2004

Annual Report on Work-Related Asthma in Michigan

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A Joint Report
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Summary:

This is the 14th annual report on work-related asthma (WRA) in Michigan. For the years 1989-2002, where all reports have been processed, an average of 141 new people each year have been reported to the Michigan Department of Labor and Economic Growth (formerly the Michigan Department of Consumer and Industry Services) with asthma caused or aggravated by exposures in the workplace. From 1988 to 2004, a total of 2,254 people with WRA have been identified through the Michigan Surveillance System that tracks occupational illness. Additional reports for 2003 and 2004 are still being processed. In this year's report we have added brief clinical summaries on each of the new cases of work-related asthma reported in 2004 (see Appendix I).

In the year 2003, one worker died after repeated exposure to an isocyanate used in the spray-on truck-bed lining industry. In 2004, a dairy farmer died from an asthma attack while cleaning out a bulk milk tank. Dairy tank cleaning involves several steps of different chemical rinses. During the first rinse, a sodium hypochlorite/sodium hydroxide solution was mistakenly mixed with the product used in the second rinse, which was an acid. Chlorine gas was generated from the mixing of these chemicals, which caused the farmer who had asthma to experience an acute asthma attack. She became acutely short of breath, collapsed and died, despite CPR from a family member and neighbor.

We know that the reports received are an under-representation of the true number of individuals with WRA in our state. There are a number of ways to estimate the extent of WRA in a given population, including: the use of self-reports from surveys, statistical estimates from studies, and an actual census count of disease. A consensus statement from the American Thoracic Society concluded: "The median value of 15% is a reasonable estimate of the occupational contribution to the population burden of asthma" (1). All of these methods to develop an estimate of the magnitude of work-related asthma in Michigan indicate that WRA is a significant problem in our state. We estimate there are 65,000 – 97,000 people in Michigan with work-related asthma.

Workplace exposures may cause new onset asthma from exposure to an allergen or an irritant that precipitates inflammatory changes, or work exposures may exacerbate pre-existing asthma from exposure to an irritant. Almost ninety percent of the reports received in Michigan involve the new onset of asthma. Michigan Occupational Safety and Health Administration (MIOSHA) enforcement

inspections at the workplaces of these individuals reveal a large number of fellow workers with asthma or respiratory symptoms compatible with asthma.

There are over 400 documented agents or work processes associated with work-related asthma. The most comprehensive listing of known causes of work-related asthma can be found at the following web site: www.remcomp.fr/asmanet/asmapro/agents.htm. Known allergens such as isocyanates and metal working fluids are the most commonly reported cause of work-related asthma in Michigan, representing 14.9% and 11.8% of the Michigan WRA cases, respectively. About 1% of the Michigan workforce is employed in manufacturing companies where isocyanates are used.

Work-related asthma is affecting men and women equally, generally in the 30-50 year old age range. The average annual incidence rate of work-related asthma among African Americans is 2.0 times greater than among Caucasians. Exposures are occurring in a wide range of workplaces. When an inspection is conducted at the workplace, significant numbers of symptomatic individuals have been identified. However, air monitoring at these same facilities typically reveals that the exposures to the suspected allergen or irritant are within existing workplace standards (95% of the time).

The Michigan WRA surveillance team has worked on many recent initiatives to understand more about certain high-risk exposures or industry and occupation groups. A manuscript on asthma among health care workers from the four states that track work-related asthma (California, Massachusetts, Michigan and New Jersey) was published (2). A second manuscript on asthma among school employees from the same four states is in preparation (3).

Another ongoing initiative in Michigan has been the development and presentation of a training workshop on work-related asthma to both the State's industrial safety and health staff and companies that have employees at risk for work-related asthma. Trainings have been completed for: Construction Safety and Health staff; General Industry Safety and Health; the Consultation, Education and Training group; and, employees at Michigan State University. The workshop's aim is to increase awareness of asthma, including its causes and triggers in the workplace so that MIOSHA field staff as well as company Health and Safety Representatives can evaluate the potential for exposures and develop work-related asthma prevention strategies. Plans are underway to present similar workshops to more employers whose workers use occupational allergens.

Background:

In 1988, the State of Michigan instituted a surveillance program for work-related asthma with financial assistance from the National Institute for Occupational Safety and Health (NIOSH). The surveillance program is a joint project of the Michigan Occupational Safety and Health Administration (MIOSHA) in the Michigan Department of Labor and Economic Growth (MDLEG) and Michigan State University (MSU). The goal of the surveillance program is to prevent work-related asthma through the reporting of index patients. The reporting of the index patient is regarded as a sentinel health event that may lead to the identification of other employees from the same facility who are at risk of developing asthma or who have developed similar breathing problems.

There are three major sources used to identify persons with work-related asthma: reports from physicians; reports from hospitals (since 1989); and claims filed since 1988 with the Bureau of Workers' Compensation. Both physicians in private practice and those working for industry send reports to the MDLEG. Reports from hospitals are requested once each year. Hospital discharge summaries for individuals with a primary or secondary diagnosis of a respiratory condition due to chemical fumes and vapors (ICD-9 506.0-.9) as well as individuals with a primary or secondary diagnosis of asthma (ICD-9 493) where the principal payer is listed as workers' compensation are obtained from the Michigan Health and Hospital Association's (MHA) Michigan inpatient database to verify the completeness of reporting by the hospitals. Other sources used to identify cases include: Michigan's two Poison Control Centers (since 2001); reports from co-workers or from the State's industrial hygienists; one report from the Mine Safety and Health Administration; and, one report from a death certificate.

A person is considered to have work-related asthma from sensitization to a workplace exposure if: A) they have a physician diagnosis of asthma, B) onset of respiratory symptoms associated with a particular job that then improve or are relieved when the patient is not working, and C) they work with a known occupational allergen, or have evidence of an association between work exposures and a decrease in pulmonary function testing.

Additional criteria are used to record three other categories of asthma associated with work. If only criteria A) and B) above are met, the person is considered to have possible work-related asthma. An enforcement industrial hygiene investigation at the patient's work site may be conducted by MIOSHA to

determine the allergen and to document its associated exposure levels. If a person had physician-diagnosed asthma before beginning work and their asthma became worse at a particular job, the person is considered to have work-aggravated asthma. Occupational asthma from exposure to an allergen at work typically develops after a variable period of symptom-less exposure to the sensitizing agent. However, if a person develops asthma for the first time immediately after an acute exposure to an irritating chemical at work, the patient is considered to have Reactive Airways Dysfunction Syndrome (RADS) (4).

After the patient is interviewed and the work-relatedness of the condition evaluated, an industrial hygiene investigation may be conducted at the patient's workplace. At this follow-up investigation, co-workers are interviewed to determine if other individuals are experiencing similar breathing problems from exposure to the suspected allergen. An industrial hygienist conducts air monitoring for any suspected allergens and reviews the company's health and safety program. After the investigation is completed, a report of air sampling results and any recommendations are sent to the company and union (or designated labor representative, if the company does not have a union).

In 1998, the surveillance program also began sending letters about potential problems with exposures to some of the companies where the index cases were exposed to an allergen but a MIOSHA inspection was not planned. These letters, in lieu of inspections, are sent to the company health and safety director, and ask the company to evaluate exposures to whatever suspected allergens were identified through the telephone interview with the index case.

Results:

Reports

Table 1 shows that 2,254 people were confirmed with work-related asthma between 1988 - 2004. Figure 1 presents the same data in a bar graph of the number of cases identified each year and the types of work-related asthma that were confirmed. The reports are divided into four categories: occupational asthma, possible occupational asthma, aggravated asthma, and RADS. One hundred eighty additional patients have been confirmed since last year's report. Figure 2 shows the overlap of the 2,142 patients by reporting sources for 1988-2003.

The data is incomplete for 1988 since the surveillance system was initiated in that year. For the year 2002, 143 cases have been confirmed; this is similar to the 139 cases reported in 2001. To date we have not yet received complete hospital reporting for the years 2003 and 2004. Patient interviews are still needed for three reports of patients from hospitals in 2003. Patient interviews are still needed for 29 reports of patients from hospitals, five reports from workers' compensation, three reports of patients from physicians, and two reports of patients from a poison control center in 2004.

Gender

One thousand one hundred and seventy-six (52.2%) of the persons with work-related asthma are women and 1,078 (47.8%) are men.

Race

Race was known for 2,229 of the 2,254 individuals with work-related asthma. Of the 2,229, 1,701 (76.3%) of the persons with work-related asthma are Caucasian, 416 (18.7%) are African American, 55 (2.5%) are Hispanic, 21 (0.9%) are Alaskan or American Indian, eight (0.4%) are Asian, and 28 (1.3%) were listed as "other."

The average number of incident cases of African Americans with work-related asthma each year for 1992-2002 was 28. In 1998 there were 539,621 African Americans in the Michigan labor force (5). The annual incidence rate for work-related asthma in African Americans, therefore, was 5.2/100,000 workers. The respective data for Caucasians was 113 new cases per year and 4,368,720 Caucasians in the Michigan labor force. The annual incidence rate of work-related asthma in Caucasians, therefore, was 2.6/100,000 workers. The African American rate of work-related asthma was 2.0 times greater than the rate for Caucasians.

Age

The dates of birth range from 1905 - 1984. The average year of birth is 1954.

Location in State

Figure 3 shows the county in which the patient worked where they developed work-related asthma. The main locations are: Wayne (560 cases, 25.5%), Oakland (293 cases, 13.3%), and Macomb (208 cases, 9.5%). Table 2 and Figure 4 show the

annual average incidence rates of work-related asthma among the general working population in each county. Based on the annual average incidence of reports of confirmed cases per 100,000 adult workers, Luce (17.9 per 100,000), Clare (11.5 per 100,000), Osceola (9.2 per 100,000), and Cheboygan (8.6 per 100,000) have the highest rates. It should be noted that, even though Luce had the highest incidence rate of work-related asthma, the rate is based on only six cases (see Table 2). Table 3 shows the annual incidence rates for the larger metropolitan areas and the whole state for the years 1990 through 2002 separately.

Type of Industry

Figure 5 shows the distribution of major industry types for all asthma cases identified from 1988-2004. Sixty-seven percent of the WRA cases worked in manufacturing, followed by 19% in the services industry, 4% in the trade industry, 3% in construction and mining, and 7% in miscellaneous industries. Table 4 shows the specific types of Michigan industries where the exposures to the occupational allergens occurred from 1988 to 2004. The predominant industries for the total number of cases identified between 1988 and 2004 were in the manufacturing sector: automobile (40.3%), fabricated metal products (4.1%), industrial and commercial machinery and computer equipment (3.9%), rubber and miscellaneous plastic products (3.5%), and foundries (3.1%). Workers in the health field also accounted for a high percentage of the total number of patients (9.6%).

The incidence rate of work-related asthma by industry type ranges from 0.4 cases per 100,000 in restaurants to a high of 20.1 cases per 100,000 in the manufacture of transportation equipment. The industries with the highest annual average incidence rates besides the manufacture of transportation equipment included: foundries with 12.0 cases per 100,000 workers; the manufacture of other nondurables with 10.6 cases per 100,000 workers; the manufacture of other durables with 7.8 cases per 100,000 workers; and the manufacture of rubber products with 7.7 cases per 100,000 workers.

Table 5 shows the annual incidence rates for the 1990 through 2002 work-related cases within those industries that had 20 or more reports.

Overall, by broad industrial classification, the average annual incidence rates were: 10.0 cases per 100,000 workers in the manufacturing industry; 2.4 cases per 100,000 workers in the construction and mining industry; and 0.8 cases per 100,000 workers in the service producing industry.

Table 6 shows the predominant exposures causing work-related asthma in Michigan. The most frequent exposures were to isocyanates (14.9%), metal working fluids (11.8%), cleaning solutions (8.1%), exhaust, smoke and fumes (5.7%), welding fumes (4.6%), and solvents (3.2%). The agent has not yet been identified for 328 patients (14.6%). The exposures to unknown agents occurred 176 times in the manufacturing sector and 152 times in an office setting.

Medical Results

Table 7 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 a blue collar working population.

Forty-three percent of the WRA patients had a family history of allergies (Table 8).

Forty-six percent of the asthma patients had a personal history of allergies or asthma (Table 9). Four hundred sixty-nine (45.2%) of the 1,038 patients with a personal history of allergies or asthma previously had asthma.

One thousand eight hundred forty of the patients identified with work-related asthma had persistence of their asthma symptoms (Table 10). This was true for 578 of 599 (96.5%) of those still exposed as well as 1,262 of 1,463 (86.3%) no longer exposed to the substance causing their asthma. Among those no longer exposed, 49.6% stated their symptoms were less severe compared to 31.2% among those still exposed who reported their symptoms were less severe. Similarly, 86.0% of those still exposed were continuing to take asthma medications while 77.8% of those no longer exposed were still taking asthma medications. Among those no longer exposed, 28.6% stated they were taking fewer medications while only 19.4% of those still exposed were taking fewer medications (Table 10).

Nine hundred seventy-six of 2,016 (48.4%) patients with known workers' compensation status had applied for workers' compensation. Cases were pending for 486 (49.8%) of those who applied, while 339 (34.7%) had received awards and 151 (15.5%) had been denied.

Although 2,254 individuals were confirmed with work-related asthma, we could find objective testing for hyperreactivity by methacholine challenge or pre- and post-

bronchoprovocation for only 65% of cases. In addition, we found only 0.7% of cases had specific antigen bronchoprovocation, 3.4% of cases had peak flow monitoring and only 3.0% of cases had pre- and post-work shift testing.

Industrial Hygiene

The 2,254 people with work-related asthma worked at 1,418 different facilities. Five hundred twenty-nine facilities were inspected 607 times. Seventy-eight of the 1,418 facilities were inspected more than once. Nineteen inspections were completed since last year's report. Inspections are scheduled at 35 (2.3%) facilities (Table 11). Eighty-three companies received letters notifying them that a disease report had been received and asked them to investigate potential exposures causing the respiratory problem, including indoor air problems. No follow-up was planned for 697 companies, 52 companies were no longer in business, and 22 companies no longer used the occupational allergen associated with the development of asthma in the index case.

Air sampling for allergens was conducted during 423 of the inspections. Forty-five of the 407 (11.1%) facilities with a NIOSH recommended exposure limit (REL) for the allergen were above the NIOSH REL. Twenty-one (5.0%) of the 422 facilities with a MIOSHA standard for the allergen were above the enforceable MIOSHA permissible exposure limit (PEL) (Table 12).

Table 13 shows the allergens that were found to be above the NIOSH and/or MIOSHA limits. Formaldehyde (40.0%) was the most frequently sampled allergen found to be above the NIOSH REL, followed by styrene (13.3%) and metal working fluids (11.1%). Welding fume (23.8%) was the most frequently sampled allergen found to be above the MIOSHA enforceable PEL, followed by styrene (19.0%) and glutaraldehyde (14.3%).

Interviews of fellow workers were performed at 474 of the 607 inspections. Co-workers of the index cases reported daily or weekly breathing symptoms or onset of new asthma since beginning to work at that company in 333 of the 474 (70.3%) companies. The average percentage of co-workers with symptoms in these 333 companies was 20.3%, ranging from 2% to 100%. Interviews of 1,044 co-workers from 141 companies found no co-workers with symptoms. One thousand four hundred twenty-one of the 8,557 (16.6%) co-workers interviewed had symptoms consistent with work-related asthma (new onset asthma or bothered at work by daily or weekly shortness of breath, wheezing or chest tightness) (Table 14).

The Michigan Occupational Safety and Health Administration (MIOSHA) Injury and Illness logs kept by employers listed 549 workers from 116 companies as having asthma or asthma-like symptoms. Only nine workers identified in the interviews with daily or weekly breathing symptoms were also listed on the Michigan OSHA log. Therefore, a total of 1,945 symptomatic workers were identified during the 607 inspections.

