactive Airways Dysfunction Syndrome (RADS)—Ammonia and Chlorine

COUNTY	COMPANY NAME	TYPE OF EXPOSURE
Alger	Munising, City of (POTW)	Chlorine
Allegan	Birds Eye Foods, Inc. Linde Gas, LLC Otsego City of, Waste Water Treatment Plant Otsego City of, Wells #3, #4, #5 Packerland Plainwell – Smithfield Beef Group Plainwell City of, Waste Water Treatment Plant Wayland	Chlorine Ammonia, Chlorine Chlorine Chlorine Ammonia Chlorine Ammonia
Alpena	Airgas Great Lakes, Inc. Alpena Supply Company	Chlorine Chlorine
Arenac	Saginaw-Midland Municipal Water	Chlorine
Baraga	Custom Composites Division	Styrene
Bay	Airgas Great Lakes, Inc. Bay City of, Bay Metropolitan Water Treatment Carbone of America – Ultra Carbon Division Essexville Waste Water Treatment Quantum Composites, Inc. – Premix, Inc. West Bay County Regional Waste Water	Chlorine Chlorine Chlorine Chlorine Styrene Chlorine
Berrien	Benton Harbor Water Plant Buchanan Waste Water Treatment Plant Buchanan Water Treatment Plant Coloma Frozen Foods, Inc. Greg Orchards & Produce, Inc. Harbor Metal Treating Company Lake Township Water Plant NCP Coatings, Inc. New Buffalo Water Plant Niles City of, Airport, Decker, Front and Fort St. Wells Niles Waste Water Treatment Plant Niles Water Dept. – Iron Removal Plant Praxair Distribution, Inc. Saint Joseph Water Plant Sandvik Materials Technology	Chlorine Chlorine Chlorine Ammonia Ammonia Ammonia Chlorine Phthalic Anhydride Chlorine Chlorine Chlorine Chlorine Ammonia, Chlorine Chlorine Ammonia
Branch	Alchem Aluminum – Aleris International Coldwater Water Treatment Plant Conagra Foods, Inc. Star of the West Milling Company	Chlorine Chlorine Ammonia Chlorine
Calhoun	Airgas Great Lakes, Inc. Anatech, Ltd. Battle Creek City of, Waste Water Treatment Plant Guardian Fiberglass, Inc. Kraft Foods Global, Inc. Prairie Farms Dairy, Inc. Verona Pumping Station	Chlorine Formaldehyde Chlorine Formaldehyde Chlorine Ammonia Chlorine



COUNTY	COMPANY NAME	TYPE OF EXPOSURE
Cass	Mennel Milling Co. of Michigan	Chlorine
Charlevoix	Airgas Great Lakes, Inc.	Chlorine
Cheboygan	Cheboygan City of, Waste Water Treatment Plant Cheboygan City of, Well house #4, #7	Chlorine Chlorine
Clinton	SCCMUA St. Johns City of, Waste Water Treatment Facility	Chlorine Chlorine
Crawford	Arctic Glacier, Inc. Grayling Generating Station	Ammonia Chlorine
Delta	Escanaba Paper Company – Newpage Corp	Chlorine
Dickinson	Iron Mountain/Kingsford Waste Water Treatment Plant Verso Paper Company – Quinnesec Mill	Chlorine Chlorine
Eaton	Axson North America, Inc.	Styrene
Emmett	Airgas Great Lakes, Inc.	Chlorine
Genesee	Flint City of, Water Plant Flint City of, Water Pollution Control Facility Genesee Cnty Drain Comm. – A. Ragnone Treatment Plt GMC Powertrain Flint, North Kelsey-Hayes Company	Chlorine Chlorine Chlorine Ammonia Chlorine
Gogebic	Ironwood City of, Water Pump Station	Chlorine
Grand Traverse	Airgas Great Lakes, Inc. Century Sun Metal Treating Linde Gas, LLC Morrison Orchards	Chlorine Ammonia Ammonia Ammonia
Gratiot	Alma City of, Waste Water Plant St. Louis City of, Waste Water Treatment Plant	Chlorine Chlorine
Hillsdale	Bob Evans Farms Hillsdale Waste Water Treatment Michigan South Central Power Agency Prattville Fertilizer & Grain	Ammonia Chlorine Chlorine Ammonia
Houghton	Michigan-American Water Company	Chlorine
Huron	Caseville Village of, Water Treatment Plant Dow Agrosiences, LLC Port Austin Area Sewer and Water	Chlorine Ammonia Chlorine
Ingham	Airgas Great Lakes, Inc. Alexander Chemical Corporation Aurora Specialty Chemistries East Lansing – Meridian Water and Sewer Lansing Board of Water & Light – Erickson Station Lansing Keystone Avenue and Mint Road Lansing River Intake House Linde Gas, LLC Michigan State University Nitrex, Inc. – Michigan Operation Quality Dairy Company Symmetry Medical, Inc. – Jet Engineering	Chlorine Chlorine Ammonia, Epichlorohydrin Ammonia Chlorine Ammonia Chlorine Ammonia Chlorine Ammonia Ammonia Cobalt
Ionia	Herbruck Poultry Ranch Portland Waste Water Treatment Plant Twin City Foods, Inc.	Ammonia Chlorine Chlorine
Iosco	Huron Shore Regional Utility – Earth Tech	Chlorine



# Tracking Work-Related Asthma

COUNTY	COMPANY NAME	TYPE OF EXPOSURE
Jackson	Nalco Company – Plant 135	Formaldehyde
Kalamazoo	AGA Gas, Inc. Cytec Industries, Inc. Kal Blue Reprographics Knappen Milling Co. Pharmacia & Upjohn, LLC – Pfizer, Inc. Mfg. Complex  Total Logistics Control, LLC	Ammonia, Chlorine Epichlorohydrin Ammonia Chlorine Ammonia, Chlorine, Epichlorohydrin, Formaldehyde Ammonia
Kent	AGA Gas, Inc. Allied Finishing, Inc. Coca-Cola Bottling Co. Country Fresh, Inc. Electro-Chemical Finishing Company-44th St Facility Electro-Chemical Finishing Company-Remico St. Facility Emerald Spa Corporation Haviland Products Company Kent County Waste-to-Energy Facility King Milling Company Lack's Trim System – Airline Plant Lack's Wheel Systems MacDonald's Industrial Products – Plant 3 Old Orchard Brands, LLC Southside Ice Center Sparta Village of, Water Dept. Spartan Stores Distribution, LLC Univar – Grand Rapids Wyoming Clean Water Plant	Ammonia Formaldehyde Ammonia Ammonia Ammonia Ammonia, Formaldehyde Styrene Formaldehyde Chlorine Chlorine Formaldehyde Formaldehyde Formaldehyde Ammonia Ammonia Chlorine Ammonia Bisphenol A, Formaldehyde Chlorine
Leelanau	Leelanau Fruit Company	Ammonia
Lenawee	Adrian City of, C. R. Nelson Waste Water Treatment Plant Anderson Development Company – Main Plant Biolab, Inc. – Chemtura Tecumseh City of, Waste Water Treatment Plant Tecumseh City of, Well house #3, #8 - #12 & #14	Chlorine Styrene Ammonia, Chlorine Chlorine Chlorine
Livingston	Alpha Technology Corporation Howell City of, Waste Water Treatment Plant Howell City of, Water Plant Pepsi Cola Metropolitan Bottling	Styrene Chlorine Chlorine Ammonia
Macomb	Ashland Distribution Company Chemtech Finishing System, Inc.  Du Pont – Mt. Clemens Plant Fini Finish Products, Inc. Mount Clemens City of, Waste Water Treatment Plant New Baltimore City of, WPCF Specialty Steel Treating, Inc. Warren City of, Waste Water Treatment	Styrene Epichlorohydrin, Formaldehyde Styrene Chlorine Chlorine Chlorine Ammonia Chlorine
Marquette	Airgas North Central, Inc. Negaunee Waste Water Treatment	Chlorine Chlorine
Mason	Ludington City of, Waste Water Plant Michigan Food Processors	Chlorine Ammonia
Menominee	L.E. Jones Company Menominee Paper Company Menominee Waste Water Treatment Plant Menominee Water Treatment Plant	Cobalt Chlorine Chlorine Chlorine
Midland	Dow Chemical USA – Midland Operations – MI Div.	Bispheno A, Chlorine, Epichlorohydrin, Methyl Acrylate, Styrene