MIOSHA Inspections to Follow-Up Cases of Work-Related Asthma

Effective surveillance requires activities that address the occupational disease identified. Michigan's intervention model for work-related asthma has been to combine disease surveillance with OSHA enforcement inspections. This model works well when the reported condition is linked to a comprehensive OSHA standard (e.g. lead poisoning) but is more problematic when the reported condition is not related to OSHA enforceable standards or the standards are not protective enough to prevent that condition (e.g. work-related asthma). We have compared the results of the 545 Michigan OSHA inspections performed from 1989-2002 to follow up reports of work-related asthma with non-SENSOR OSHA inspections performed during the same time period. Two control groups of inspections were used; inspections matched by five year time periods and industry type (same two-digit SIC code) and all inspections from 1989-2002. SENSOR asthma inspections were more likely to be conducted in larger, more unionized employers. Although the likelihood of citations (~50%), type of citation, and penalties (~30%) were no different between SENSOR and non-SENSOR inspections, the number of citations and amount of penalties were fewer for SENSOR inspections (Tables 15, 16 and 17).

Michigan Workforce Exposed to Isocyanates

Isocyanates are the most commonly reported cause of work-related asthma 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, mining or 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 on facilities.

We identified Michigan's isocyanate-using companies in the Toxic Release

Inventory to estimate the number of workers employed in manufacturing companies that use isocyanates in the state. This estimate under-counts non-manufacturing exposed workers such as auto body paint shop employees since the EPA database does not include these types of non-manufacturing establishments. On the other hand it is an over-count of manufacturing employees since the total number of employees at a given manufacturing facility that reported isocyanate use were counted even though only a smaller percentage of the workers would have directly worked with and therefore have been potentially exposed to isocyanates.

A list of counties with the companies that reported the use of isocyanates in calendar year 2003 (the most recent year for which this information is available) can be found in Table 18. The number of employees 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.

Work-Related Asthma Fatality

Fortunately, a very small percentage (0.01-0.02%) of individuals with asthma die from asthma. In 2003, there was an acute fatality from a work place exposure to methylene diphenyl diisocyanate (MDI) used in the truck bed spray-on lining business. In 2004, there was an acute fatality of a dairy farmer from exposure to the chemicals used to clean a milk tank. A description of the death of the female dairy farmer follows:

A 75-year-old female dairy farmer died from an acute bronchial asthma attack while cleaning out a bulk milk tank. Tank cleaning involves a rinse with a sodium hypochlorite/sodium hydroxide mix, followed by an acid rinse. The victim rinsed the tank with the sodium hypochlorite mixture. It appears that the sodium hypochlorite rinse was mixed with the acid rinse. A family member working in another area smelled the strong odor produced and went to see if the victim was okay. The family member saw the victim outside of the milking bulk tank room leaning against a fence, having difficulty breathing. Upon seeing her, the family member went to get a truck to transport her to the house. Upon returning, the victim was unconscious. Returning home, the family member called 911. A neighbor arrived and together they began CPR. The victim was transported to the hospital where she was declared dead. When the police investigated the incident, the family member stated that the victim used an inhaler regularly; one was found at the fence where she exited the milking bulk tank room. The victim died of an acute asthma attack.

Discussion:

In our previous annual reports, we have emphasized the fact that the cases reported in Michigan's surveillance system are likely an undercount of the true number of cases of work-related asthma in the state. This continues to be true. Studies suggest that work exposures are important etiologic agents in a significant percentage (15%) of adults with asthma (1,6).

An average of 141 new people each year are reported to the Michigan Department of Labor and Economic Growth (DLEG) with confirmed work-related asthma. One hundred forty-three reports were confirmed in 2002, 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 definite downward trend. There was a peak of 87 cases in 1990 with a drop to 39 cases in 2002 (see Table 1). The reason for this trend is unknown and may be related to changes in reporting sources or to the success of work places in better controlling their employees' exposures to known sensitizers.

Based on responses from the 2001 BRFSS random sample of Michigan residents, we would estimate that there are a total of 62,693 (95% CI 42,011 - 83,375) Michigan adults with work-related asthma in the state. Based on the medical literature we would estimate that there are 97,500 Michigan adults with work-related asthma (1,6). Using capture-recapture analysis, we estimate 228 - 801 adults in Michigan develop work-related asthma each year (7).

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. 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 recent trend and 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 exposures to agents in the manufacturing sector, particularly automobiles, machinery, metals, chemicals, and rubber and plastics. The predominant causes of work-related asthma remain isocyanates (14.9%) and metal working fluids (11.8%). We have again updated the table first presented in the 2002 Work-Related Asthma Annual Report (Table 18) on the number of manufacturing workers in companies that use isocyanates. In some counties, more than 5% of the workforce is employed in manufacturing facilities where isocyanates are used: Montcalm (11%); Barry (8%); Mecosta (8%); and Wexford-Missaukee (6%). Health care providers can use this information to heighten their awareness of potential exposure to isocyanates among their patients with asthma. We will consider ways to refine these estimates on isocyanates in future years and expand the listing to include more asthma-causing agents.

Asthma symptoms persist despite removal from the precipitating work exposures (Table 10). Studies have shown that the sooner an individual is removed from the exposure causing their asthma after symptoms develop, the more likely the individual's symptoms will resolve (5). On the average, among the 1,463 individuals no longer exposed, 2.8 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 as measured by personal or family history of allergies are predictive of 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 7-9).

Although most facilities where the patient developed asthma were not found to be in violation of exposure standards, there were high percentages of symptomatic fellow workers in those facilities. Inspections of these sites also found that 50% were in violation of other MIOSHA standards (Tables 15, 16 and 17). It is possible that sampling was not conducted under similar enough working conditions as the exposures associated with the development of the index cases' asthma, such as incidents of spills or leaks. We identified 1,405 fellow workers with symptoms compatible with work-related asthma. Five hundred forty-nine individuals were listed on the Michigan OSHA log as having work-related asthma. There was 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 work-related asthma 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. Ideally, the state would institute comprehensive standards that 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 (8). The Occupational Health Standards Commission has a draft standard from the advisory committee that is currently reviewing the need for a new standard for the diisocyanates. The death in 2003 of a worker from exposure to isocyanates might have been prevented if standards for the use of isocyanates were in place. The 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.

The percentages of individuals reported with work-related asthma that this surveillance system documented as having had 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 patient 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 of work-related asthma. Patients who are removed from exposure the soonest have the best prognosis (8).

Ongoing vigilance in the identification of WRA, and using opportunities for education and intervention at many levels continues to be a priority in Michigan. For example, the Michigan Chapter of the American Lung Association, under contract to the Michigan Department of Community Health maintains a web site of resources on asthma called the Michigan Asthma Communication Network (MACN). The web site can be accessed at: www.getasthmahelp.com. Information on work-

related asthma is included on this web site.

An educational initiative that continued this past year provided workshops on asthma in the workplace for the MIOSHA safety and health field staff and employers. The program was developed to increase awareness of asthma, the hazards commonly found in the workplace, and ways to help facilities control exposures that could cause or aggravate asthma among their employees. In the coming year, we plan to continue to provide similar workshops to more employers who use allergens.

Recognition of work-related asthma is critical in managing adults with asthma. The deaths in 2003 and 2004 of individuals with asthma from work place exposures are attributable to the lack of recognition of an association by the employer, employee and health care provider between the individual's respiratory problems and work exposure to occupational sensitizers. The deaths of these Michigan workers underscore the importance of efforts aimed at the understanding and reduction of WRA in our state.

The report of a patient with known or suspected work-related asthma 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, work-related asthma needs to be integrated into all asthma initiatives planned on surveillance and education, both for health care providers and the public.

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

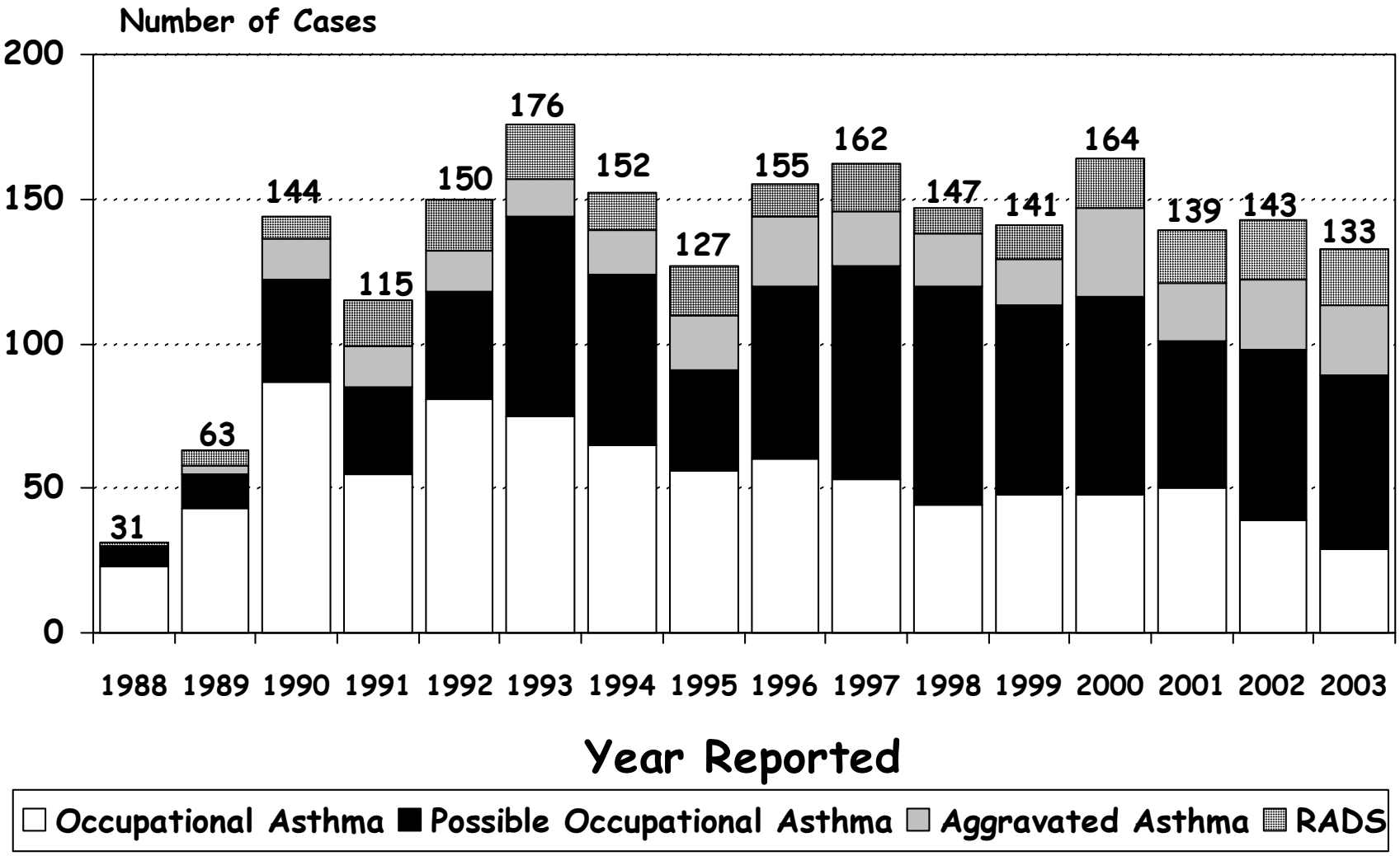
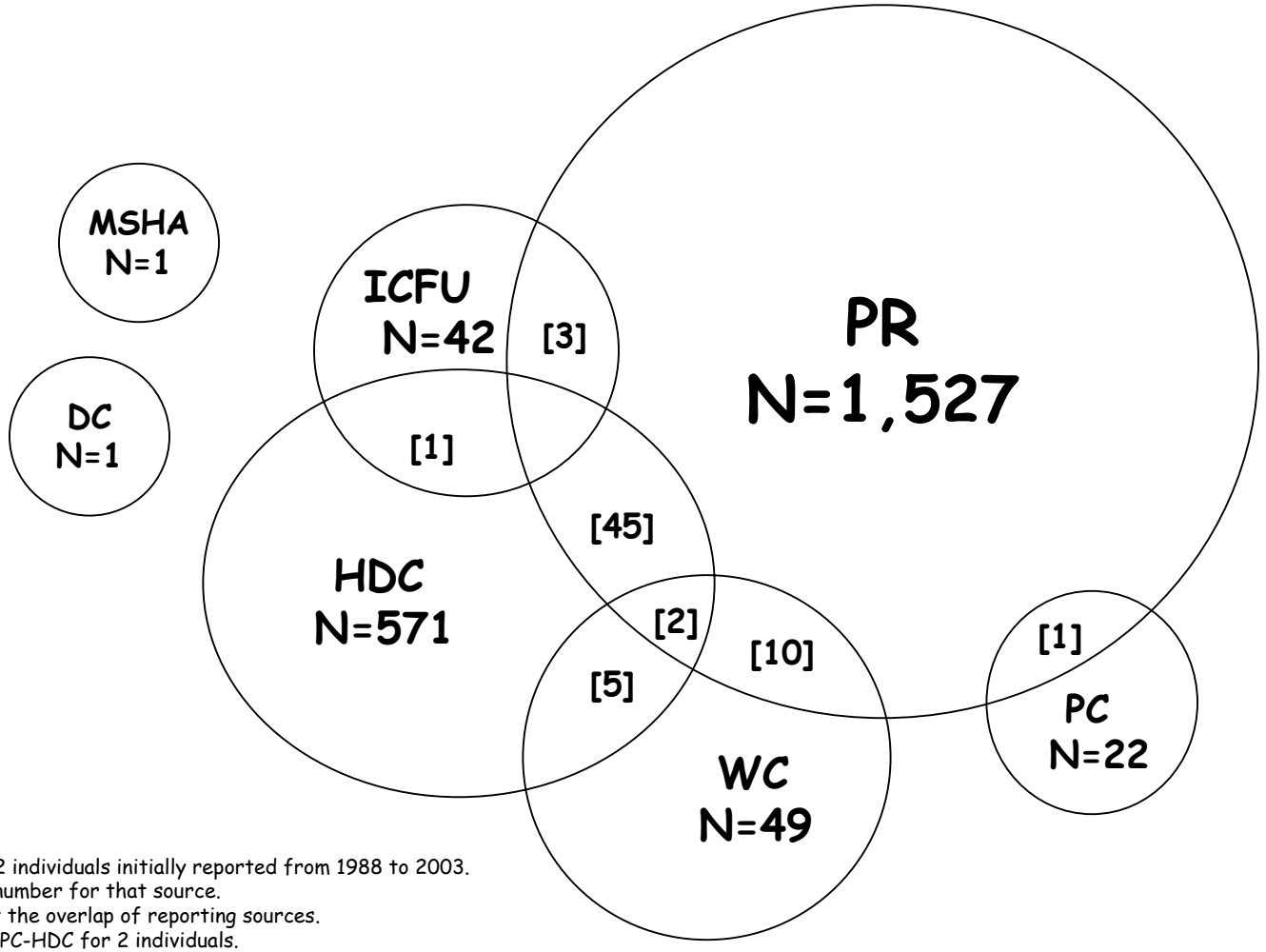
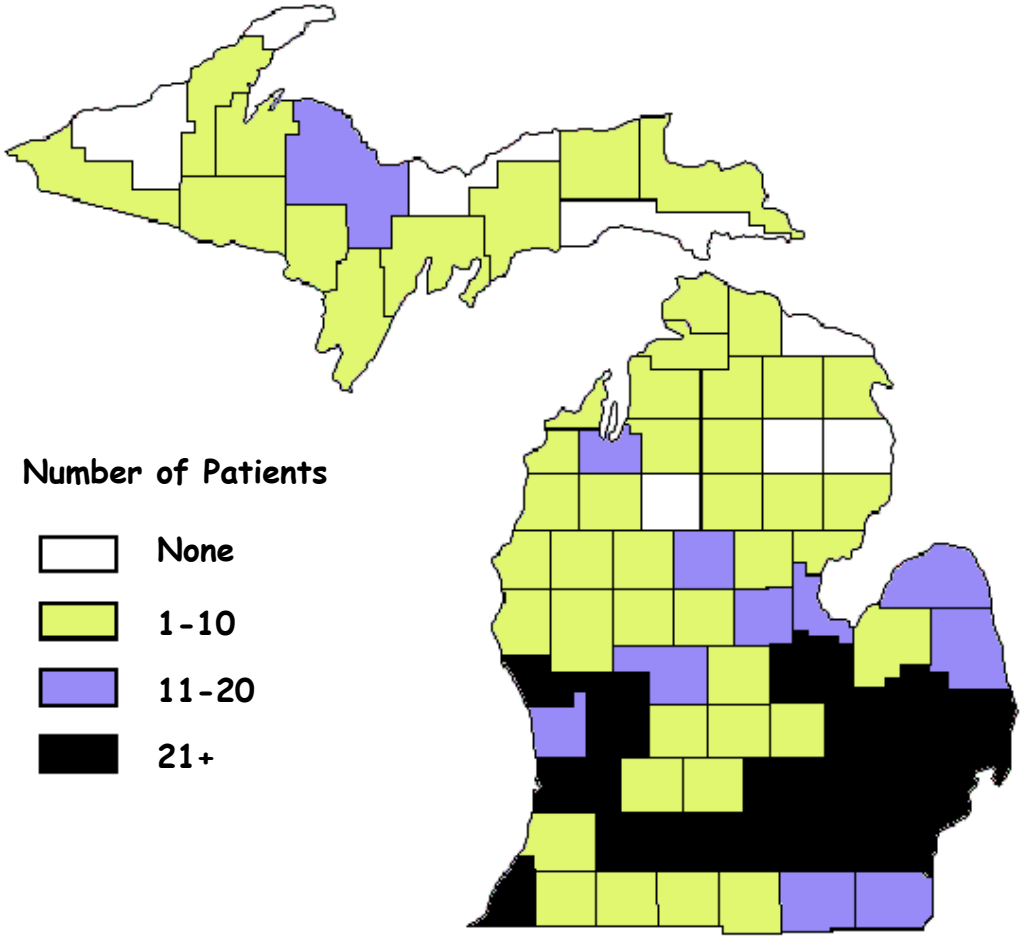


Figure 2. Overlap of Reporting Sources for Confirmed Work-Related Asthma Patients: 1988-2003[a]



[a]Diagram represents 2,142 individuals initially reported from 1988 to 2003.
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 2 individuals.
Reporting Source Codes: HDC=Hospital Discharge Data; PR=Physician Referral; DC=Death Certificate; WC=Workers' Compensation; ICFU=Index Case Follow Up; MSHA=Mine Safety and Health Administration; PC=Poison Control Center.

Figure 3. Distribution of Confirmed Work-Related Asthma Patients by County of Exposure: 1988-2004

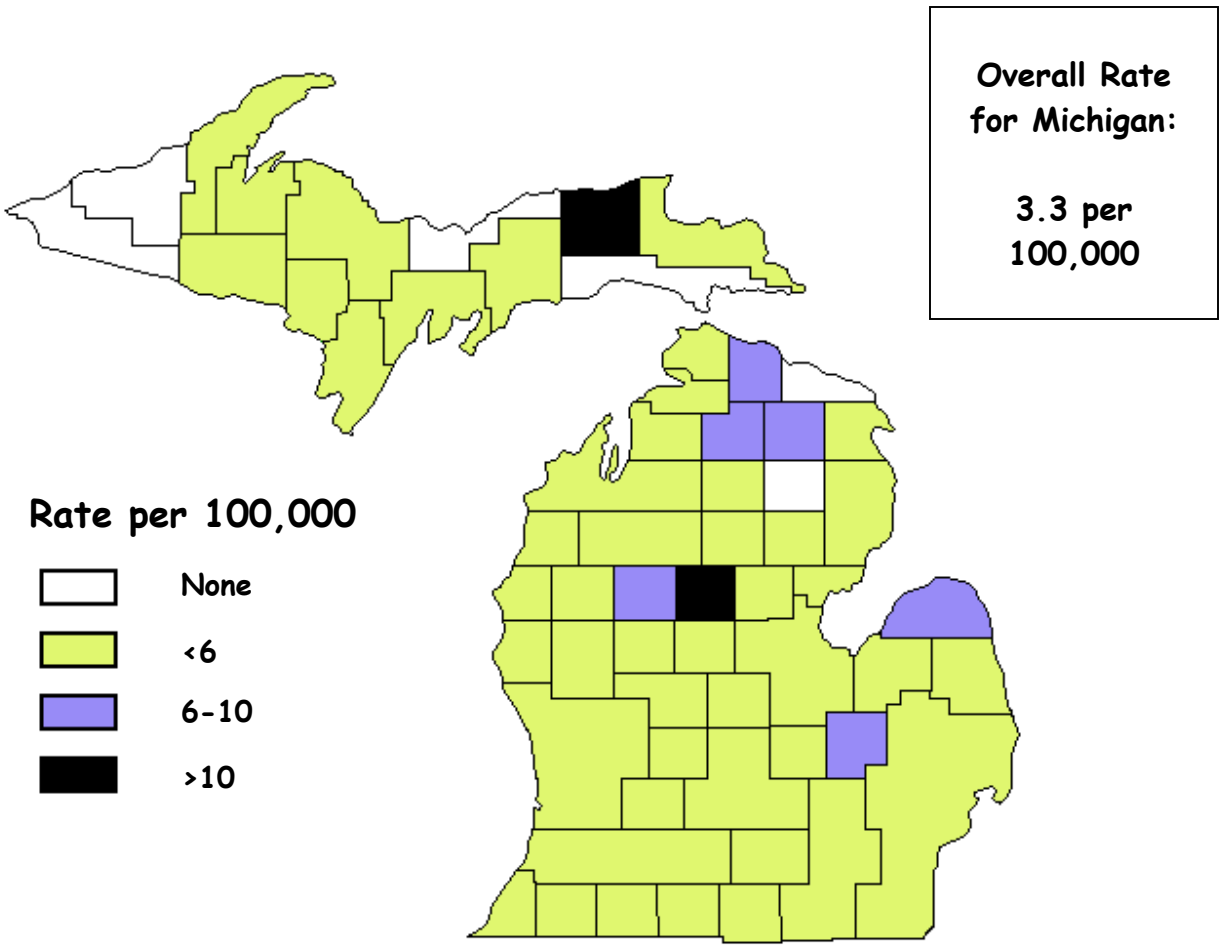


Total Michigan Patients: 2,196[a]

Oakland and **Wayne** counties had the highest number of work-related asthma patients, with 293 and 560 individuals, respectively.

[a] County of exposure was unknown for 20 patients. Thirty-eight patients were exposed out-of-state to an allergen.

Figure 4. Average Annual Incidence Rates of Work-Related Asthma Among Michigan Workers by County of Exposure: 1989-2002[a]



[a] Rate per 100,000 among Michigan workers. Source: MESC 1995 Annual Average Labor Statistics for Employment by Place of Work. In 1995, there were a total of 4,252,000 Michigan workers.

Figure 5. Major Industry Type for Confirmed Work-Related Asthma Patients: 1988-2004

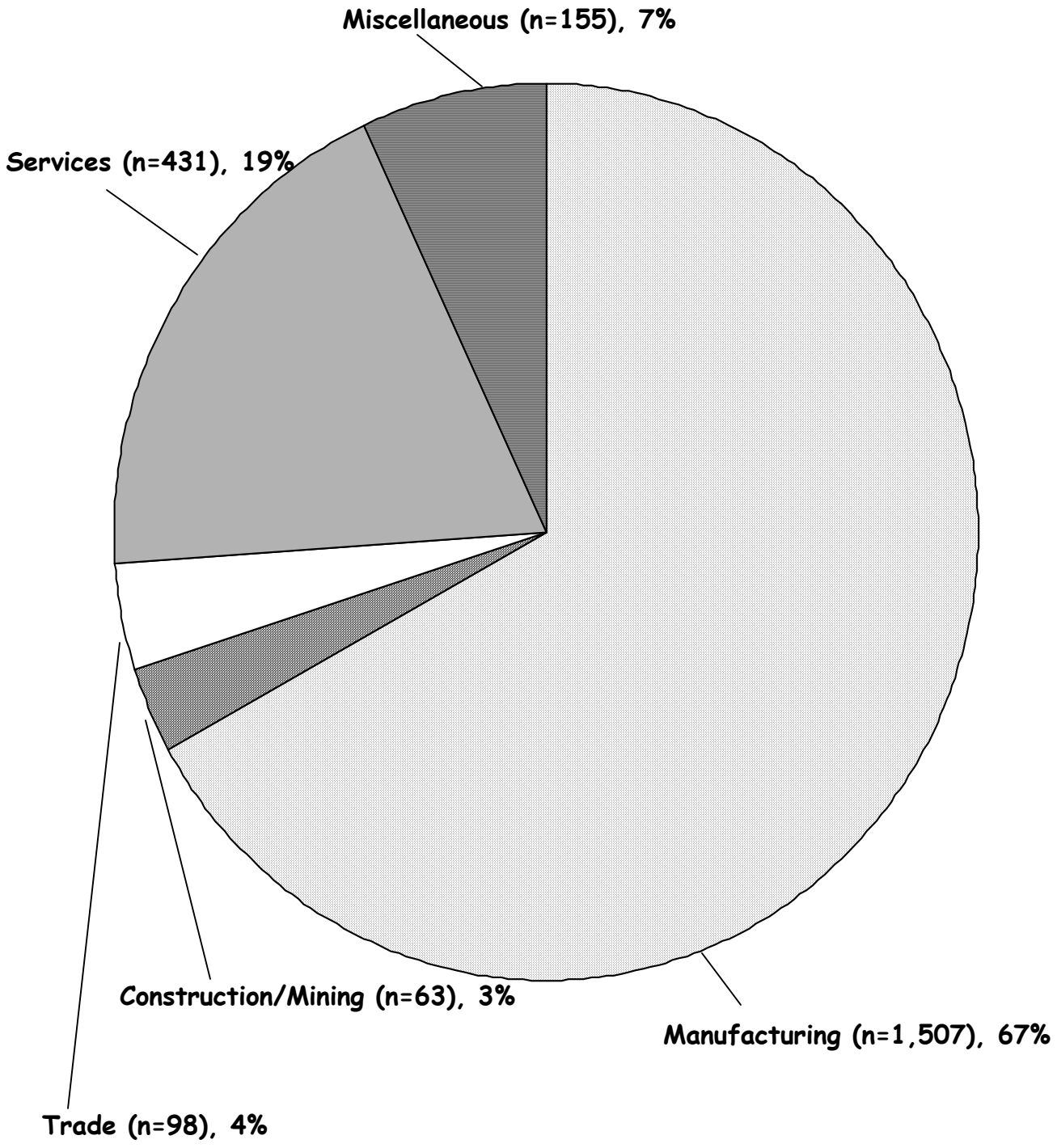


Table 1. Number of Confirmed Cases of Work-Related Asthma by Year and Type

	Disease Status[a]				
YEAR	OA	POA	AA	RA	TOTAL
1988	23	7	0	1	31
1989	43	12	3	5	63
1990	87	35	14	8	144
1991	55	30	14	16	115
1992	81	37	14	18	150
1993	75	69	13	19	176
1994	65	59	15	13	152
1995	56	35	19	17	127
1996	60	60	24	11	155
1997	53	74	19	16	162
1998	44	76	18	9	147
1999	48	65	16	12	141
2000	48	68	31	17	164
2001	50	51	20	18	139
2002	39	59	24	21	143
2003	29	60	24	20	133
2004	33	44	21	14	112
Total	**889**	**841**	**289**	**235**	**2,254**

[a]OA = occupational asthma; POA = possible occupational asthma; AA = aggravated asthma; RA = reactive airway dysfunction syndrome.

Table 2. Average Annual Incidence Rates of Work-Related Asthma Among Michigan Workers by County of Exposure: 1989-2002

County	Number of Employees[a]	Avg. Annual Inc. Rate[b]	Total # Cases 1989-2002
Alcona and Iosco (0, 2 cases respectively)	11,100	1.3	2
Alpena	12,675	2.3	4
Antrim	5,225	2.7	2
Arenac	4,425	4.8	3
Baraga	3,450	4.1	2
Barry	11,200	1.3	2
Berrien	70,900	1.9	19
Branch	13,225	5.4	10
Cass	10,775	2.0	3
Charlevoix	9,850	2.9	4
Cheboygan	7,450	8.6	9
Chippewa	15,025	1.4	3
Clare	7,425	11.5	12
Clinton-Eaton-Ingham (4, 10, 63 cases respectively)	224,200	2.5	77
Crawford	4,425	3.2	2
Delta	14,725	1.9	4
Dickinson	13,825	4.6	9
Emmet	14,425	1.5	3
Genesee	180,600	6.2	157
Gladwin	4,925	2.9	2
Grand Traverse-Benzie-Kalkaska-Leelanau (11, 2, 6, 3 cases respectively)	56,075	2.8	22
Gratiot	13,775	2.6	5
Hillsdale	14,975	3.8	8
Houghton-Keweenaw (3,0 cases respectively)	14,400	1.5	3
Huron	12,850	6.1	11
Ionia	15,800	4.1	9
Iron	4,025	1.8	1
Isabella	24,575	1.5	5
Jackson	58,600	3.8	31
Kalamazoo-Calhoun-VanBuren (22, 18, 6 cases respectively)	204,600	1.6	46
Kent-Ottawa-Muskegon-Allegan (47, 16, 19, 23 cases respectively)	515,300	1.5	105
Lake	1,650	4.3	1
Luce	2,400	17.9	6
Manistee	7,300	2.0	2
Marquette	28,075	3.3	13
Mason	10,300	0.7	1
Mecosta	12,600	0.6	1
Menominee	9,375	0.8	1
Montcalm	19,100	3.7	10
Montmorency	2,175	6.6	2
Newaygo	9,875	3.6	5
Oceana	5,900	1.2	1
Ogemaw	6,125	1.2	1
Osceola	7,775	9.2	10
Otsego	10,400	6.2	9
Roscommon	6,375	2.2	2
Sanilac	12,750	6.2	11
Schoolcraft	2,675	2.7	1
Shiawassee	18,950	1.9	5
St. Joseph	25,050	1.4	5
Tuscola	13,800	5.2	10
Washtenaw-Lenawee-Livingston (118, 13, 27 cases respectively)	253,600	4.5	158
Wexford-Missaukee (4, 0 cases respectively)	16,525	1.7	4
Saginaw-Bay-Midland (65, 15, 17 cases respectively)	172,600	4.0	97
Detroit, MSA[c]	2,002,000	3.6	999
Out of State	---	---	34
Unknown	---	---	14
All Michigan Counties	**4,252,000**	**3.3**	**1,978**

[a]Source: MESC 1995 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. [b]Rates are based on the average number of cases per year from 1989-2002, per 100,000 Michigan workers.
[c]MSA=Metropolitan Statistical Area and includes Lapeer (23 cases), Macomb (182 cases), Monroe (16 cases), Oakland (268 cases), St. Clair (20 cases) and Wayne (490 cases) counties.