COUNTY	COMPANY NAME	TYPE OF EXPOSURE
	Dow Corning Corporation – Midland Plant Homestead Tool & Machine – SMC Plant Midland City of, Waste Water Plant Midland City of, Water Treatment Midland Materials Research, Inc. – Carbone of America	Chlorine Styrene Chlorine Chlorine Chlorine
<b>Monroe</b>	Advanced Heat Treat Corp. Independent Dairy, Inc. Meijer Newport Distribution Monroe City of, Waste Water	Ammonia Ammonia Ammonia Chlorine
<b>Montcalm</b>	Federal Mogul Corporation	Ammonia
<b>Muskegon</b>	Cole's Quality Foods, Inc. ESCO Company LTD Partnership Howmet Corporation – Plants 1 & 3 Howmet Corporation – Plant 5 Howmet Corporation – Plant 10 Intra City Dispatch Lake Welding Supply Company, Inc. M. Arguesi & Co., Inc. Muskegon Heights Filtration Plant S.D. Warren Company Webb Chemical Service Corp., Inc.	Ammonia Phthalic Anhydride Cobalt Bisphenol A, Cobalt Cobalt Bisphenol A Ammonia Bisphenol A Chlorine Chlorine Formaldehyde
<b>Oakland</b>	Detroit Skating Club Drayton Pool & Spa Supply Inc. Engineered Heat Treat, Inc. General Motors Proving Ground Holly Village of, Waste Water Treatment Plant JHP Pharmaceuticals Lakeland Arena MacDermid, Inc. Midwest Region Milford Village of, Iron Removal Plant Milford Village of, Waste Water Treatment Plant Specialty Steel Treating, Inc. Stone Soap Company, Inc. Sulzer Metco (US), Inc.	Ammonia Chlorine Ammonia Chlorine Chlorine Chlorine Ammonia Ammonia, Formaldehyde Ammonia Chlorine Chlorine Ammonia Formaldehyde Cobalt
<b>Oceana</b>	Hanson Logistics Group Kurdziel Iron Rothbury	Ammonia Styrene
<b>Ogemaw</b>	Sandvik Hard Materials	Cobalt
<b>Ontonagon</b>	Smurfit-Stone Container Enterprises	Chlorine
<b>Osceola</b>	Advanced Fibermolding Yoplait USA	Styrene Ammonia
<b>Ottawa</b>	Airgas Great Lakes, Inc. Board of Light & Power Crème Curls Bakery, Inc. Hudsonville Creamery & Ice Cream, LLC Lake Welding Supply Company, Inc. Lakeshore Filtration Plant Mead Johnson and Company Polyply Composites, Inc. Tiara Yachts, Inc. Wyoming Water Treatment Plant	Chlorine Chlorine Ammonia Ammonia Ammonia Chlorine Chlorine Styrene Styrene Chlorine
<b>Saginaw</b>	Airgas Great Lakes, Inc. Bridgeport Waste Water Treatment Plant Buena Vista Waste Water Treatment Plant Frankenmuth City of, Waste Water Treatment Plant Linear Motion, LLC Saginaw Charter Township Retention Basin Saginaw Water Treatment Plant Star of the West Milling Company Waste Water Treatment Plant	Chlorine Chlorine Chlorine Chlorine Ammonia Chlorine Chlorine Chlorine Chlorine

# Tracking Work-Related Asthma

COUNTY	COMPANY NAME	TYPE OF EXPOSURE
Saint Clair	Dunn Paper, Inc. Lake Huron Water Treatment Plant	Chlorine Chlorine
Saint Joseph	Abbott Nutrition Leco Corporation Sturgis Waste Water Treatment Plant Three Rivers Waste Water Treatment	Ammonia Ammonia Chlorine Chlorine
Sanilac	Croswell Water Plant DGP, Inc.	Chlorine Styrene
Shiawassee	Machine Tool & Gear, Inc. UAP Distribution, Inc.	Ammonia Ammonia
Tuscola	Advanced Decorative Systems Caro Village of, Waste Water Treatment Plant Cass City Village of, Waste Water Treatment Plant Precision Concepts, Inc.	Ammonia Chlorine Chlorine Styrene
Van Buren	Coca-Cola North America Paw Paw Plant South Haven City of, Water Filtration Plant Total Logistic Control – Paw Paw Logistic Center Welch Foods, Inc.	Ammonia, Chlorine Ammonia Chlorine Ammonia Ammonia
Washtenaw	Astro Cap Manufacturing Airgas Great Lakes, Inc. Kalitta Charters, LLC Chelsea Milling Company NSK Corporation Photo Systems, Inc. Thetford Corporation	Styrene Chlorine Ammonia, Formaldehyde Chlorine Ammonia Formaldehyde Formaldehyde
Wayne	Aldoa Company Apollo Plating, Inc. Arbor Hills Electric Arted Chrome Plating, Inc. BASF Corporation Bottling Group LLC, Pepsi Bottling Canton-Detroit COC Cardinal Health Chemtech Finishing System, Inc. Dairy Fresh Foods, Inc. – Detroit City Dairy Detroit Waste Water Treatment Durcon Laboratory Tops, Inc. Dynamic Metal Treating, Inc. Freezer Services of MI, LLC Fritz Products Gutter Suppliers Huron Metallurgical, Inc. Interstate Chemical Co., Inc. JCI Jones Chemicals, Inc. KA Steel Chemicals Lincoln Distributing – Painters Supply & Equipment Linde Gas, LLC Norquick Distributing Company Northeast Water Plant Pepsi Bottling Group, LLC Praxair Distribution, Inc. PVS Nolwood Chemicals, Inc. PVS Technologies, Inc. Quaker Chemical Corporation South Huron Valley Waste Water Treatment Plant Steel Processing Company, LLC Trenton City of, Waste Water Treatment Plant Trenton Engine Plant Water Works Park Plant White Tower Industrial Laundry Wyandotte City of, Municipal Power Plant	Epichlorohydrin Ammonia Ammonia Chlorine Styrene Ammonia Ammonia, Chlorine Formaldehyde Epichlorohydrin Ammonia Chlorine Phthalic Anhydride Ammonia Ammonia Chlorine Formaldehyde Ammonia Formaldehyde Chlorine Chlorine Styrene Ammonia, Chlorine Ammonia Chlorine Chlorine Ammonia Formaldehyde Chlorine Formaldehyde Chlorine Ammonia Chlorine Ammonia Chlorine Chlorine Chlorine
Wexford	AAR Mobility Systems Airgas Great Lakes, Inc. Fiber-Tech Industries Four Winns, Cruiser Four Winns Inc., Sport Division Haring Township Water Supply	Formaldehyde Chlorine Styrene Styrene Styrene Chlorine

\*Source: Michigan Department of Environmental Quality (DEQ), Michigan Facilities' Guide to SARA Title III, Emergency Planning and Release Reporting, December 2007, 6th edition. The chemicals listed in this table are subject to reporting under the Emergency Planning and Community Right-to-Know-Act (EPCRA) section 313, which is triggered by threshold amounts of 25,000 pounds manufactured or processed or 10,000 pounds otherwise used at facilities in Michigan. The companies listed in this table were current as of a report generated by the Michigan DEQ on June 26, 2008.



## WORK-RELATED ASTHMA FATALITIES

Fortunately, a very small percent (0.01-0.02%) of asthmatics die from asthma. In 2007, an individual died from an asthma attack triggered by exposure to chlorine fumes in the laundry room where she worked for over 20 years. In prior reports, we described investigations of five asthma deaths: a 77 year old former automotive worker who died in 2006 from long term complications of her asthma, which she developed from toluene diisocyanate exposure after working 22 years as a machine operator; a production worker who died from exposure to isocyanates in an adhesive manufacturing facility in December 2005; a waitress who died from exposure to second hand cigarette smoke in a bar in May 2004 (2); a dairy farmer who died in 2004 from exposure to the chemicals used to clean a milk tank; and a worker who died in 2003 from exposure to methylene diphenyl diisocyanate used in the truck bed spray-on lining business (3). A summary of the most recent death follows:

In 2007, a 52-year-old female laundry worker died from an asthma attack at work where she was exposed to a high concentration of bleach fumes. She had worked for 24 years at the nursing home laundry room. On the day of her asthma attack that led to her death, she came to work and noticed a strong smell of bleach in the laundry room. She began coughing and became short of breath. She went to the restroom where she was found by a co-worker, unconscious and unresponsive. She was given CPR and taken to a local hospital, but she never regained consciousness and died three days later.

## 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 (4).

On average, 144 new people each year are reported to the Michigan Department of Labor and Economic Growth (DLEG) with confirmed work-related asthma. One hundred fifty-three reports were confirmed in 2005, the most recent year with complete data. Although the total number of

work-related asthma 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 2001 BRFSS random sample of Michigan residents, we estimate that there are a total of 62,693 (95% CI 42,011 - 83,375) Michigan adults with work-related asthma in the state (5). Based on the medical literature we would estimate that there are 97,500 Michigan adults with work-related asthma (4). Using capture-recapture analysis, we estimate 228 - 801 adults in Michigan develop work-related asthma each year (6).

As in the previous annual reports on work-related asthma in Michigan, the workers reported are generally young to middle age Caucasian men and women, with the greatest number being reported from the Detroit metropolitan area. However, the rate of work-related asthma in African Americans is 2.0 times greater than among Caucasians. Based on an analysis conducted for previous annual reports, factors from the work-related asthma surveillance data that would contribute to greater morbidity among African-Americans include: a greater likelihood to continue to be exposed to the allergen, 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, more temporary workers are being hired to do work on an as-needed basis. The transient nature of temporary work underscores the potential for undercounting 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 work-related

# Tracking Work-Related Asthma

asthma remain isocyanates (13.8%) and metal working fluids (11.0%). We have again 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, 4-6% of the workforce is employed in manufacturing facilities where isocyanates are used: Wexford (5.9%), Mecosta (5.3%), Luce (4.9%), Allegan (4.8%), and Dickinson (4.2%). Health care providers can use this information to heighten their awareness of potential exposure to isocyanates among their patients with asthma.

Table 15 shows selected agents by county and company that have been associated with work-related asthma. 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 1,741 individuals no longer exposed, almost 3 years elapse from time of 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.

Neither personal habits such as cigarette smoking nor individual susceptibility measured through personal or family history of allergies predict who will develop work-related asthma. Approximately 50% of the asthma patients have no personal or family history of allergies and 80% are not smoking cigarettes at the time their asthma symptoms develop (Tables 6-8).

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

are not protective enough. We identified 1,485 fellow workers with symptoms compatible with work-related asthma (Table 13). Five hundred sixty-four individuals were listed on the MIOSHA log as having work-related asthma. There was only a small overlap (nine individuals), although one might expect a greater overlap of the co-workers with symptoms to be reported on the 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.

The high percentages of symptomatic individuals are consistent with estimates of the prevalence of WRA in the state. The presence of symptomatic co-workers suggests that some of the occupational health standards may not be sufficiently protective to ensure a safe workplace. The adoption of comprehensive standards for known causes of WRA, such as the isocyanates or metal working fluids, would better protect exposed workers. These standards would ideally cover medical surveillance programs for potentially exposed workers, work practices, education, and procedures to handle non-routine exposures such as during maintenance, as well as spills or leaks and other unexpected releases.

Medical monitoring is particularly relevant to reducing the burden of work-related causes of asthma. The longer a person with symptoms remains exposed, the more likely their asthma will become a chronic problem (7). MIOSHA is currently promulgating a new standard for the diisocyanates. The deaths in 2003 and 2005 of workers from exposure to isocyanates might have been prevented if more comprehensive standards for the use of isocyanates were in place. The 2003 death occurred in a small three-person shop and reflects the spread of the use of new technology without adequate information on safe work practices. Small employers require additional knowledge of safe work practices to prevent sensitization of their employees.

The 2005 death occurred in a company that, although it provided medical monitoring, did not properly utilize the results of the medical monitoring. Employers, employees and medical professionals need to be aware of the hazards related to returning sensitized individuals to their places of employment. If an individual is returned to the work





environment where the substance is being used, there must be well-defined and frequent medical assessments of the sensitized employee.