Table 3. Annual Incidence Rates of Work-Related Asthma Among Michigan Workers by Major Metropolitan Area: 1990-2002

	Clinton-Eaton-Ingham[a]	Kent-Ottawa-Muskegon-Allegan	Saginaw-Bay-Midland	Detroit MSA[b]	Total (all Michigan)
1990	1.4 (3)	2.2 (8)	2.4 (4)	3.0 (58)	3.6 (144)
1991	3.8 (8)	1.4 (5)	4.3 (7)	2.7 (50)	3.0 (115)
1992	5.6 (12)	0.7 (3)	1.8 (3)	4.6 (86)	3.8 (150)
1993	3.7 8)	1.3 (6)	1.8 (4)	6.4 (121)	4.4 (176)
1994	1.8 (4)	3.5 (7)	1.8 (3)	4.4 (85)	3.7 (153)
1995	2.2 (5)	1.2 (6)	1.7 (3)	3.4 (69)	3.0 (127)
1996	1.3 (3)	0.9 (5)	2.9 (5)	4.0 (91)	3.5 (154)
1997	2.2 (5)	1.1 (6)	4.5 (8)	3.7 (77)	3.6 (162)
1998	2.6 (6)	1.4 (8)	3.9 (7)	3.7 (79)	3.3 (147)
1999	0.9 (2)	1.7 (10)	5.5 (10)	2.7 (59)	3.1 (141)
2000	1.3 (3)	1.5 (9)	8.7 (16)	3.0 (66)	3.6 (164)
2001	3.0 (7)	0.9 (5)	6.2 (11)	2.9 (62)	2.7 (120)
2002	3.4 (8)	1.0 (6)	4.6 (8)	3.2 (67)	3.2 (143)

[a]Rate per 100,000 Michigan workers. Rate, number of cases in parentheses. Source: MDCD (formerly the MESC) Annual Average Labor Statistics for Employment by Place of Work, for each year 1990-2002 separately.

[b]MSA=Metropolitan Statistical Area. For the years 1990-1995, includes Lapeer, Livingston, Macomb, Monroe, Oakland, St. Clair, and Wayne counties. For 1996- 2002 does not include Livingston county because of a change in the counties associated with certain MSA's (including Detroit).

Table 4. Primary Industrial Exposure for Confirmed Work-Related Asthma Patients: 1988-2004

Industry (SIC Code)[a]	Number of Cases 1988-2004[b]		Number of Employees[c]	Ann. Average Incidence Rate 1989-2002[d]	
MANUFACTURING (20-39)					
Automobile (37)	908	(40.3)	294,000	20.1	(829)
Fabricated Metal Products (34)	93	(4.1)	129,000	4.5	(81)
Ind. & Comm. Mach. & Computer Equipment (35)	89	(3.9)	134,000	4.1	(76)
Rubber and Misc. Plastic Products (30)	78	(3.5)	66,000	7.7	(71)
Foundries (33)	69	(3.1)	37,000	12.0	(62)
Food and Kindred Products (20)	49	(2.2)	45,000	6.5	(41)
Printing and Publishing (27)	20	(0.9)	44,000	3.1	(19)
Electrical Equipment (36)	19	(0.8)	34,000	3.2	(15)
Lumber and Wood (24)	18	(0.8)	18,000	7.1	(18)
Paper and Allied Products (26)	18	(0.8)	22,000	5.5	(17)
Furniture and Fixtures (25)	8	(0.4)	39,000	1.5	(8)
Apparel Made from Fabric (23)	2	(0.1)	21,000	0.7	(2)
Other Durables (32,38,39)	53	(2.4)	44,000	7.8	(48)
Other Nondurables (22,28,29,31)	83	(3.7)	49,000	10.6	(73)
WHOLESALE AND RETAIL TRADE (50-59)					
Eating and Drinking Places (58)	22	(1.0)	279,000	0.4	(17)
Wholesale-Nondurable Goods (51)	17	(0.8)	74,000	1.4	(14)
Wholesale-Durable Goods (50)	15	(0.7)	137,000	0.8	(15)
Food Stores (54)	12	(0.5)	105,000	0.7	(11)
Automotive Dealers and Gasoline Services (55)	12	(0.5)	83,000	0.8	(9)
General Merchandise Stores (53)	9	(0.4)	128,000	0.4	(7)
Miscellaneous Retail (52, 56, 57,59)	11	(0.5)	194,000	0.4	(10)
SERVICES					
Health (80)	217	(9.6)	385,000	3.5	(189)
Education (82)	88	(3.9)	371,000	1.3	(68)
Business (73)	23	(1.0)	257,000	0.5	(18)
Social Services (83)	17	(0.8)	81,000	1.0	(11)
Automotive Repair (75)	16	(0.7)	36,000	2.4	(12)
Engineering, Accounting, etc. (87)	12	(0.5)	92,000	0.7	(9)
Other Services (70,72,76,79,81,86,89)	58	(2.6)	256,000	1.4	(51)
CONSTRUCTION AND MINING (10-17)					
Special Trade Construction (17)	48	(2.1)	106,000	2.8	(41)
Other Construction (15-16)	9	(0.4)	48,000	1.2	(8)
Mining (10-14)	6	(0.3)	8,000	4.5	(5)
MISCELLANEOUS INDUSTRIES					
Government (91-97)	65	(2.9)	274,000	1.4	(55)
Transportation and Utilities (40-49)	46	(2.0)	166,000	1.6	(37)
Finance, Insurance and Real Estate (60-67)	27	(1.2)	196,000	0.5	(15)
Agricultural Production and Services (01,02,07)[e]	10	(0.4)	38,727	1.7	(9)
Unknown	7	(0.3)	-	-	(7)
Total	**2,254**		**4,290,727**	**3.3**	**(1,978)**

[a]1987 Standard Industrial Classification code.
[b]Number of cases, percentages are in parentheses.
[c]Source:MESC 1995 civilian labor force and industrial employment estimates.
[d]Average annual incidence rate, total number of cases for 1989-2002 are in parentheses. Rates are based on average number of cases from 1989-2002 per 100,000 adult workers in each industrial category.
[e]Source: Michigan Department of Career Development, Statewide Average Monthly Industry Employment, 1995.

Table 5. Primary Industrial Exposure for Confirmed Work-Related Asthma Patients: 1990-2002

INDUSTRY (SIC)[a]	1990[b]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Manufacturing													
Food (20)	20.0 (9)	6.7 (3)	2.3 (1)	-- (0)	2.3 (1)	4.4 (2)	6.8 (3)	4.9 (2)	7.5 (3)	2.6 (1)	8.1 (3)	10.8 (4)	10.5 (4)
Chemicals (28,29)	17.0 (8)	4.3 (2)	14.0 (7)	12.0 (6)	7.8 (4)	14.3 (7)	6.1 (3)	14.3 (7)	10.0 (5)	10.2 (5)	10.6 (5)	6.5 (3)	4.3 (2)
Rubber & Plastics (30)	9.3 (5)	19.6 (10)	-- (0)	7.3 (4)	11.3 (7)	15.1 (10)	10.4 (7)	13.2 (9)	4.5 (3)	5.8 (4)	6.2 (4)	1.6 (1)	6.5 (4)
Foundries (33)	9.5 (4)	23.7 (9)	8.1 (3)	19.4 (7)	18.9 (7)	5.4 (2)	18.9 (7)	8.1 (3)	10.5 (4)	7.9 (3)	13.2 (5)	8.3 (3)	8.6 (3)
Fabricated Metals (34)	6.6 (8)	4.4 (5)	2.6 (3)	3.4 (4)	5.7 (7)	3.1 (4)	12.5 (16)	8.6 (11)	4.7 (6)	1.6 (2)	3.8 (5)	0.8 (1)	5.0 (6)
Industrial Mach. (35)	6.3 (8)	1.7 (2)	6.1 (7)	8.5 (10)	6.6 (8)	3.0 (4)	3.0 (4)	2.2 (3)	3.7 (5)	2.3 (3)	6.0 (8)	5.7 (7)	0.9 (1)
Transportation Equip. (37)	19.0 (56)	15.6 (44)	28.7 (82)	26.5 (74)	25.0 (71)	17.3 (51)	21.1 (59)	21.1 (61)	23.7 (65)	23.9 (65)	23.0 (70)	22.5 (64)	16.8 (47)
Other Durables (38,39)	19.2 (5)	8.0 (2)	4.9 (2)	9.8 (4)	-- (0)	-- (0)	6.7 (3)	4.4 (2)	6.5 (3)	8.9 (4)	10.6 (5)	4.4 (2)	2.3 (1)
Miscellaneous Industries													
Special Trade Const'n. (17)	1.1 (1)	2.3 (2)	4.6 (4)	6.7 (6)	3.2 (3)	0.9 (1)	1.7 (2)	0.8 (1)	2.4 (3)	2.3 (3)	1.4 (2)	3.6 (5)	3.7 (5)
Transp. & Util. (40-49)	0.6 (1)	1.3 (2)	1.9 (3)	4.5 (7)	2.5 (4)	1.2 (2)	-- (0)	0.6 (1)	0.6 (1)	1.7 (3)	1.6 (3)	2.2 (4)	2.2 (4)
Health (80)	1.6 (5)	1.9 (6)	3.4 (11)	3.6 (12)	3.8 (13)	3.7 (13)	3.3 (12)	6.3 (23)	6.0 (22)	4.6 (17)	4.6 (18)	3.8 (15)	5.0 (20)
Education (82)	0.6 (2)	0.6 (2)	0.8 (3)	2.2 (8)	0.8 (3)	1.1 (4)	2.1 (8)	2.3 (9)	1.3 (5)	0.3 (1)	1.2 (5)	0.7 (3)	3.3 (14)
Government (91-97)	8.1 (5)	6.6 (4)	7.9 (5)	14.3 (9)	6.3 (4)	1.1 (7)	0.8 (5)	0.5 (3)	0.5 (3)	0.2 (1)	0.7 (2)	0.7 (2)	1.4 (4)
Total (all industries)	3.4 (144)	2.8 (114)	3.5 (150)	4.0 (176)	3.4 (152)	3.0 (127)	3.3 (152)	3.2 (161)	3.0 (147)	3.4 (141)	3.5 (164)	3.0 (139)	3.1 (143)

[a]1987 Standard Industrial Classification code.
[b]Annual incidence rate (number of cases for each year). Rates are based on the number of cases per 100,000 adult workers in MI for each year separately.
Source: MI Department of Career Development, Employment Service Agency, Annual Average civilian labor force and industrial employment estimates (formerly the MESC).

Table 6. Occupational Agents Associated with 2,254 Confirmed Work-Related Asthma Patients: 1988-2004

Allergen	Number	Percent
Isocyanates	335	14.9
Metal Working Fluids	266	11.8
Cleaning Solutions	182	8.1
Unknown (Mfg.)	176	7.8
Unknown (Office)	152	6.7
Exhaust/Smoke/Fumes	129	5.7
Welding Fumes	104	4.6
Solvents	72	3.2
Latex/Rubber	56	2.5
Epoxy	55	2.4
Paint Fumes	54	2.4
Formaldehyde	48	2.1
Acids	41	1.8
Acrylates	35	1.6
Chlorine	32	1.4
Cobalt	28	1.2
Plastic Fumes	25	1.1
Styrene	20	0.9
Wood Dust	20	0.9
Flour	19	0.8
Ammonia	18	0.8
Animal Dander	14	0.6
Chromium	14	0.6
Cigarette Smoke	14	0.6
Herbicide/Pesticide	13	0.6
Chemicals Used in Construction	12	0.5
Fiberglass	12	0.5
Printing Inks	12	0.5
Fire	11	0.5
Grain Dust	11	0.5
Amines	10	0.4
Glutaraldehyde	10	0.4
Caustics	9	0.4
Fungus	9	0.4
Cement Dust	8	0.4
Meat Wrapper's Asthma	7	0.3
Pickling Ingredients	6	0.3
1,1,1 Trichloroethane	5	0.2
Cosmetology Chemicals	5	0.2
Paper Dust	5	0.2
Rust Inhibitor	5	0.2
Solder Fumes	5	0.2
Asbestos	4	0.2

Table 6, continued.

Asphalt	4	0.2
Enzymes	4	0.2
Ethyl Alcohol	4	0.2
Freon	4	0.2
Nitrogen	4	0.2
Photo Developing Fluids	4	0.2
Rose Hips	4	0.2
Sulfonate	4	0.2
Sulfur Dioxide	4	0.2
Trichloroethylene	4	0.2
Cadmium Solder	3	0.1
Colophony	3	0.1
Drywall Dust	3	0.1
Insecticide	3	0.1
Lime Dust	3	0.1
Maleic Anhydride	3	0.1
Mold Release	3	0.1
Perfume	3	0.1
Phthalic Anhydride	3	0.1
Polyhexamethylene Biquanide	3	0.1
Sand	3	0.1
Tar Fumes	3	0.1
X-ray Developing Fluids	3	0.1
Other[a]	107	4.7
Total	**2,254**	**99.4[b]**

[a]There were two cases each with the following exposures: Azodicarbamide, Coal Dust, Copier Toner, Copper Oxide, Ethylene Glycol Monobutyl Ether, Exercise, Fireproofing Chemicals, Gas and Oil Refinery Exposures, Hay, Heat, Hydraulic Oil, Isolyzer, Medications, Naptha, Nickel, Ozone, Pepper Gas, Phosgene, Polyester, Polyethylene, Polyvinyl Butyrate, Psyllium, Sewage, Sodium Hydroxide, Sulfite, Teflon, Textile Lint, Zinc, Zinc Oxide.

There was one case each with the following exposures: 1,3, Dichloro-2-Propanol, 1,3 Dichloro 5 5-Dimethyl Hydrantoin, Ammonium Hydroxide, Anesthesia , Blood, Blue Prints, Cellulose, Chlorpyrifos, Citrus Spray, Cyanide, Ethylene Oxide, Explosion, Fire Extinguisher Powder, Flares, Flux, Glaze, Gortex, Hair Remover, Heptane, Hydrogen Peroxide, Hydrogen Sulfide, Iodine, Lactase, Lavender Soap, Limone, Methamphetamine Lab, Methanol, Methylene Chloride, Monoammonium Phosphate, Natural Gas, Ninhydrin, Nylon-polyhexamethylene Adipamide, Odor, Perchloroethylene, Platinum, Potassium Aluminum Fluoride, Potassium Hydroxide, Premicide, Propylene, Sludge, Soda Ash, Sodium Acetate, Soot, Stress, Tetrahydrofuran, Tuberculosis Vaccine, Vinyl Acetate, Weeds, Zinc Borate.

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

Table 7. Cigarette Smoking Status of Confirmed Work-Related Asthma Patients: 1988-2004

	Disease Status[b]									
Smoking Status	**ALL[a]**		**OA**		**POA**		**AA**		**RA**	
Current Smoker	444	(20.3)	187	(21.5)	130	(15.9)	58	(21.7)	69	(30.5)
Ex-Smoker	861	(39.4)	346	(39.7)	346	(42.2)	81	(30.3)	88	(38.9)
Non-Smoker	879	(40.2)	338	(38.8)	344	(42.0)	128	(47.9)	69	(30.5)
Total	**2,184**		**871**		**820**		**267**		**226**	

[a]Total number of cases: 2,184. Smoking status was missing on 70 individuals. Number of patients, percentages are in parentheses.
[b]OA=occupational asthma; POA=possible occupational asthma; AA=aggravated asthma; RA=reactive airway dysfunction syndrome.

Table 8. Family History of Allergies Among Confirmed Work-Related Asthma Patients: 1988-2004

Family History	Disease Status[b]									
of Allergies	ALL[a]		OA		POA		AA		RA	
YES	846	(43.0)	321	(39.7)	321	(43.0)	131	(59.0)	73	(38.2)
NO	1,122	(57.0)	487	(60.3)	426	(57.0)	91	(41.0)	118	(61.8)
Total	**1,968**		**808**		**747**		**222**		**191**	

[a]Total number of cases: 1,968. Missing data on 286 patients. Number of patients, percentages are in parentheses.
[b]OA=occupational asthma; POA=possible occupational asthma; AA=aggravated asthma; RA=reactive airway dysfunction syndrome.

Table 9. Personal History of Allergies or Asthma Among Confirmed Work-Related Asthma Patients: 1988-2004

	Disease Status[b]									
Personal History	**ALL[a]**		**OA**		**POA**		**AA**		**RA**	
YES	1,038	(46.1)	343	(38.6)	355	(42.2)	264	(91.3)	76	(32.3)
NO	1,216	(53.9)	546	(61.4)	486	(57.8)	25	(8.7)	159	(67.7)
Total	**2,254**		**889**		**841**		**289**		**235**	

[a]Number of patients, percentages are in parentheses.
[b]OA=occupational asthma; POA=possible occupational asthma; AA=aggravated asthma; RA=reactive airway dysfunction syndrome.

Table 10. Persistence of Symptoms and Medication Use in Confirmed Work-Related Asthma Patients: 1988-2004

Medication Exposure Status	Total[a]	*Breathing Problems Still Present* Yes		Less		*Still Taking Asthma Medications* Yes		Less	
Still Exposed	599	578	(96.5)	187	(31.2)	515	(86.0)	116	(19.4)
No Longer Exposed	1,463	1,262	(86.3)	725	(49.6)	1,138	(77.8)	418	(28.6)
Total	**2,062**	**1,840**		**912**		**1,653**		**534**	

[a]Total number of cases: 2,062. Information missing on 192 individuals. Number of patients, percentages are in parentheses.

Table 11. Status of Facilities Where 2,254 Patients with Confirmed Work-Related Asthma were Exposed to Allergens: 1988-2004

Inspection Status	Number of Patients Represented	Companies Number	Companies Percent
Inspected	1,012	607[a]	40.6
No Follow-up Planned	1,035	697	46.6
Scheduled for Inspection	36	35	2.3
Out of Business	58	52	3.5
No Longer Use Occupational Allergen	23	22[b]	1.5
Sent Company an Indoor Air Letter	41	35	2.3
Sent Company Letter to Check Exposures	49	48	3.2
Total	**2,254**	**1,496[c]**	**100.0**

[a]607 inspections were conducted in 529 different facilities.
[b]Eight companies that no longer use the allergen were previously inspected.
[c]Represents 1,418 different facilities.

Table 12. Results of 607 Industrial Hygiene Inspections in 529 Facilities Where Patients with Confirmed Work-Related Asthma were Exposed to Allergens: 1988-2004

Inspection Results

Air Sampling – NIOSH Standard	Number	Percent
Above NIOSH Standard	45	7.4
Below NIOSH Standard	362	59.6
No NIOSH Standard	16	2.6
Unknown (no report yet)	6	1.0
Did Not Sample for an Allergen	17	2.8
Did Not Sample	161	26.5
Total	**607**	**99.9[a]**

Air Sampling – MIOSHA Standard	Number	Percent
Above MIOSHA Standard	21	3.5
Below MIOSHA Standard	401	66.1
No MIOSHA Standard	1	0.2
Unknown (no report yet)	6	1.0
Did Not Sample for an Allergen	17	2.8
Did Not Sample	161	26.5
Total	**607**	**100.1[a]**

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

Table 13. Allergens Found to be Above the MIOSHA Permissible Exposure Limit (PEL) and/or NIOSH Recommended Exposure Limit (REL): Michigan 1988-2004

	Above NIOSH REL		Above MIOSHA PEL	
Asthma-Causing Agents	Number	Percent	Number	Percent
Formaldehyde	18	40.0	1	4.8
Styrene	6	13.3	4	19.0
Metal-Working Fluids	5	11.1	1	4.8
Glutaraldehyde	3	6.7	3	14.3
Cobalt	3	6.7	2	9.5
HDI	3	6.7	No PEL	--
MDI	2	4.4	0	--
Wood Dust	2	4.4	2	9.5
Chromic Acid	1	2.2	1	4.8
Ethylene Oxide	1	2.2	0	--
Starch	1	2.2	0	--
Welding Fume (Total Particulate)	No REL	--	5	23.8
Flour Dust	No REL	--	2	9.5
TOTAL	45	99.9[a]	21	100.0

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

Table 14. Symptoms Consistent with Work-Related Asthma Among Fellow Workers of the 2,254 Confirmed Work-Related Asthma Patients

	Disease Status of the Index Patient									
Symptoms[a]	**ALL**[b]		**OA**		**POA**		**AA**		**RA**	
Daily or Weekly SOB, Wheezing or Chest Tightness	1,405	(16.5)	1,054	(17.1)	316	(15.0)	4	(16.0)	31	(12.9)
OSHA Log[c]	549	(19.2)	392	(22.8)	146	(13.8)	2	(12.5)	9	(9.5)
Total[d]	**1,954**		**1,446**		**462**		**6**		**40**	

[a]Denominator for calculating percentages was the number of workers interviewed. SOB=shortness of breath.
[b]Number of individuals with symptoms, percentages are in parentheses. OA=occupational asthma; POA=possible occupational asthma; AA=aggravated asthma; RA=reactive airways dysfunction syndrome.
[c]Numerator for calculating percentages was the number of companies with an employee other than the index patient on the OSHA log. Denominator for calculating percentages was the number of companies inspected.
[d]Eight individuals were identified both on the questionnaire and the OSHA log.

Table 15. Summary of Crude Odds Ratios (OR) between Covariates and Five Outcome Measures: All MIOSHA Health Inspections Conducted 1989-2002

	Citation Event OR		Penalty Event OR		Repeat OR		Serious OR		Other OR	
	M[a]	A[a]	M[a]	A[a]	M[a]	A[a]	M[a]	A[a]	M[a]	A[a]
SENSOR (ref=Non-SENSOR)	0.9	0.8	0.9	0.8[c]	1.5	1.4	0.9	0.7[c]	0.9	0.9
Union (ref=Non-Union)	0.6[d]	0.7[d]	0.8[b]	0.9[d]	1.5	1.7[d]	0.8[b]	0.9[c]	0.6[d]	0.6[d]
Worksite Employees										
1 – 10	4.7[d]	2.9[d]	3.0[d]	2.1[d]	1.0	0.4[c]	3.4[d]	1.9[d]	4.7[d]	3.0[d]
11 – 49	3.6[d]	3.1[d]	2.3[d]	2.0[d]	1.6	0.9	2.7[d]	1.9[d]	3.6[d]	3.5[d]
50 – 249	3.0[d]	2.1[d]	2.2[d]	1.7[d]	1.2	0.7	2.6[d]	1.7[d]	3.0[d]	2.5[d]
250 – 999	2.0[d]	1.4[d]	1.5[b]	1.1	1.6	1.7	1.6[b]	1.1	2.0[d]	1.7[d]
1,000 or more (ref)	1.0		1.0		1.0		1.0		1.0	
Corporate Employees										
1 – 10	4.5[d]	2.3[d]	2.8[d]	1.8[d]	0.9	0.4[d]	3.0[d]	1.6[d]	4.7[d]	2.2[d]
11 – 49	3.1[d]	2.5[d]	2.2[d]	1.8[d]	1.3	0.9	2.3[d]	1.7[d]	3.1[d]	2.5[d]
50 – 249	2.5[d]	1.8[d]	2.0[d]	1.5[d]	0.9	0.8	2.0[d]	1.4[d]	2.5[d]	1.8[d]
250 – 999	1.8[d]	1.1	1.4[b]	1.0	0.8	0.6[b]	1.5[c]	1.0	1.8[d]	1.2[c]
1,000 or more (ref)	1.0		1.0		1.0		1.0		1.0	

[a]Comparison set "M": SENSOR with matched Non-SENSOR worksites (n=2,180).
Comparison set "A": SENSOR with all Non-SENSOR worksites (n=12,813).
[b]p<0.05
[c]p<0.01
[d]P<0.001

Table 16. Summary of Adjusted Associations[a] between Covariates and Seven Outcome Measures: Odds Ratios (OR) and Rate Ratios (RR) for Selected Study Comparisons: All MIOSHA Health Inspections Conducted 1989-2002

	Citation Event OR		Penalty Event OR		Citation Total[c] RR		Penalty Total[c] RR		Repeat OR	Serious OR	Other OR
	M[b]	A[b]	M[b]	A[b]	M[b]	A[b]	M[b]	A[b]	A[b]	A[b]	A[b]
SENSOR (ref=Non-SENSOR)	1.0	1.0	0.9	0.9	0.9	0.8[e]	0.8[d]	0.8	1.4	0.9	1.0
Union (ref=Non-Union)	1.0	0.8[f]	1.1	0.9	1.0	1.0	1.0	0.9[d]	1.2	0.9	0.8[f]
Worksite Employees											
1 – 10	1.6	1.7[f]	1.1	1.1	2.1[e]	1.2[d]	4.4[e]	1.3	0.5	1.1	2.5[f]
11 – 49	1.8	1.9[f]	1.1	1.2	1.6[d]	1.3[e]	3.2[e]	1.5[d]	1.0	1.3	2.6[f]
50 – 249	1.8[d]	1.7[f]	1.2	1.3[d]	1.6[e]	1.3[d]	2.1[d]	1.3	0.8	1.4[e]	2.1[f]
250 – 999	1.5	1.4[e]	1.4	1.1	1.4	1.2	2.0[d]	1.3	1.0	1.2	1.8[f]
1,000 or more (ref)	1.0		1.0		1.0		1.0		1.0	1.0	1.0
Corporate Employees											
1 – 10	3.3[d]	1.4[e]	2.7[d]	1.5[e]	0.8	1.3[e]	0.5	1.0	0.7	1.5[e]	1.2
11 – 49	2.1[d]	1.4[e]	2.0[d]	1.4[e]	1.2	1.2[d]	0.9	0.9	0.9	1.4[d]	1.3[d]
50 – 249	1.7[e]	1.1	1.5	1.2	1.0	1.1	1.0	0.9	0.9	1.2	1.1
250 – 999	1.4	0.9	1.5	0.9	1.0	1.0	0.0	1.0	0.6	0.9	0.9
1,000 or more (ref)	1.0		1.0		1.0		1.0		1.0	1.0	1.0

[a]Simultaneous adjustment for all covariates including Year and SIC code.
[b]Comparison set "M": SENSOR with matched Non-SENSOR worksites (n=2,180).
Comparison set "A": SENSOR with all Non-SENSOR worksites (n=12,813).
[c]RR's for Citation Total and Penalty Total reported only for non-zero counts.
[d]$p<0.05$
[e]$p<0.01$
[f]$P<0.001$

Table 17. Summary of Association between Year Stratum and Eight Outcome Measures: Adjusted[a] Odds Ratios (OR) and Rate Ratios (RR) for All SENSOR and Non-SENSOR Worksites: All MIOSHA Health Inspections Conducted 1989-2002 (n=12,157)

	Citation Event OR	Citation Total RR	Penalty Event OR	Penalty Total RR	Serious OR	Repeat OR	Other OR	Willful OR
Year Category 1: 1989-1992 (ref)	1.0		1.0		1.0	1.0	1.0	1.0
Year Category 2: 1993-1997	1.5[b]		1.8[b]		2.0[b]	1.0	1.3[b]	0.2[b]
Year Category 3: 1998-2002	1.7[b]		1.5[b]		2.2[b]	0.5[b]	1.2[b]	0.3[b]
Year Category 1: 1989-1992 (ref)		1.0		1.0				
Year Category 2: 1993-1997 (predicting non-zero counts)		1.26[b]		1.1[c]				
Year Category 3: 1998-2002 (predicting non-zero counts)		1.25[b]		0.9				

[a]Simultaneous adjustment for all covariates including Year and SIC code.
[b]$p<0.001$
[c]$p<0.01$

Table 18. Michigan Workers Employed in Manufacturing Facilities Where Isocyanates Are Used, by County, in Calendar Year 2003

County	# Workers Employed in Isocyanate-Using Facilities[b] Divided by Total # Workers in the County[c]	% Workers Where Isocyanates are Used	
Allegan, Kent, Muskegon, Ottawa	**10,875/ 576,300**	**2**	**COMPANIES[a]----------**
			Brunswick Bowling
			Counter Point Furniture
			Donnelly
			G P M
			H B Fuller
			Haworth
			Howard Miller
			Johnson Controls Interiors
			Knape & Vogt
			Meridian Auto Systems
			Purforms, Inc.
			Steelcase
			Wolverine World Wide
Barry	**1,040/ 12,900**	**8**	**COMPANIES----------**
			Bradford White
Bay, Saginaw, Midland	**7,714/ 174,600**	**4**	**COMPANIES----------**
			Bay Cast
			Delphi Saginaw Steering
			Dow Chemical Company
			Glastender
			Saginaw Metal Casting Operations (GM)
			GM Powertrain/Saginaw Malleable Iron
			Lendell Manufacturing

Berrien	**2,845/ 71,000**	**4**	**COMPANIES----------**
			Ancast, Inc. Bosch Braking Leco Tyler Refrigeration
Branch	**25/ 16,250**	**<1**	**COMPANIES----------**
			Acore Door
Calhoun, Kalamazoo, Van Buren	**1,223/ 213,800**	**1**	**COMPANIES----------**
			Arvco Container Azon USA Cello-Foil Checker Motors Comcast Urethane Degussa Construction Special-lite
Charlevoix	**500/ 10,575**	**5**	**COMPANIES----------**
			East Jordan Iron Works
Clare	**300/ 7,950**	**4**	**COMPANIES----------**
			Renosol
Eaton, Clinton, Ingham	**230/ 233,700**	**<1**	**COMPANIES----------**
			Axson Collins & Aikman Innovative Polymers Philips Products Vantico
Genesee	**500/ 159,300**	**<1**	**COMPANIES----------**
			Delphi Energy and Chassis Flint East

Hillsdale	**200/ 16,800**	**1**	**COMPANIES----------** Dow
Iosco	**60/ 10,125**	**1**	**COMPANIES----------** Tawas Industries
Isabella	**850/ 29,500**	**3**	**COMPANIES----------** Delfield Randell Manufacturing
Jackson	**929/ 62,700**	**1**	**COMPANIES----------** Adco Products Michigan Seat Tac Manufacturing
Lapeer, Macomb, Monroe, Oakland, St. Clair, Wayne	**16,324/ 2,105,000**	**1**	**COMPANIES----------** Armaly Sponge Autolign Manufacturing BASF Cass Polymers Collins & Aikman Daimler-Chrysler Jefferson Assembly Du Pont EFTEC EQ Detroit, Inc. H P Pelzer International Casting ITW Foamseal Lear Lymantal International M & H Industries Plastomer Recticel Recycled Polymeric Materials, Inc. Romeo Rim Takata Petri US Farathane Visteon Visteon Utica

			Wolverine Bronze Woodbridge
Lenawee, Livingston, Washtenaw	**5,575/ 282,900**	**2**	**COMPANIES----------** Anderson Development Atreum Howell (Intier Automotive) Brighton Interiors (Ontegra) Collins & Aikman Ixtlan Technologies Pilkington Clinton Tecumseh Compressor Products Visteon Saline Woodbridge
Mason	**300/ 10,700**	**3**	**COMPANIES----------** Great Lakes Casting
Mecosta	**1,000/ 13,225**	**8**	**COMPANIES----------** Wolverine World Wide
Montcalm	**2,175/ 19,500**	**11**	**COMPANIES----------** Electrolux Refrigerator Division Northland Corp.
Ogemaw	**200/ 7,025**	**3**	**COMPANIES----------** Taylor Building Products
Sanilac	**150/ 12,975**	**1**	**COMPANIES----------** Numatics
Upper Peninsula	**1,310/ 126,800**	**1**	**COMPANIES----------** Emerson Tool Grede Foundries Louisiana Pacific

	1,080/	**6**	**COMPANIES----------**
Wexford, Missaukee	**18,200**		
			Four Winns Sport
			Hayes Lemmerz
TOTAL	**59,173/ 4,475,000**	**1**	

[a]Source: U. S Environmental Protection Agency. Toxics Release Inventory, Michigan Companies Using Isocyanates in 2003 (report generated June 8, 2005).

[b]Source: Michigan Manufacturer's Directory, 2002 and 2003.

[c]Source: Michigan Department of Career Development/Employment Service Agency. Annual Average 2002 Area Labor Statistics, Total Wage and Salary Employment by Place of Work (5/9/2002).