The percentages of individuals reported with work-related asthma 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 work-related asthma 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 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 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 the 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 work-related asthma 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 current permissible exposure limits, document the need for the development of new standards, identify new occupational allergens, and prevent co-workers from developing disease.



Given the potential that 15% or more of adults with asthma have work-related asthma, WRA must be integrated into all asthma initiatives planned on surveillance and education, both for health care providers and the public.





# Tracking Work-Related Asthma

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### ABOVE:

There are many opportunities for maintenance and production workers to have exposure to chemicals when they are pumped from a drum to a machine: hook up and disconnection of hoses, broken seals, and other maintenance issues.



## APPENDIX 1

### 2007 Patient Narratives by Type of Industry and 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.

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## MANUFACTURING

### Exposure to Anhydrides

**OA- Case 2628.** A man in his 20s worked for a countertop manufacturer where he developed asthma from exposure to phthalic anhydride. He had never smoked cigarettes. He had multiple visits to the local hospital emergency room for wheezing and difficulty breathing, during which he was given oxygen and nebulizer treatments. He continues to work at this facility, and wears a respirator to help minimize his exposure.

### Exposure to Cleaning Agents

**POA- Case 2733.** A woman in her 50s worked for an automotive trim manufacturer for over ten years when she developed asthma from exposure to chemicals used to clean the machines that made the parts. She had never smoked cigarettes. She was prescribed Albuterol and reassigned to an area where the cleaners were not used. Since then, her symptoms have worsened, although her medicine dosage has remained unchanged.

**POA- Case 2719.** A woman in her 40s worked for a pharmaceutical manufacturer. She was exposed to cleaning agents and experienced wheezing. She was prescribed an inhaler and allergy medicine. She had never smoked cigarettes. She continues to work at this company and experiences breathing problems when cleaning agents are used.

### Exposure to Heated Plastics

**POA- Case 2730.** A man in his 20s worked through a temporary agency for a plastic injection molding facility. After working for a few months he experienced wheezing, chest tightness and shortness of breath from exposure to fumes when the machines were purged in order to set up for running new parts. He went to a local emergency room and was

prescribed Albuterol. He continued to work at the facility for a few months after his asthma developed, but was eventually let go because the company “no longer needed him.” After leaving this company, his breathing improved, although he continues to take Albuterol. He had smoked cigarettes for over five years, and continued to smoke about a pack a day even after his breathing problems developed. He has since found new employment.

**POA- Case 2677.** A woman in her 20s developed asthma while working through a temporary employment agency at a plastic injection molding facility. A couple months after working at the facility, she developed asthma from exposures associated with the plastic molding operations. She experienced a severe asthma attack at the end of a shift where she reported the ventilation had been turned off, and went to a local emergency room where she was treated. She was prescribed Flovent, Albuterol, Combivent, and Prednisone. She continued to work at the facility for another six months, but her breathing problems continued so the temporary agency assigned her to a different company. Since then, her breathing has improved and she requires less asthma medicine. She had smoked cigarettes for over five years, and continues to smoke about a half a pack a day.

**AA- Case 2691.** A woman in her 40s worked for a plastic parts manufacturer for about three years. She experienced an exacerbation of her pre-existing asthma when she was exposed to fumes during purging of the plastic injection mold machines where she had recently been assigned. She had smoked cigarettes for about 25 years, a pack and a half a day, but quit smoking in her 30s. She continues to work at the facility.

# Tracking Work-Related Asthma

## Exposure to Isocyanates

**OA- Case 2584.** A male in his 40s worked as a core setter in an automotive parts manufacturing facility where he was exposed to MDI. One year after beginning work at a new plant, he developed symptoms of wheezing, chest tightness and shortness of breath. He began to take Advair and Albuterol. He had smoked an average of 30 cigarettes a day for 30 years but had stopped smoking three years ago. Baseline spirometry was markedly reduced. He had a positive pre-and post-bronchodilation test. He retired on sick leave six years after his symptoms began. His breathing problems lessened but were still present and he continued to take the same amount of asthma medication.

**OA- Case 2625.** A male in his 30s worked on a production line that made headliners for cars; he was exposed to phenol and isocyanates. He developed asthma one year after beginning work at this job. He had never smoked cigarettes. He required asthma medicine, which significantly reduced his symptoms of wheezing and shortness of breath but did not improve his cough. He continues to work at this facility doing the same job and was recently given a respirator to wear at work.

**OA- Case 2560.** A male in his 40s worked as a laborer at a facility that assembles ice bins. He developed asthma five months after beginning work at this plant from exposure to isocyanates and was prescribed Advair and Albuterol. He did not wear any protective equipment while working. He had smoked an average of 20 cigarettes a day for 20 years but had stopped smoking 12 years ago. Baseline spirometry was reduced and he had a positive pre-and post-bronchodilation test. He went on sick leave one year after his symptoms of wheezing, cough and shortness of breath began. His breathing problems decreased but are still present. He no longer requires asthma medicine.

**OA- Case 2656.** A man in his 30s worked for less than a month at an automotive parts manufacturing facility when he developed asthma from exposure to MDI. He described an initial skin exposure from a leaking seal and tip on a hose used by robots to spray MDI-based foam into molds. When his first asthma attack occurred at work during clean up of a leak, he was taken to an emergency room and

subsequently hospitalized overnight. Baseline spirometry was normal, but he had a positive methacholine challenge test. He was prescribed Albuterol and Flovent. He had never smoked cigarettes. A few weeks after he was placed on medical restriction, he was laid off. Since this time, his symptoms have become worse and he is taking increased asthma medicine.

**OA- Case 2713.** A woman in her 50s developed asthma from working on the glue line at an automotive manufacturing facility. The glue was isocyanate-based. She had worked at this company for over 10 years before her asthma developed. She had smoked a pack of cigarettes a day for 30 years but quit about five years before her asthma developed. Baseline spirometry was normal but she had a positive methacholine challenge test. She was prescribed inhalers. After her diagnosis, she was assigned to a new work area free from isocyanate exposures. Since that time, her symptoms have improved and she has discontinued her asthma medication use.

**POA- Case 2654.** A woman in her 50s had been working for over 15 years at a plastic and resin mold manufacturing facility when she developed asthma from exposure to MDI. She was prescribed Advair, Spiriva and a nebulizer to control her symptoms. She was placed on medical leave and her symptoms remained unchanged. She had smoked one and a half packs of cigarettes a day for 20 years, but had quit several years before her asthma developed. Baseline spirometry showed minimal obstructive airways disease.

## Exposure to Metal Working Fluids

**OA- Case 2700.** A man in his 60s worked as a millwright at an automotive manufacturing plant for 40 years. He developed asthma from exposure to metal working fluids about 15 years into his employment at the plant. Spirometry testing showed severe obstruction. He described exposure to the metal working fluids especially when helping to drain and change the fluids used at the facility. He had smoked a pack of cigarettes a day for 30 years, but quit in his mid-50s. Because of his continued symptoms and the inability of the company to provide him a job free from the coolant exposures, he was placed on permanent medical leave. Since that time his symptoms have improved.



**OA- Case 2612.** A male in his 40s worked as a machinist in an automobile parts manufacturing facility. He was exposed to Isopar and metal working fluids in his work. He developed asthma 23 years after beginning to work at this company with symptoms of chest tightness and shortness of breath. He had never smoked cigarettes. He was hospitalized once because of his breathing problems. He required Advair and Albuterol, and was reassigned to another job in the factory. Baseline spirometry was normal. He had a positive methacholine challenge test. After being reassigned, his breathing problems lessened but were still present. He no longer requires asthma medicine.

**OA- Case 2671.** A female in her 40s worked as a press operator at an automotive parts manufacturer where she was exposed to metal working fluids. Eight years after working at the facility, she developed wheezing, cough, chest tightness and shortness of breath. She had smoked an average of 30 cigarettes a day for the past 35 years. She was prescribed Albuterol and Proventil for her breathing problems. She was fired from her job. Her breathing problems did not improve and she continued to use her asthma medication as needed.

**AA- Case 2607.** A woman in her 20s experienced an exacerbation of her pre-existing asthma from exposure to coolants in her job at an automotive parts manufacturing plant. Her breathing symptoms began to flare up approximately one month after she began to work at the facility. She had been hired through a temporary agency, and was laid off due to lack of work about six months later. She had never smoked cigarettes. She had not yet found new work one month after being laid off.

### Exposure to Solvents

**POA- Case 2561.** A man in his 30s developed asthma after working for five years at a automotive parts manufacturing company where he was exposed to solvents. He had smoked a quarter of a pack of cigarettes a day for about four years, but quit when his breathing problems developed. Methacholine challenge testing demonstrated a significant decrease in expiratory airflow. His symptoms improved after being removed from the exposures at work.

**POA- Case 2689.** A man in his 40s worked over 10 years as a spray painter at an automotive manufacturing facility. He was exposed to paints and solvents, and reported wearing a respirator

most of the time doing this job. He had never smoked cigarettes. Baseline spirometry indicated moderate obstruction, and pre- and post-shift spirometry was positive. He was prescribed Advair and Albuterol, and assigned to a new job at the company. Since that time, his symptoms have improved.

### Exposure to Welding Fume

**POA- Case 2608.** A male in his 50s developed asthma two months after beginning work as a welder at an automotive parts manufacturing facility. His symptoms of wheezing, cough and shortness of breath were worse when he was at work. He never smoked cigarettes. Baseline spirometry was normal. He had a positive methacholine challenge test. His employer has reassigned him to a new position not doing welding. He was recently prescribed asthma medicine and he continues to work at the facility.

**POA- Case 2732.** A man in his 70s worked at an automotive manufacturing plant. He was exposed to welding fume. He developed a cough and trouble breathing, and was brought to an emergency room where he received Solu-medrol and Albuterol. After spending several hours in a hospital emergency department, he was discharged home. It is unknown how long he worked at this facility or what job duties and department he normally worked.

**POA- Case 2664.** A woman in her 40s developed asthma four years after she began working at an automotive stamping plant. She was exposed to welding fume and aerosol cleaners used to clean the stamping machines. She was prescribed multiple asthma medicines, including Albuterol, Prednisone, and Proventil. About 10 years later she was prescribed additional medicines, including a nebulizer and Spiriva. She has continued to work at the facility, her symptoms have worsened and she requires increased asthma medicine. She had smoked a pack a day of cigarettes for almost 30 years, but quit about a year ago. Recent spirometry showed moderate restriction and obstruction.

**POA- Case 2618.** A man in his 60s worked as a spot welder in an automotive assembly shop. After working at this company for 15 years and being exposed to welding fume, he gradually developed wheezing, cough, shortness of breath and chest tightness. He had smoked only a cigarette a day for three years when he was in his late teens.

# Tracking Work-Related Asthma

He was prescribed Theophylline, Singulair, Zyrtec and a nebulizer treatment. Twenty-five years after his diagnosis, he continues to work at the company and reports a worsening of his symptoms, although his medication use has decreased.

**POA- Case 2706.** A woman in her 50s worked for an automotive manufacturer as a welder. She was exposed to welding fume for over 20 years in this job before her asthma developed. Baseline spirometry showed mild obstruction. She was prescribed an Albuterol inhaler. She noted her symptoms resolved when on vacation and returned when she came back to work. She continues to work as a welder at this facility.

## Multiple Exposures

**POA- Case 2600.** A female in her 50s worked as a laborer at a facility that manufactured range hood filters. She was exposed to an unknown chemical used to cover the charcoal filters they were producing. She developed wheezing, cough, shortness of breath and chest tightness and was treated at the emergency room 30 times. She never smoked cigarettes. Baseline spirometry was normal. She had a negative pre-and post-bronchodilation test. She was fired from her job. Twenty-one years later, she continued to have breathing problems and took a beta-2 agonist, Accolade, Claritin and used a nebulizer.

**POA- Case 2593.** A female in her 40s worked as a hand spray paint supervisor in a facility that applied phosphate coatings to metal parts. She developed asthma after exposure to Siloxirane over a ten year period. She was prescribed Proventil, Singulair and Azmacort. She had smoked an average of ten cigarettes a day for 30 years. Baseline spirometry was normal. She had a negative pre-and post-bronchodilation test. She continued to work at this facility. She was out on workers' compensation for six weeks but then returned to work. The facility stopped using Siloxirane in the building. Her breathing difficulties were still present and she continued to use increased amounts of asthma medication.

**POA- Case 2667.** A male in his 50s worked at a steel foundry as an overhead crane operator for 15 years. About one year after starting to work at the foundry, he developed wheezing, cough, chest tightness and shortness of breath. He described

exposure to fume from the melted steel, as well as hydraulic fluid leaks and chemicals used to harden the sand molds that made the steel parts. He was prescribed a nebulizer, three inhalers and steroids. He continued to smoke an average of ten cigarettes a day since his early 20s. Baseline spirometry was reduced with obstructive findings, and he had a positive pre- and post-bronchodilation test. He continued to have breathing problems while temporarily off work and to take his prescribed asthma medicine.

**POA- Case 2726.** A woman in her 50s worked for a sugar manufacturer. She was exposed to sulfuric acid a couple months after beginning to work at this company. She had never smoked cigarettes. Spirometry was consistent with obstructive lung defect with a significant response to bronchodilators. She was prescribed Pulmicort and Albuterol. She has continued to work at the company for over five years, and avoids being in the areas where sulfuric acid is used. Her symptoms have remained the same and she continues to take the same amount of asthma medicine.