Appendix I

2004 Case Narratives by Type of Exposure & Industry

Abbreviations:
POA = Possible Occupational Asthma
OA = Occupational Asthma with a Known Sensitizer
AA = Aggravated Asthma (Pre-existing Asthma Exacerbated at Work)
RA = Reactive Airway Dysfunction Syndrome

The case narratives that follow are based on information collected from interviews of patients about their health and work status. Information was also obtained from patient medical records.

Animal Dander

GOVERNMENT

OA-Case 2222. A female in her 50s developed asthma while working as a mental health advocate. Her job was to visit the homes of her impaired clients. She had been doing this job for a year when she visited a client's home that had 17 cats. Upon entering the home, she experienced immediate breathing difficulties. She was prescribed asthma medication, which she continues to take. Her symptoms have become worse and additional exposures now trigger asthma attacks, such as perfume and cigarette smoke. She continues to work at the same job, but is no longer assigned to the home of the client with the cats.

RESEARCH

OA-Case 2284. A female in her 50s developed asthma while working as a consultant for animal testing labs. She had been doing this work for two years before her asthma developed. The day her breathing symptoms began, she had been in a lab that tested various chemicals on rats. At first, she thought she had a very bad cold; when her symptoms did not resolve, she was tested for and diagnosed with asthma. She was prescribed asthma medication, which she continues to take. She has not returned to the lab with the rats, and her symptoms have lessened. She continues to consult with other labs.

Cleaning Products

OFFICE WORK

POA-Case 2232. A female in her 20s developed asthma while working as a maintenance worker for a property management corporation. She had been working for the company for three months when her symptoms first began. She was exposed to toilet bowl cleaner and mildew remover. Cleaning with those chemicals triggered her symptoms. She was fired shortly after she was diagnosed with asthma, because she refused to work with those chemicals. Later the company rehired her in a position that did not involve exposure to those cleaners. She continues to experience symptoms, although they occur less frequently than when she was a maintenance worker. She continues to take asthma medication, although not as frequently as when her symptoms began.

AA-Case 2192. A male in his 40s experienced an exacerbation of his asthma when he was exposed to a floor stripper while working as a custodian for a vocational assistance program. His usual job was to vacuum in the building, but was asked to use a floor stripper one time. He has since been assigned to a different building and is not exposed to the floor stripper, but four months after this incident he was still not back to feeling "OK." He had asthma since he was an infant.

HEALTH CARE SERVICES

POA-Case 2199. A female in her 50s developed asthma while working as a nurse at a nursing home when she was exposed to cleaning agents, including an anti-microbial carpet cleaner. She had worked at the nursing home for 11 years before her breathing problems developed. She continues to work at the nursing home, but the carpet was removed. Since that time, her symptoms have improved and she no longer takes asthma medicine.

POA-Case 2151. A female in her 20s developed asthma three years after working as an RN at a hospital. Her symptoms began with exposure to a floor stripper applied in her work area. She reports that the floor stripper continues to be used in the hospital.

RA-Case 2185. A female in her 40s developed RADS after an acute exposure to the mixing of bleach with an industrial cleaner. She was working as a paraprofessional church minister at a substance abuse facility. She immediately experienced breathing problems when the cleaners were mixed. She was started on asthma medication, but discontinued taking the medicine one month after the incident even though she continues to experience some breathing problems. Since the exposure, the cleaners are labeled more clearly and she continues to work at that facility.

AA-Case 2240. A female in her 30s experienced an exacerbation of her asthma while working as a caregiver at a group home. She was cleaning and had mixed bleach with a toilet bowl cleaner. The fumes from the mixing of these chemicals triggered an immediate reaction. Her symptoms resolved over a few hours after she got out of the exposure.

AA-Case 2246. A female in her 30s experienced an exacerbation of her asthma while working at a group home as a patient care worker. She was exposed to cleaners she was not normally exposed to, when she worked a double shift and some cleaning was being done earlier than usual. Normally, she did not work when this cleaning was being done. Since that incident, her asthma has improved and she continues to take her asthma medication. Cleaning is not done on the shifts that she works.

MANUFACTURING

POA-Case 2106. A female in her 50s developed asthma while working in a tool crib at an automotive manufacturing plant. Her asthma developed 24 years after beginning to work at this facility. She describes exposure to cleaning agents as well as dust and dirt in the plant. She continues to work at the facility, despite a worsening of her asthma, and having to take more asthma medication since her symptoms started.

EA-Case 2205. A female in her 50s experienced an exacerbation of her asthma while working as supervisor in an automotive parts manufacturing facility. Her asthma was triggered when the carpet in a meeting room was cleaned on the shift before she came in to work. When she got to work, the fumes in the air were overwhelming. She had been working at this facility for 26 years, and had asthma since she was in her teens. She is still exposed to irritants at work, including floor sealer, carpet cleaner, other cleaners, and paint fumes from maintenance painting activities at the facility.

AA-Case 2245. A male in his 40s experienced an exacerbation of his asthma while working at his job at a bottling company. Some construction work was being done next to his work area, where contractors were replacing a tile floor. There was mold under the tiles so the contractors poured chlorine over the floor. In addition, there was a considerable amount of cement dust from the work being done, and other chemicals being used on the floors, including glues and solvents. The patient was given a paper mask at the time. He notified his supervisor that he was having trouble breathing and went to the clinic. During the time that the floor was being replaced, his supervisor placed him in different jobs away from where that work was being done to help keep his symptoms from worsening. It took about one month before this patient's symptoms improved. He continues to work at this facility, and is back at his bottle-labeling job since the floor work is completed.

RA-Case 2233. A male in his 30s developed RADS after an acute exposure to a leak of bleach. He had been working as a truck driver for a paper products manufacturing facility for four years prior to this incident. He breathed bleach fumes from a leak at the chemical unloading bay. When the incident occurred, the shower at the unloading bay did not work, but has been repaired since the incident that sent this individual to the hospital. He was started on asthma medication when this incident occurred; four months later his symptoms had lessened and he was no longer taking asthma medication. He continues to work as a truck driver for this company.

RA-Case 2325. A female in her 40s developed RADS after working at an automotive parts manufacturer for 10 years. She was exposed to cleaning agents while cleaning under an assembly line. She immediately experienced breathing problems and was taken to a local hospital by ambulance. She has been taking less asthma medication since the initial exposure occurred. Since this incident, she now also experiences breathing problems when exposed to other chemicals and cigarette smoke.

WHOLESALE AND RETAIL TRADE

AA-Case 2257. A female in her 40s experienced an exacerbation of her asthma when she was exposed to some cleaning agents being used in the area where she worked as a manager of respiratory services at a medical supply company. She experienced her asthma symptoms immediately when she was walking by the area that was being cleaned. After this incident, the company substituted a new cleaner for the agent that caused her problems. Her symptoms have lessened although her asthma medications have increased.

RA-Case 2264. A female in her 20s developed RADS a year after beginning to work as a cashier at a wholesale food store. In addition to running the check out counter for customer purchases, she was also responsible for mopping the floors. Her breathing troubles began when she was mopping the floors with bleach, and there was already a cleaning product on the mop she was using. The mixing of the bleach with the other cleaning product caused her to have an immediate reaction—with chest tightness, coughing, wheezing and shortness of breath. She continues to work at this store, and is not allowed to use bleach. Her symptoms have worsened since this incident, and now other chemical fumes trigger her asthma. She continues to take asthma medication to control her symptoms.

EATING AND DRINKING ESTABLISHMENTS

RA-Case 2165. A male in 50s developed RADS with an acute exposure to a cleaning agent when fumes were drawn into a fan in the kitchen, about one year after beginning to work as a cook at a bar and grill. Within 24 hours of exposure, he developed wheezing, cough, chest tightness and shortness of breath and was prescribed multiple asthma medication to control his symptoms. He was off work for two months. His symptoms have become less since he no longer does any cleaning at the bar and grill where he works, and he is no longer taking any asthma medication.

RA-Case 2310. A female in her 20s developed RADS with an acute exposure to bleach while working at a sandwich shop. She immediately experienced breathing difficulties and was placed on asthma medication. A co-worker was

cleaning the kitchen with undiluted bleach. She is currently not working. Since that time, her asthma has worsened and she is now taking more asthma medicine.

EDUCATION

RA-Case 2255. A female in her 40s who had worked at a library for three years developed RADS after an incident where there was flooding in the library. Bleach was used to clean up the mold that grew as a result of the flooding. Since the clean up of the flooded area, her symptoms have resolved.

Cobalt-Tungsten Carbide

MANUFACTURING

OA-Case 2184. A male in his 20s developed asthma while working for a tool and die company as a machinist. His job was to grind tungsten-carbide, which contained cobalt; he was exposed to cobalt in this job for three years before his asthma developed. For the first 2 ½ years that he worked in this job, there were no dust collectors on the grinders. In addition, the workers were not provided with any respiratory protection, and not provided with MSDS on the substances they were working with. After new ownership, dust collectors were put on the grinders. However, this worker is currently on medical leave with FEV_1 < 50%. He continues to experience breathing problems and take asthma medication.

Exercise-Induced

CHEMICAL RESEARCH AND PRODUCTION

POA-Case 2315. A female in her 40s had been working for a research and development company for approximately 10 years. She experienced an asthma episode when having a pulmonary function test for her job. She started having breathing difficulties after this testing. She was placed on asthma medication and continues to work at this facility.

Formaldehyde

MANUFACTURING

OA-Case 2202. A male in his 40s developed asthma while working as a machine operator at a company that made plastic molded parts. About a year after he began to work at this company, he was exposed to formaldehyde when the plastic-injection molding machine he was running malfunctioned and "blew up in his face." Since the incident, he quit per his doctor's advice. His symptoms have become less severe and he is taking fewer asthma medications. Four months after leaving that job, he had not yet found a new job. His doctor advised him that he must not be exposed to chemicals in any new job he finds.

Glue

MANUFACTURING

POA-Case 2259. A female in her 40s developed asthma while working at an automotive parts manufacturing facility. Her job was to trim, grind, and send the parts to a prep station for painting. She had worked at this company for 19 years before being assigned to this job. The same month she was assigned to this job she developed asthma, and was prescribed asthma medication. She was working with a glue to attach parts, and it was this glue that caused her asthma. After she was diagnosed, the company reassigned her to a different job at a different location in the plant. She continues to work for this company. She continues to experiences asthma symptoms, although they have lessened since she moved out of the gluing job. She continues to take asthma medication to control her symptoms.

POA-Case 2260. A female in her 40s developed asthma while working at an automotive assembly plant. Her job was to glue parts on automotive headliners. She did this job for approximately two years before her asthma developed. The development of her asthma coincided with the use of a new glue by the company. When she started to use the new glue, she and several of her co-workers experienced coughing, wheezing, dizziness, blurry vision and vomiting. She was relocated to a different job, but her breathing symptoms persisted. She was given an inhaler and kept off for work for one month. When she returned to work, she was assigned to the gluing job again, and again her symptoms worsened. She was given a paper mask. She was eventually reassigned to a different job away from the glue, and continues to work for this company, although she continues to experience asthma symptoms and continues to take asthma medication.

Glutaraldehyde

HEALTH CARE SERVICES

OA-Case 2196. A female in her 30s developed asthma from working with glutaraldehyde and formaldehyde at a hospital where she was responsible for cleaning endoscopes. Her asthma developed 12 years after beginning to work at the hospital; the last two of those 12 years she had been assigned to the endoscopy unit. Since her asthma developed, she was reassigned to an office job at the hospital and her medication use and symptoms have lessened.

Grain Dust

MANUFACTURING

OA-Case 2297. A male in his 50s developed asthma from exposure to grain dust after working at a food manufacturing plant for 18 years. His job as a maintenance mechanic in the plant production area exposed him to grain dust. When his asthma was diagnosed, he was prescribed asthma medication. Before going on medical leave, he tried working in a different area of the plant, but it was impossible to avoid the exposure to the grain dust, even in other areas of the plant. Since being on medical leave, his symptoms have lessened and he continues to take his asthma medication.

OA-Case 2295. A male in his 50s developed asthma from exposure to grain dust after working for 25 years at the same food manufacturing plant as Case 2297. His job in the processing department and elsewhere in the plant exposed him to grain dust on a daily basis. Since he has been on medical leave, he continues to experience symptoms and continues to take asthma medication on a daily basis.

Grass/Pollen

EDUCATION

OA-Case 2262. A female in her 50s developed asthma 24 years after working at a public school as a teacher. She was exposed to cut grass on a weekly basis, along with poor air circulation and the school's failure to clean the air filters. She was prescribed asthma medication, which she continues to take. Her symptoms have improved and the grass is not cut when she is working.

RETAIL TRADE

AA-Case 2176. A female in her 40s experienced an exacerbation of her asthma while working at a large retail store at the service desk. Her asthma was triggered at work by plant pollen, when plants available for purchase were placed in her work area. After meeting with management, and with a note from her doctor, it was agreed to keep these plants away from her work area. Her symptoms have lessened since that time.

Indoor Air Quality

OFFICE WORK

AA-Case 2146. A female in her 40s experienced an exacerbation of her asthma during her work as a phone company service representative. When she was moved to a new building after working 13 years for the company, she noticed that her breathing problems became worse at work. The patient described wet ceiling tiles when it rained, sewer problems, and cockroaches at her place of work. In addition, she stated that the cooling system would often "get plugged up" and once it was working again would blow out lots of dust. Both an occupational physician and a pulmonologist told the patient that her asthma had become worse over the years, and that something at work is triggering her episodes.

AA-Case 2219. A female in her 50s experienced an exacerbation of her asthma while working as a medical transcriptionist at a hospital. Some remodeling work was being done, including tile cutting, dust from knocking down walls, and mold from carpeting. She was given a new office to work in. She developed her asthma in her 20s.

AA-Case 2324. A female in her 50s experienced an exacerbation of her asthma while working in the office of an architectural firm. Construction work was being done at her workplace, and it was the dust from this work that caused her asthma to worsen while at work. The construction work was completed after approximately six months. After the renovations were completed, her asthma no longer bothered her at work.

AA-Case 2313. A female in her 30s experienced an exacerbation of her asthma while working as a teller at a credit union. Some construction work was being done at the building where she worked, and it was the dry wall dust that would trigger asthma attacks. Since that time, other exposures now also trigger attacks, including perfume from customers as well as bathroom cleaners. She has been to the Emergency Room for asthma attacks over 70 times since her asthma developed in her 20s.

POA-Case 2164. A male in his 30s developed asthma symptoms two years after beginning to work as a customer relation representative at an automotive manufacturing facility. He reports the offices had "bad ventilation," with exposure to smoke and dust from the plant. He continues to work in the building. His symptoms are worsening and he is taking more asthma medication since his asthma began.

POA-2182. A female in her 40s developed asthma while working as a secretary in an office building. She had worked there for eight years before her symptoms developed. Her breathing became worse after her office was remodeled five years after her symptoms began. The remodeling work revealed mold in the office walls. She is currently not working because of her breathing problems. Her symptoms have lessened and she is taking fewer asthma medications.

POA-Case 2261. A female in her 40s developed asthma approximately two years after beginning to work in an office setting. Her asthma worsened after eight years of working in the building, when there was a flood in the basement and mold grew. The basement was cleaned up, including replacement of the dry wall and carpeting. During that time, she was off work. She continues to work at this location. She continues to take asthma medication and she still experiences breathing problems.

POA-Case 2147. A female in her 40s developed asthma 26 years after working at a municipality as a clerk. The onset of her asthma coincided with the remodeling of one of the rooms in the building where she worked, where old carpet was being torn up. She continues to work at this job, but continues to have difficulty breathing when in the building. The employee reports that her co-workers, including her supervisor have not been supportive of her illness, and in fact have joked about her breathing difficulties, even going as far as imitating a hacking cough when in her presence. She is currently attempting to qualify for family medical leave.