**POA- Case 2614.** A woman in her 40s was hired through a temporary agency to work at a company that manufactured transportation equipment. Her job was to unload products off the production line. She developed chest tightness and shortness of breath after working at this job for two years. She was prescribed Asmanex and Combivent. She had smoked half a pack of cigarettes a day for almost 20 years but quit when her asthma began. It was unclear what exposure triggered her breathing problems. She described the plant as being dusty/dirty with poor air quality. She continues to work at the facility, although she was moved to a different work area. Her symptoms have improved although she continues to take the same amount of asthma medicine.

**POA- Case 2708.** A man in his 40s had been working at a rubber manufacturer for almost 15 years when he developed asthma from exposures during the mixing of compounds to make the rubber products. He described doing this job in a poorly ventilated area. He was prescribed Albuterol and Advair. He had smoked a pack a day of cigarettes for 30 years, but quit a couple years prior to his diagnosis. He continues to work at this facility.

**POA- Case 2735.** A man in his 30s worked in an office at an auto manufacturing facility. After working there for about a year, he developed wheezing and chest tightness. He described exposure to mold from roof leaks in the building. Baseline spirometry showed minimal obstructive airways disease. He had never smoked cigarettes. He was prescribed Singulair and Asmanex. He was placed on medical leave, and despite being out of the exposure his breathing problems became worse and he required greater amounts of asthma medicine.

**RADS- Case 2615.** A female in her 40s worked for one year as a laborer at a facility manufacturing oil and transmission coolers. She was exposed to fumes the first time she ran a turbo machine which led to symptoms of wheezing, cough, shortness of breath and chest tightness. She was treated at the emergency room and given a beta-2 agonist and oral corticosteroids. She stated she was fired the same day because of her breathing problems. She had never smoked cigarettes. Her breathing difficulties decreased but were still present and she continued to take a beta-2 agonist and Advair.

**RADS- Case 2635.** A man in his 30s worked for ten years as a pipe fitter at an automotive manufacturing facility when he developed RADS after an acute exposure to Freon and ammonia from a high pressure pipe leak. Spirometry testing showed reduced lung volumes, and a positive pre- and post-bronchodilation test. He began taking Advair, Albuterol, Proventil, Spiriva, Flonase and Pulmicort. He had never smoked cigarettes. He quit his job because of his breathing problems. Since then his asthma has not improved and he is taking increased asthma medicine.

**RADS- Case 2653.** A man in his 60s worked almost 40 years at an automotive manufacturing facility when he developed RADS after an acute exposure to a chlorine gas leak. He developed a cough and shortness of breath from this acute exposure, for which he was prescribed Flovent. Baseline spirometry was normal and he had a positive methacholine challenge test. He had smoked an average of ten cigarettes a day for 15 years, but had quit smoking three years prior to the chlorine gas leak. After the leak, he continued to work at the facility, although he reported that more substances at work began to trigger his breathing problems.

He continued to take asthma medicine to control his symptoms, as needed.

**RADS- Case 2649.** A man in his 30s developed RADS after a fire at his workplace. He had run a press machine for almost three years at a company that manufactured housing panels before the fire occurred. When some panels caught fire, he immediately experienced wheezing, chest tightness, cough and shortness of breath. He went to an emergency room where he was prescribed Advair. He smoked a half a pack of cigarettes a day for the past 14 years, and has continued to smoke since his asthma diagnosis. Baseline and pre- and post-bronchodilation spirometry conducted since his initial exposure was normal. He did have a positive methacholine inhalation challenge test. Over time, his symptoms have improved and he continues to take Advair. He was reassigned to a different department at the facility where he continues to work.

**RADS- Case 2674.** A woman in her 50s worked in an office at an automotive manufacturing facility for over 30 years when she developed RADS from exposure to water-damaged moldy documents. She had smoked less than a pack of cigarettes a day for over 20 years, but quit smoking about four years before her symptoms began. She was prescribed an inhaler, and assigned to an area that was free of the mold exposure. Since that time, her symptoms have remained the same, but she has decreased the use of her inhaler. Other triggers now cause her breathing problems, including dust and pollen.

**RADS- Case 2690.** A man in his 30s worked for an equipment manufacturer. He developed RADS from an acute exposure to phosphoric acid. He was treated at an emergency department with bronchodilators and steroids. His symptoms improved after his emergency room visit.

**RADS- Case 2722.** A woman in her 20s worked for an automotive parts manufacturer for almost a year when she developed RADS from an acute exposure when a solvent and a heated adhesive were mistakenly mixed. Within 24 hours of exposure, she developed chest tightness, shortness of breath, cough and wheezing. She was given four nebulizer treatments and steroids. After this incident, the adhesive used was changed to a less toxic product. She continues to work at this facility.



# Tracking Work-Related Asthma

**AA- Case 2704.** A woman in her 30s experienced an exacerbation of her pre-existing asthma while working at her office job for a pharmaceutical manufacturer. Her office was located next to a mixing room where products were developed. Exposure to chemicals being used in this room triggered her asthma. Since that incident, she was relocated to an office area away from the mixing room, and has not had any more asthma attacks at work.

## HIGHWAY, STREET & BRIDGE CONSTRUCTION

**POA- Case 2583.** A male in his 60s worked driving a sweeper truck for a paving company. He developed asthma shortly after beginning work for this company and required asthma medicine. He had smoked cigarettes for 20 years starting at a very young age, averaging 40 cigarettes per day, but had stopped smoking about 30 years ago. His symptoms of a cough and shortness of breath did not improve with medicine and he quit working for this company after three years, on the advice of his doctor. His baseline spirometry was significantly reduced and he had a positive pre-and post-bronchodilation test. He has not worked in the two years since he left his job.

**AA- Case 2652.** A man in his 20s with pre-existing asthma experienced an exacerbation of his breathing problems while working on a summer road maintenance crew. Exposure to high heat and humidity while working outdoors triggered his symptoms. This was seasonal work. After he returned to school in the fall, his symptoms improved although his asthma medicine use increased. He had never smoked cigarettes. He currently takes Advair and Albuterol.

## OFFICE

### Exposure to Cleaning Agents

**AA- Case 2627.** A female in her 50s worked for one year in a government office. She was exposed to several unknown chemicals when her office area was cleaned. Within 48 hours of the cleaning she developed hives on the parts of her body that came in contact with surfaces that had been cleaned. She had symptoms of anaphylaxis and was taken to the emergency room. She has not returned to work since this incident on the advice of her doctor.

She was diagnosed with asthma at the age of seven which was controlled with Singulair. She smoked an average of two cigarettes a day for three years but stopped more than 30 years ago. Baseline spirometry was normal and she had a negative pre-and post-bronchodilation test. She continued to have worsening breathing difficulties three months after leaving her job as well as less severe hives and still required Zantac, Zyrtec, Atarax, and Prednisone.

### Exposure to Indoor Air Contaminants from Water Damage

**POA- Case 2687.** A woman in her 40s had worked in an office setting for approximately 20 years when she developed asthma from unknown exposures. She described leaking roofs and poor ventilation in the building where she worked. She had never smoked cigarettes. She was prescribed Prednisone, an Albuterol inhaler and a nebulizer. She continues to work at the facility and since being prescribed the asthma medication her symptoms have improved.

**POA- Case 2597.** A female in her 50s worked as an office manager at a restaurant with significant water damage in her workspace. This subsequently led to mold growth. She began experiencing shortness of breath and a cough. She was prescribed Zyrtec, Singulair, and a beta-2 agonist which she stated did not help her symptoms. She also began using multiple herbal medicines. She had smoked an average of seven cigarettes a day for two years but had quit smoking 28 years ago. She had previously been diagnosed with asthma in her 40s but it stopped after two years. Baseline spirometry was normal. She had a negative pre-and post-bronchodilation test. She continued to work in this office. Her breathing problems remained the same.

**POA- Case 2699.** A woman in her 60s worked in an office for almost 20 years. She developed asthma from exposure to mold after building renovations were begun. Baseline spirometry showed obstructive changes. She was prescribed Albuterol and Singulair. She had never smoked cigarettes. After the renovations were completed, her symptoms improved and she discontinued taking her asthma medicine.

## Exposure to Multiple Contaminants from Construction-Related Activities

**AA- Case 2650.** A woman in her 50s with pre-existing asthma worked in a billing office for over 10 years when she experienced an exacerbation of her symptoms from exposure to re-roofing that was being done at the building where she worked. She described a fire-proofing product being part of the re-roof. She had never smoked cigarettes. She continues to work in the same office, and reports a worsening of her symptoms and increased asthma medicine usage since the re-roofing was done. She currently takes Prednisone, Advair, Nasacort, Spiriva, and a Qvar inhaler. Recent spirometry indicated a moderate obstructive lung defect.

**POA- Case 2670.** A woman in her 30s worked in an office for three years, and developed asthma after remodeling construction work was done in the building where she worked. She had smoked an average of two cigarettes a day for two years, but had quit smoking shortly after her breathing problems developed. Baseline spirometry was normal. She was prescribed multiple asthma medication including: Advair, Spiriva, Pulmicort, Albuterol, Singulair, Allegra D, and Prednisone. She worked at this job for several more years, and continued to experience breathing problems. When she left this job, her symptoms improved and she discontinued taking asthma medicine. She had not found new employment at the time of the interview.

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## Exposure to Pesticides and Pests

**AA- Case 2665.** A woman in her 50s with pre-existing asthma worked in an office setting. She had never smoked cigarettes. She experienced a worsening of her asthma symptoms when pesticides were sprayed to control pests in her building. When the pesticides were applied, she immediately had trouble breathing and had to seek care at a local emergency department. She left this job because she continued to have trouble breathing with ongoing pesticide applications. Since the incident, her medication use has increased.

**OA- Case 2673.** A woman in her 30s worked in an office for over 10 years when she developed asthma from exposure to mouse dander. She had never smoked cigarettes. Baseline spirometry was

normal. She was prescribed Qvar, Singulair, Allegra D, and Advair. Extensive cleanup of the office area was conducted. Afterwards, she was able to resume work at this job, her symptoms improved and she decreased her asthma medicine.

## EDUCATIONAL SERVICES

### Exposure to Chemicals

**POA- Case 2642.** A female in her 40s worked as a high school science teacher for more than 15 years. She developed asthma following exposure to hydrogen sulfide gas, cyclohexamine and a refrigerant from a leak in her classroom over a period of a few months. She began to take Azmacort, Xopenex, Nexium, Singulair and Prednisone. She never smoked cigarettes. Baseline spirometry was normal. She had a negative pre-and post-bronchodilation test. Her symptoms of chest tightness, shortness of breath and cough decreased when new engineering controls were put in place in her classroom. After these classroom changes, she no longer required the use of asthma medication.

**OA- Case 2643.** A woman in her 40s worked as a custodian at a college. She developed cough, wheezing, chest tightness and shortness of breath after doing this job for fourteen years. She was exposed to formaldehyde used to prepare specimens for a biology laboratory in a science building at the school. She was prescribed Asmanex. Her spirometry was reduced and she had a positive pre- and post-bronchodilation test. She had never smoked cigarettes. Her symptoms improve when out of this environment.

### Exposure to Indoor Air Contaminants, Including Water Damage

**POA- Case 2580.** A female in her 30s worked as an art teacher at an elementary school for 12 years where she was exposed to mold from standing water in tunnels under the school as well as a flood in her classroom. She had been diagnosed with asthma as a child but never required asthma medicine until she began work at this school. She had never smoked cigarettes. Baseline spirometry was normal and she had a negative pre-and post-bronchodilation test. Her breathing problems have worsened and she requires more asthma medicine (Advair, Zyrtec and Nasacort). She continues to work at this school.

# Tracking Work-Related Asthma

**POA- Case 2663.** A man in his 40s worked as a custodian for a public school system. After working for the school system for two years, he developed chest tightness and shortness of breath. He described exposure to dusts and mold in the buildings where he worked, and poor ventilation contributing to his symptoms. He had never smoked cigarettes. Spirometry showed minimal airway obstruction. He was prescribed an Albuterol inhaler, Prednisone and Advair. After being off work for about a year, his symptoms improved and he was taking less asthma medicine.

**POA- Case 2707.** A woman in her 50s worked at a school as a teacher. She developed asthma from exposure to mold in the building, about three years after she started working there. She was prescribed Singulair and Xopenex. She had never smoked cigarettes. About three months after her diagnosis, she left this job because the school was unable to remediate the building. Since leaving, her symptoms have improved.

**POA- Case 2729.** A woman in her 40s worked for eight years as a library technician. She developed asthma from exposure to multiple indoor air contaminants including paint fumes, industrial carpet fumes (including adhesives), and cleaning compounds. She was prescribed Singulair, Advair and Albuterol as needed. She had smoked cigarettes for a very brief period of time in her teens, on average two cigarettes a day for about a year. She left this job and had not found new employment. Since leaving, her symptoms and medication use have remained the same.

## FOOD & BEVERAGE SERVICES

**AA- Case 2725.** A woman in her 50s worked over ten years at a restaurant as a cook. Her preexisting asthma was aggravated from exposure to cleaning agents and fumes from the deep fryer at the restaurant. She had never smoked cigarettes. She used an Albuterol inhaler to control her symptoms. She noted an improvement in her asthma when off work on weekends or vacations. She eventually quit working at the restaurant due to other health problems.

**AA- Case 2684.** A young man in his late teens worked at a restaurant as a bus boy when he experienced an exacerbation of his asthma from

an accidental mixing of ammonia and bleach. He immediately experienced an asthma attack when this happened, and went to an emergency room for treatment. In response to this incident, restaurant management held a two-day training for all employees about the chemicals used on site. He continues to work at the restaurant.