POA-Case 2253. A female in her 40s developed asthma while working through a temporary agency as a customer service representative. The room she was assigned to work in was full of dust and had not been cleaned for a long time. The carpet was dirty and had obviously not been vacuumed either. She developed breathing problems after working in that environment for approximately one month. She was off work for approximately one week, and then returned to work. However, when she returned to work she was fired, after she asked her supervisor to stop stirring up the dust in her work area. Her supervisor was cleaning out cabinets of old papers. She had not found a new job since that time.

POA-Case 2187. A female in her 60s developed asthma after 24 years of working at a bank. She reported mold on the walls in the furnace room, standing water in the stairway and elevator shaft, and dust from ceiling renovations. She reported that the employer had an employee cover up the mold in the basement with wrapping paper, and that some of the mold was removed on the weekends by hired abatement workers. Eventually she was reassigned to a different building, and since then her symptoms are less and she is taking less asthma medication.

POA-Case 2211 A female in her 20s developed asthma less than a year after beginning to work in an office as a mortgage consultant. She reported exposure to mold in the office building. Three months after the development of her symptoms, she was reassigned to work out of her home. She was not placed on any asthma medication and her symptoms have not gotten worse. A company was hired to evaluate the air quality in the building and reported that there was nothing wrong with the air in her office.

POA-Case 2298. A male in his 50s developed asthma while working as a resident manager for two residential condominium units. Four years after working for the condominiums, heavy rain and subsequent flooding caused water damage in the building where his office was located. The condominium association directed the resident manager to perform the cleanup of the water-damaged building, instead of hiring a professional cleaning company. The manager was exposed to wet carpets and raw sewage. He moved to a new building, but continues to experience breathing symptoms and continues to take asthma medication.

EDUCATION

POA-Case 2244. A female in her 40s experienced intermittent wheezing, chest tightness, cough and shortness of breath seven months after beginning to work at a preschool as a teaching assistant. Approximately 12 years after

starting this job, she was prescribed five asthma medications. She was exposed to mold from the plants in the classrooms as well as animal feed kept in the rooms for deer and rabbits. Shortly after being prescribed all the asthma medication, she quit working at this job because of her breathing problems. She has since found a new job at a medical clinic. After leaving her job at the preschool, her breathing problems have resolved and she is no longer taking any medication.

POA-Case 2230. A male in his 50s developed asthma 27 years after working as a teacher at a high school. He was exposed to mold and cleaning agents at the school. A talk with the school engineer suggested the ventilation system for the school was not functioning properly. The teacher was put on medical leave and started on asthma medication five years after his breathing symptoms began. He continues to be out on medical leave.

POA-Case 2209. A female in her 40s developed asthma while working in an office setting at a community college. She had been working for the college for eight years before her breathing troubles began. Her symptoms developed when some old, moldy carpeting was removed from a conference room. Her symptoms continued when other carpet was removed, and eventually the college moved her to a different campus. However, since her asthma began, her symptoms have become worse and she is taking more asthma medication.

POA-Case 2179. A female in her 40s developed asthma while running a day care center in her home. She related the presence of mold, approximately five years after she began running the day care center, and being started on asthma medication a year after the mold appeared. According to the patient, the mold was especially noticeable in the attic of the home. She continues to live in the home but no longer cares for children in her home. She continues to have symptoms, and is taking more asthma medicine than when she first developed her asthma.

POA-Case 2277. A female in her 50s developed asthma after having worked in a school for nine years. Her asthma began when the school had some construction work done, producing dust from the construction work as well as fumes from the construction vehicles. Two months after this work was started, she had to leave her job at the school because of her breathing problems. She was prescribed many asthma medications. Since she has been out of the school her symptoms have improved and she is taking less asthma medicine. She will be returning to her job after the construction work is completed.

HEALTH CARE SERVICES

POA-Case 2250. A female in her 50s developed asthma 13 years after working at a hospital as a nurse in the operating room. Her asthma started when some roof repairs were being done. She was placed on asthma medication, which helped to lessen her symptoms. Since the roofing incident, the formaldehyde-based product the hospital uses to dispose surgical fluids by causing them to solidify also causes her symptoms to occur.

MANUFACTURING

POA-Case 2143. A female in her 40s developed asthma while working as an administrative assistant at a turbine engine components manufacturing facility. Her symptoms developed 16 years after beginning to work at the company, while running a photocopier machine in a small, unventilated room. At the time of the interview, the patient was on extended sick leave.

POA-Case 2100. A female in her 50s developed asthma after working for six years doing computer-modeling work in an automotive prototype shop. She describes exposure to industrial clay, spray paint and poor ventilation at the facility. She is on medical leave and reports that she has fewer breathing problems now, but is taking the same amount of asthma medicine.

Isocyanates

MANUFACTURING

OA-Case 2251. A female in her 40s developed asthma while working at an automotive seat manufacturing facility. Her job was to clean out the hot molds after the foam was pumped into the mold to make car seats. The foam was an isocyanate. There would be small particles of the foam and wax in the molds that she would use a rag and a scraper to clean out the mold each time a seat was made. She had worked at this job for approximately two years before her asthma developed. Even after being out of the facility, she continues to experience breathing problems, and is taking more asthma medication to control her symptoms.

OA-Case 2081. A male in his 50s developed asthma after working at an automotive parts manufacturing facility for 34 years. He was exposed to MDI in the sand core production area while running an isocure machine. He continues to work at this facility, and is still exposed to MDI.

OA-Case 2236. A male in his 50s developed asthma while working as a line worker at an automotive parts manufacturing facility. He had worked at this company for 19 years before his asthma developed. Six months prior to the development of his asthma, he had been moved to a job to position foam sheets at the start of the line where a roller coater would apply an isocyanate-based adhesive and catalyst to the foam, in order to make headliners for vehicles. Fiberglass sheets were then sandwiched to the foam sheets and a forming press would then heat the sheets and shape them in the correct form. When his asthma developed, he experienced weakness and fatigue, shortness of breath with minimal exertion, dizziness and wheezing. He stopped working at this facility approximately one year after this and his asthma symptoms have lessened.

OA-Case 2229. A male in his 30s developed asthma while working at a company that makes stainless steel restaurant food serving equipment such as salad serving tables. His asthma developed the same month he began to work at this plant, from exposure to isocyanates used in a foaming process as insulation for the food serving tables. He was given a dust mask to wear while doing his job as a "foamer," which involved filling the table sections with foam. He was started on asthma medication one month after his symptoms began. He was reassigned to a new job and since then his symptoms have lessened, although he is taking the same amount of medication.

OA-Case 2327. A male in his 40s developed asthma from exposure to MDI at a facility that made restaurant-serving tables. The isocyanate was sprayed into the welded, stainless steel tables to serve as a hot-cold insulation material. His job at this facility was a door assembler, foaming the doors with this isocyanate-based insulation. He had worked at this company for three months before his asthma developed. He was prescribed asthma medication, and reassigned to an area free from isocyanate exposure. He continues to work at this facility, although his symptoms have worsened and his asthma medication use has increased.

OA-Case 2181. A male in his 50s developed asthma five years after beginning to work as a form grinder at a broach-cutting tool manufacturing facility. He described a co-worker using a coolant in the workstation behind his workstation. He was started on asthma medicine the year after his symptoms began, and was placed on additional asthma medication two years later. He described exposure to cobalt and oil mists at his work place. This was a non-union shop. He was laid off the year after his symptoms began and never called back to work. His breathing problems are worse, and he has been taking more asthma medication over the past four years.

OA-Case 2300. A female in her 40s developed asthma 13 years after working at an automotive parts manufacturing facility. Her job in the foam department involved separating parts and packing them for shipment. She worked another 10 years at the plant before she was put on medical disability leave. She continues to take asthma medication, and her symptoms have lessened since going on disability.

RA-Case 2227. A male in his 40s had worked at a company that makes stainless steel restaurant food serving equipment such as salad serving tables. He had worked at the company for 20 years with no breathing problems until there was a isocyanate foam fire in the welding assembly area one day when none of the regular response team members were working. He helped put out the fire then drove himself to the local hospital emergency room for treatment for his breathing difficulties. He was placed on asthma medication that he continues to take for his continued breathing problems. For a brief period, he was assigned to work at a different location. However, he was moved back to his original location due to lack of work at the other facility. He continues to take asthma medication and his symptoms have not resolved. Despite his breathing problems, he was placed back at his same job, welding foamed parts.

Latex

MANUFACTURING

OA-Case 2220. A male in his 20s developed asthma while working for a temporary agency. He was assigned a one-day job of scooping out a latex powder to put into a mold to make foam automotive parts. He did this job for approximately four hours, during which time he felt progressively worse and went to the hospital because he was experiencing chest tightness and shortness of breath. He did not return to this job. He then began to work for a different temporary agency. He was assigned to a job applying putty to automotive parts, and was given latex gloves to wear. He was told they were not latex gloves. Shortly after wearing the gloves, he experienced an allergic rash on his hands. After that incident, he worked other jobs for this agency, but none where latex was involved.

HEALTH CARE SERVICES

OA-Case 2145. A female in her 40s developed work-related asthma from exposure to latex gloves. She is an OB/GYN physician working in both a hospital and a clinic. Her asthma developed 13 years after beginning to work at the hospital. She continues to practice medicine and mainly experiences symptoms when delivering babies at the hospital.

Metal Working Fluids

MANUFACTURING

AA-Case 2140. A female in her 40s experienced an exacerbation of her asthma from exposure to metal working fluids at her work in an auto parts manufacturing facility. Her job as a maintenance supervisor required her to go into and fix machines that use metal working fluids. She had asthma since the age of 17 years. Her symptoms got worse at work after working at the plant for four years. She was reassigned to a different area of the plant shortly after her at-work symptoms began.

OA-Case 2242. A male in his 30s developed asthma approximately one year after beginning to work at an automotive stamping plant as a welder. He continued to work at the facility for six more years until he quit upon his doctor's advice. He was exposed to metal working fluids at the plant. He had not found a new job since quitting his job as a welder. He continues to take asthma medication and experience symptoms. The interviewer noted he coughed throughout the entire interview.

OA-Case 2237. A male in his 30s developed asthma while working at a training center. Near where he was conducting information technology training was a training shop for automotive parts manufacturing. The metal working fluid fumes from that automotive parts manufacturing training shop caused him to develop asthma. Three years after the development of his symptoms, he was reassigned to a new location free from such exposures, when his doctor wrote him a work restriction. His symptoms have lessened although he continues to take the same amount of asthma medication.

OA-Case 2234. A female in her 20s developed asthma the day she began to work as a temporary employee as a steel cutter at an automotive parts manufacturing facility. For six months before this incident, she had previously done temporary work at other parts manufacturing facilities and had been exposed to cutting oils. As time went on while she worked at these types of jobs, she began to develop hives and breathing difficulties from exposure to the metal working fluids. At this particular job, she was told that she would not be working with any oils, and she was given gloves. However, the gloves were not the appropriate type of glove for this work activity, and oil on the parts leaked through the gloves. She had to leave the facility, and it took her five hours for her breathing symptoms to resolve. She was started on asthma medication. Three months after this incident, her asthma symptoms are the same. She no longer was taking any medication, however, because she had no medical insurance and the temporary agency that was paying for her medicine fired her. She has been unable to find a new job since then.

OA-Case 2189. A female in her 30s developed asthma from exposure to metal working fluids and solvents at an automobile manufacturing facility. Her job was a drill press operator and her duties were to unload the machine where the axles came off. Her symptoms began five years after working at the plant, and she reports that on a daily basis there would be metal working fluids spilling on the floor in addition to mist in the air. Her family doctor first diagnosed her asthma, and this was followed up and confirmed by the company doctor, who then recommended she work in a different area. She reports being hospitalized over 30 times for her asthma, going to the emergency room over 40 times, and has been started on multiple asthma medication. She was reassigned to a new work area, and her asthma symptoms have lessened, although she still takes the same amount of medicine.

OA-Case 2150. A female in her 50s worked at an automotive engine manufacturing facility as an inspector on an assembly line, checking engines. She developed asthma 21 years after working as an inspector, from exposure to metal working fluids. Her doctor repeatedly advised her to quit her job, but she kept asking to continue to work at her well-paying job. She is currently on medical leave for her breathing problems.

OA-Case 2153. A female in her 50s developed asthma while working as a hi-lo driver at an automotive parts stamping plant. She described being exposed to cutting oils and metal working fluids from the stamping machines. Her breathing problems developed three years after she started working at that facility; after her asthma developed, she would experience breathing difficulties shortly after she would enter the building. She got a new job at a hospital and did not seem to have any symptoms in that environment.

OA-Case 2162. A male in his 40s developed asthma while working as a machine operator in a cast iron and aluminum parts manufacturing facility, approximately 20 years after he began to work there. He was exposed to metal working fluids sprayed on the parts, and describes a mist in the air. This worker said that the metal working fluids were used and reused for as long as possible, and bacteria would build up in them, creating a very bad smell. He said that he had asked for a mask but the company refused to allow employees to wear masks. He stated that the company had threatened to fire employees who wore masks, because they didn't want to "start a situation." Currently, he is on medical leave and since that time his breathing problems have become less severe, although he continues to take the same amount of medicine.

OA-Case 2168. A female in her 60s developed asthma eight years after she began to work as an assembler at an automotive assembly plant. The assembly line where she worked was near a line where metal working fluids were used. She had worked at other departments of this facility for 11 years prior to this. She retired from the

company and since then her symptoms have become worse. She is taking the same amount of asthma medicine as when she was working.

OA-Case 2172. A male in his 30s developed asthma the same month he began working as a C & C machine operator at an automotive parts manufacturing facility. He was exposed to a "continuous leakage of coolant vapors," and reported that the ventilation did not remove the vapors. In addition, a spray painting line was located adjacent to his workstation, and the sprayed paint would blow over to his section because of the positioning of a comfort fan. He was reassigned to another job at the company and he notes a lessening of his symptoms. He is no longer taking any asthma medication, because the company doctor says he does not need them and therefore the company will not pay for them. However, his family doctor says he still needs the medicine, but the patient reports being unable to pay for them.

OA-Case 2173. A male in his 50s developed asthma 11 years after beginning to work at an automotive stamping plant, in the assembly department as a spot welder. He continued to work at the facility for 24 more years, and continued to experience asthma symptoms during that time. He was exposed to a drawing compound used in the stamping machines. He describes doing spot-welding on parts that were covered with the drawing compound, and the smoke that resulted from the weld on the oil. His asthma symptoms have lessened and he no longer uses asthma medication since he stopped working at the facility.

OA-Case 2198. A female in her 60s developed asthma from her work as an inspector at an automotive parts manufacturing facility. Her asthma developed 28 years after working at this plant. She reports exposure to metal working fluids, including regular spills of these coolants. She was reassigned to a new plant after her asthma developed, but the new plant still uses metal working fluids and has a similar work environment. She reports her symptoms are worse and that she continues to take the same amount of asthma medication.

OA-Case 2133. A male in his 40s developed work-related asthma from exposure to metal working fluids at an automotive parts manufacturing facility, five years after beginning to work at that plant. His job was to machine parts. He continues to do this job at the facility, and is still exposed to metal working fluids.

OA-Case 2124. A female in her 50s developed asthma 19 years after beginning to work as an inspector at an automotive engine prototype development facility. Her asthma began about a year after moving to a new prototype development building for the same company. She was exposed to metal working fluids and solvents at both locations. Since she went on medical leave, her symptoms have become less severe, although she is taking more medication than when her asthma first developed.

OA-Case 2225. A male in his 40s developed asthma nine years after beginning to work at a tool and die shop. His job as a grinder operator at the plant exposed him to metal working fluids on the metal parts being machined. He continued to work for six years after his diagnosis at the plant, despite his continued exposure to the metal working fluids. After six years, he went on a long-term medical leave and then quit work after that, because of his breathing problems. He continues to take asthma medication. His symptoms have stopped, since he quit working at that facility. He is not currently working.

OA-Case 2301. A male in his 50s developed asthma after working for 23 years at an auto manufacturing plant. He works in the machining department and is exposed to coolants. Five years after the development of his asthma, he continues to work at this facility, his symptoms have worsened, and he is taking more asthma medication. The last time he was hospitalized for an asthma attack, he was intubated.