## HEALTH CARE SERVICES

### Exposure to Agents from Construction and Building Maintenance-Related Activities

**POA- Case 2601.** A female in her 30s worked for 15 years as a therapist in a hospital. She was exposed to welding fumes from elevator repairs over a period of four months which led to symptoms of chest tightness, cough and shortness of breath. She was diagnosed with asthma two months prior to her first exposure. She had never smoked cigarettes. Her baseline spirometry was normal and she had a negative pre-and post-bronchodilation test. Since the completion of the elevator repairs, her breathing problems only occur occasionally but are increasingly worse when they do occur. She requires increased asthma medication: Advair, Singulair and Albuterol.

**POA- Case 2644.** A woman in her 50s worked at a long-term care facility for a total of 20 years over a 30-year time period. Within the past few years, she experienced wheezing, cough, chest tightness and shortness of breath. She noted the emergence of her breathing problems when black mold was identified in an air conditioner at work. She had smoked cigarettes for 35 years, but had quit about the same time as the development of her breathing problems. She was prescribed Advair, Albuterol, DuoNeb, and Prednisone. She continues to work at the facility, and reports that her symptoms have worsened and her use of asthma medicine increased.





**RADS- Case 2660.** A woman in her 40s developed RADS from an acute exposure to roofing asphalt fumes at the hospital where she worked in the housekeeping department. Immediately after she first smelled the roofing fumes, she experienced wheezing, shortness of breath, cough and chest tightness. She had smoked a half a pack of cigarettes a day for 20 years but quit shortly before her asthma developed. Baseline spirometry showed minimal obstructive airways. She was prescribed Advair, Prednisone, Singulair and Clarinex. Since the incident, she has been off work and her symptoms have been unchanged although she now requires a greater amount of asthma medicine.

**AA- Case 2712.** A woman in her 50s worked as a nurse at a hospital for five years when her pre-existing asthma was triggered by mold in the hospital ventilation system. The hospital cleaned the air ducts as well as carpets thoroughly and since that time she has been symptom-free at work.

### Exposure to Cleaning Agents

**AA- Case 2662.** A female in her 20s had been diagnosed with asthma since her childhood. She worked at a hospital for two years as a nurse technician, where strong scented cleaning products, including bleach, would aggravate her asthma. She had never smoked cigarettes. After earning a degree in nursing, she started working at a different hospital. Her breathing problems have remained the same and she continues to take Albuterol as needed.

**AA- Case 2648.** A woman in her 40s worked at a mental health facility as a housekeeper. She had been diagnosed with asthma in her 20s. About seven years after working at the mental health facility, she experienced an exacerbation of her pre-existing asthma from exposure to room deodorizers and pine-scented cleaning products. She had never smoked cigarettes. She was reassigned to a different building and no longer works around the products that trigger her asthma at work.

**AA- Case 2669.** A man in his 40s worked in the laundry room of a long-term care facility. He developed wheezing and a cough from exposure to bleach. He had never smoked cigarettes. He was prescribed Albuterol. He continues to work at the facility and his breathing problems have improved.

**OA- Case 2641.** A woman in her 30s developed asthma from exposure to a glutaraldehyde-based disinfectant used at the veterinary hospital where she worked. An acute exposure to the disinfectant resulted in a trip to the hospital emergency room where she was treated and prescribed an Albuterol inhaler. She continues to work at the veterinary hospital.

**EA- Case 2636.** A woman in her 50s worked in the laundry room at a nursing home. One morning she was exposed to a high concentration of bleach. The fumes from the bleach triggered an asthma attack. She began coughing and became short of breath, and went to the restroom where a coworker found her unconscious and unresponsive. She was given CPR and taken to a local hospital but she never regained consciousness. She died three days later.



# Tracking Work-Related Asthma

## TRANSPORTATION SERVICES

**RADS- Case 2679.** A man in his 20s worked as a package handler loading and unloading delivery trucks for about a year when he developed RADS from an acute exposure to leaking hazardous chemicals in a box he handled on a hot and humid day. He immediately experienced breathing trouble and was transported to a local emergency room. He was prescribed Advair and Albuterol. He had never smoked cigarettes. He continues to do this job, and since the initial asthma attack, his symptoms have worsened and he requires more asthma medicine. Spirometry showed borderline obstruction, with no acute bronchodilator response.

**RADS- Case 2709.** A man in his 40s worked as a driver for a shipping company. He had been working for the company for about six months when he was exposed to a chemical spill of an unknown substance on the floor of the trailer he was loading. His breathing trouble progressed as the day went on. Baseline spirometry with pre- and post-bronchodilators demonstrated severe obstructive airways disease. He had never smoked cigarettes. He was prescribed Spiriva, Albuterol, Advair, Asmanex and Proventil. After he stopped working for this company, his symptoms improved and he required less asthma medicine. He has been unable to find a new job.

## MISCELLANEOUS SERVICES

**RADS- Case 2619.** A female in her 50s worked for three years at an organization that trained janitors. She was exposed to construction dust and fumes from remodeling work being done near where she worked. She developed wheezing, cough, chest tightness and shortness of breath which required hospitalization. She was prescribed Albuterol and given a nebulizer. She smoked cigarettes for fifteen years, averaging 10 cigarettes per day. She had stopped smoking earlier in the year. She was fired a month after going on medical leave due to her breathing difficulties and she has not worked since that time. Her symptoms have lessened although they are still present and she continues to take the same amount of asthma medicine.

**POA- Case 2696.** A woman in her 50s worked as a hairdresser for six years. She developed a cough, wheezing, chest tightness and shortness of breath while working with hair care products in a small, poorly ventilated room. She had smoked an average of 10 cigarettes a day for almost 40 years, but quit about the time her symptoms worsened. Spirometry testing showed reduced lung volumes, and a positive pre- and post-bronchodilation test. She was prescribed Pulmicort, a nebulizer, and Spiriva. After she left this workplace, her symptoms continued to worsen and she required more asthma medicine.

**RADS- Case 2718.** A man in his 40s developed asthma from an acute exposure to bleach and drain cleaner while working as a plumber. He received Prednisone, Solu-medrol and Albuterol in the emergency room.

**RADS- Case 2723.** A woman in her 30s developed RADS from exposure to a leak of perchloroethylene a few months after beginning to work at a dry cleaning company. When this leak occurred, she immediately experienced breathing difficulty and was prescribed Advair and steroids. She had smoked a pack a day of cigarettes for 20 years, but quit smoking after this incident. She left that job and almost a year later her symptoms have improved although she is taking more asthma medicine to control her symptoms.

**RADS- Case 2695.** A man in his 20s worked for a lawn care company. He developed RADS from exposure to fumes generated during the cutting of a plastic part. He was treated at a local emergency department for his symptoms. He was prescribed Albuterol and Prednisone with a nebulizer. He had never smoked cigarettes. Since that incident his breathing has improved and he requires less asthma medicine.