Multiple Exposures

UTILITY SERVICES

AA-Case 2134. A male in his 20s experienced an exacerbation of his asthma from exposure to coal dust blowing on him in the security guard shed for the power plant where he worked. He had been working as a security guard at this facility for a little over one year before his work-related symptoms developed. He continues to work at this job, with continued exposure to coal dust. He had asthma since he was 15 years old, and had never experienced a break in his symptoms.

MANUFACTURING

AA-Case 2216. A male in his 30s experienced an exacerbation of his asthma while working as a laborer at an automotive manufacturing facility. There was a propane tank fire and he was exposed to the smoke from that fire. In general, his work at the facility did not aggravate his asthma.

POA-Case 2263. A female in her 50s developed asthma while working at an automotive manufacturing facility as a parts packer. She had worked at this facility for 23 years, and in that particular job for the last 9 of those 23 years. She was exposed to smoke fumes, cleaning products, and dust from remodeling work being done at the facility where she worked. She was prescribed asthma medication and continues to work at the plant. Her symptoms have continued, although she is now taking fewer asthma medicines.

POA-Case 2265. A male in his 40s developed asthma while working at a manufacturing facility that made welding racks for the automotive industry. His job was to weld the parts on the racks together. He had worked at this job for approximately six months before his symptoms developed. Approximately two months after his symptoms started, he was prescribed asthma medication. He was exposed to grinding dust, welding fumes, paint fumes and solvents. There was no ventilation provided for the welding fumes and grinding dust generated, and no protective equipment available. He left the exposure approximately two years after his asthma developed, and was put on medical leave. He is using less medicine and his symptoms have improved since being out of the exposures that caused his asthma. However, the company eventually went out of business and he has been unable to find a new job in the past year.

POA-Case 2136. A female in her 30s developed asthma while working at a circuit board manufacturing facility. Her job was to hand-solder the circuit boards using a solder paste. She was also exposed to lead fume. This job was performed under low lighting, and to fix the components on the circuit board required her to have her face close to the board. After the chips are soldered onto the board, the workers spray the board with a plastic coating, then spray a foam coating, and let the completed boards dry on a table with no ventilation. When the company moved the soldering operation to a building down the street, they never installed a ventilation system for the operation. Her asthma developed eight years after beginning to work at this facility. She was fired because she had taken too much time off for her asthma and at the time of the interview had not yet found a new job.

POA-Case 2281. A male in his 40s developed asthma 26 years after working for a company that made automotive parts. His duties included driving a hi-lo forklift truck through the plant and running a wax machine. He was exposed to solvents and other fumes in the plant, and developed his breathing problems after 26 years of working there. He was prescribed asthma medication and is currently on medical leave. Since he has been out of the plant, his symptoms have lessened, although he continues to take the same amount of asthma medicine.

POA-Case 2210. A male in his 30s developed asthma eight years after beginning to work at an automotive assembly plant. He was exposed to sealer fumes, metal working fluids, and welding fumes in his job as a plasma cutter. He

continued to be exposed to these substances for eight months after his breathing problems began, and then took unpaid leave upon the recommendation of his doctor. When he was interviewed, he stated that his employer was asking him to return to this same job despite the medical restriction from his doctor. He was extremely concerned about the damage to his lungs and the potential for more damage if he returned to the same exposures at this facility. Since the development of his asthma, his symptoms had worsened and he has been taking more asthma medication.

POA-Case 2247. A female in her 40s developed asthma while working at an automotive manufacturing plant. She worked at the facility for six years before being assigned to work in a job where she used a chemical stripper to remove paint off the parts being made. The work was done in a small area with no ventilation. A few days after doing this job, she went to the medical department and was told she had carbon monoxide poisoning. A month after doing this job, she had an asthma attack. She continues to work at this facility, and she continues to experience asthma symptoms despite taking more asthma medication since her asthma attack. She now experiences frequent asthma attacks.

POA-Case 2208. A male in his 50s developed asthma while working as a maintenance electrician at an automotive parts manufacturing facility. He had been working at the facility for 19 years before his symptoms developed, and was exposed to caustics, plastic fumes, solvents and other chemicals. His symptoms improved somewhat after being placed on medical leave, although he was still taking the same amount of asthma medication.

POA-Case 2193. A male in his 40s developed asthma while working as a grinding machine operator at a plastic automotive parts manufacturing facility. He had worked at this company for approximately three months before he developed asthma symptoms. He describes exposure at work to grinding and plastic fumes. He was put on restricted duty when his asthma began, and over a year later has not been given any work, although he has not been fired.

POA-Case 2154. A female in her 20s developed asthma the year she began working at an automobile manufacturing plant. She first noticed breathing problems when working on the assembly line, bolting down seats and putting batteries in the vehicles. In this job she was exposed to carpet fibers and metal fibers. She reported that normally, when she would begin to experience breathing difficulties, she would take herself out of the area where she experienced the problem. She also reported breathing difficulties from a fire in a foam booth in the assembly area that caused her immediately to have breathing problems. She has continued to work at the same plant for eight years. Her symptoms are less severe than when they first developed, but she is taking more asthma medicine to control her symptoms.

POA-Case 2161. A female in her 40s developed asthma working as a model maker in a pre-production prototype shop where she sanded fiberglass panels for automotive models as well as applied an epoxy to the models. Other exposures in the shop include isocyanates, wood dust, and welding fumes—she described working in the shop as working in a "chemical soup." She had worked at the facility for 11 years before her asthma developed, and continues to work there. She describes the ventilation as inadequate, that the ventilation in the locker rooms is better than in the production area.

POA-Case 2169. A male in his 40s developed asthma one month after beginning to work as a temporary/contract laborer at a manufacturing facility. He stopped working there approximately seven months later.

Paint Fumes

MANUFACTURING

AA-Case 2142. A male in his 40s experienced an exacerbation of his asthma from exposure to paint fumes at a plastic auto parts manufacturing facility, when staff from the maintenance department were doing maintenance painting in the building. The patient continues to work in his same job as a die setter at this facility, but when maintenance-type painting activities are done in his area, the company moves to him to another area to work.

POA-Case 2256. A male in his 30s developed asthma after working for about one month as a spray painter at a manufacturing facility. He did the painting in an enclosed room with no respirator. After noticing trouble breathing, he was seen by his primary care physician and given an inhaler to use. The paint booth did have a ventilation system, but it was not working properly. The company refused to provide the employee with an MSDS for the paint he was using.

POA-Case 2131. A female in her 40s developed asthma from exposure to a paint not typically used in her work place. The facility had run out of a yellow marker used to mark rejected parts, so had substituted it with a yellow paint. The employee was placed on a different job until the usual marker was restocked. Once the usual marker was restocked, she was able to return to her usual job and no longer experienced asthma symptoms.

POA-Case 2249. A male in his 30s developed asthma nine years after beginning to work at an automotive manufacturing facility. His asthma developed when he was assigned to a job as a painter. He worked in an enclosed paint booth, and noticed breathing problems on the second day of doing that job. He was given a used dust mask to wear after notifying a safety representative about the breathing trouble he was having. A few days later when he was still experiencing symptoms, he was told by the medical department that he had an upper respiratory infection, and placed on antibiotics. In addition, he was given a different respirator. However, although this was the correct type of respirator, it had been used by someone else and the filters on it were full of paint. He continued to feel progressively worse, and ended up in the hospital. After this incident, he returned to the plant and was told he would be assigned to the paint booth again, and told to "get used to it." He is currently on medical leave, with an improvement in his symptoms and taking fewer asthma medications.

POA-Case 2155. A male in his 40s developed asthma 16 years since beginning to work as a truck spray painter in the paint department at an automotive parts manufacturing facility; he had been working at that company in a different department for 12 years prior to this. He was exposed to formaldehyde and paint fumes, and reported that his symptoms became worse when the doors on an "oven" were not closing properly and he had to manually close them each time a truck went through to cure the paint. He also notices symptoms now when maintenance employees paint the handrails in the plant. He was reassigned to a new department and reports that he is generally not exposed to paint fumes anymore, other than maintenance-related painting.

POA-Case 2178. A male in his 40s developed asthma while working through a temporary agency as a custodian changing the filters in a paint spray booth at a company that painted car parts. He would go into the spray booths while the painters were on lunch and change the filters. Shortly after he was placed at this company, he noticed a burning sensation in his throat and was given a used respirator mask. He was told by the environmental health representative that "you temporary service guys turn over so fast…I don't give out [new] masks to everyone." The patient went to the head of Health and Safety at the company to request a MSDS for the paint, because his symptoms were still present; he was refused a copy. He was started on asthma medication, but stopped taking them about one month after they were prescribed because he does not have the money to pay for them. The temporary agency has not assigned him to any new work since the one month he worked at this facility, stating that they didn't have any other work for him to do during the four months that have passed since he last worked.

POA-Case 2243. A female in her 40s developed asthma approximately two months after starting to work at a parts painting facility. Five months after she began to work for this company, she quit her job because of her breathing problems. The fumes from the sprayed paint and the ovens that baked the parts after spraying to cure them bothered her on a daily basis. She was given a dust mask, along with safety glasses and gloves. Since she left the job, her symptoms have lessened in severity and she is not taking any asthma medicine. She is currently working at a printing company.

RETAIL TRADE

AA-Case 2226. A female in her 40s experienced an exacerbation of her asthma while working as a salesperson in a showroom for heating and air conditioning equipment. She had been working at this showroom for nine years. Her asthma was triggered by an incident involving exposure to diesel fumes from a hi-lo truck without ventilation, as well as from painting without ventilation. Since the incident, she was reassigned to a new location.

Pesticides: Herbicides and Insecticides

WHOLESALE AND RETAIL TRADE

AA-Case 2129. A male in his 40s experienced an exacerbation of his asthma at work when an outdoor insecticide fogger was applied several times inside his work place that mails and ships packages. In addition to the insecticide, dusts in the facility aggravated his asthma while at work. Despite employee concerns, the facility's health and safety committee had not met in over two years. The patient's asthma originally started in his 30s, while working with water-based coolants at an automotive throttle control manufacturing facility.

RA-Case 2171. A female in her 30s developed RADS while working as a cake maker at a baked goods store. She was exposed to an insecticide sprayed in the office and immediately experienced breathing difficulties. She had been working at this store for seven years prior to this event. The patient reports that her supervisor has been very careful around her, and does not use the insecticide as well as any cleaners around her, but she reports she still feels "not right." She continues to experience wheezing and shortness of breath, although she has stopped using the inhaler prescribed when the acute exposure occurred.

GOVERNMENT

AA-Case 2252. A female in her 50s experienced an exacerbation of her asthma while employed at a school as a grounds maintenance worker. Her asthma was triggered from back spray on her face and clothes of a weed killer she was applying outside the school. She was treated at a local hospital ER and released.

OFFICE WORK

RA-Case 2148. A female in her 50s worked as an office clerk in a county building. She developed RADS after working there for six years, when remodeling was being done in the building where she worked. New countertops were being glued, and the employee experienced wheezing, chest tightness and shortness of breath and had to go to the local hospital Emergency Room. A few months later, the hallways were being painted, and an insecticide "bomb" was used in the stairwell to eliminate a beehive, and these incidents also caused breathing difficulties. The employee continues to work at this job; signs are now posted prior to any painting or insecticide applications. Her symptoms improved.

Smoke

OFFICE WORK

RA-Case 2254. A female in her 50s developed RADS while working in an office at a hospital. She had been an office supervisor there for 30 years prior to the incident when she developed RADS. There was a microwave fire in her office area; the fumes and smoke from that fire caused her to go home, not feeling well. She went to her doctor and was put on asthma medication. Her breathing did not improve after this fire. She died from an asthma attack five months later, while working at her second job in retail sales at a clothing store in a mall. Her employers probably did not know she had asthma; she did not want anyone to know she was sick.

EDUCATION

AA-Case 2276. A female in her 40s experienced an exacerbation of her asthma while working as a teacher at a public school. She had been working in the school district for seven years. She was exposed to a fire in the girls' bathroom when she helped a student out of the bathroom. Smoke from a burning roll of toilet paper that then melted the paint on the bathroom stall aggravated her asthma, along with the wrong type of fire extinguisher being used to put out the fire. Three months after that incident, she has been unable to return to work because of her breathing problems. She has been on increased asthma medicine to control her symptoms.

FIRE FIGHTING

RA-Case 2280. A male in his 40s developed RADS while fighting a fire at a gun shop. He had been a fire fighter for 14 years before this incident. He was exposed to fumes from gunpowder, and other unidentified fumes in the burning building. He was off work for four months after this incident, until his breathing improved. At the time of this incident, he was prescribed asthma medicine, which he has continued to take as needed. His breathing problems have improved.

Solvents/Other Chemicals

CONSTRUCTION

RA-Case 2258. A male in his 40s developed RADS doing structural steel work at an oil refinery. He had worked as an ironworker for 19 years prior to this incident. On this particular job at the oil refinery, there were numerous activities with various exposures, including: grinding preparation of lead-based paint on steel beams; refinery gas; and cleaning solvents. Within three weeks of working on this job in these exposures he developed wheezing, cough, chest tightness and shortness of breath and was given asthma medication to treat his symptoms. He quit that job, but had a worsening of his symptoms since then and is taking his asthma medicines more frequently.

RA-Case 2311. A female in her 60s developed RADS working in production at an electric motor manufacturing shop. The incident associated with her breathing difficulties involved an exposure to fumes from a malfunctioning degreaser tank. She continues to work at this facility, but not in the area where the degreaser tanks are located. She currently takes no asthma medication, although in the winter months she notes increased breathing difficulties.

POA-Case 2248. A male in his 20s had worked for less than a year at a company that repairs elevators, as an elevator installer when he developed asthma. He was exposed to concrete dust and mineral spirit fumes. He wore a

dust mask when installing elevators. He was placed on asthma medication and continues to work at this job. His breathing problems have lessened and he continues to take asthma medication daily.

POA-Case 2241. A male in his 30s developed asthma four months after beginning to work at a highway construction job. He was exposed to asphalt chemicals and vehicle exhaust while helping to load the asphalt trucks indoors. He was placed on asthma medication and continues to work at this location. His symptoms are less and he was taking his asthma medication less frequently.

HEALTH CARE SERVICES

AA-Case 2275. A female in her 40s experienced an exacerbation of her asthma while working at an out patient medical office. She had worked at this location for seven years. Some roof repairs were being done at the building where she worked, which caused an immediate reaction. Since the roofing exposure, she has been taking more asthma medicine.

MANUFACTURING

POA-Case 2228. A female in her 40s developed asthma two years after beginning to work at a steel spring manufacturing facility. She was exposed to a chemical washing fluid (solvent) used to clean the oil off the metal parts after they were made. One time, her supervisor improperly mixed the washing fluid, causing her to seek care at a local hospital emergency department. She was reassigned to a new department after the incident where she went to the ER. She continues to experience symptoms, although they are somewhat improved, and continues to take asthma medicine.

POA-Case 2158. A male in his 40s developed asthma while working as a machinist at an automotive engine parts manufacturing facility. His asthma developed approximately 20 years after he began to work at this plant. He relates his exposure to kerosene as the trigger for his breathing problems. He is no longer exposed to the kerosene because he was placed on medical leave. His symptoms are less severe now and his medication use is less than when he was exposed to kerosene.

Welding Fume

MANUFACTURING

OA-Case 2290. A male in his 40s developed asthma two years after working as a welder at a company that made industrial truck suspensions. He continued to work at the facility for 16 years as a welder, until he was placed on disability leave. He continues to experience asthma symptoms and take his prescribed asthma medication.

POA-Case 2110. A male in his 30s developed asthma two years after beginning to work at an automotive manufacturing plant as a welder, using zinc oxide tips. He also reports the generation of smoke from the oil on the parts as they are welded. He continues to do this job, and his symptoms have become worse. He has had to increase his asthma medication use.