

## Surveillance for Occupational Asthma — Michigan and New Jersey, 1988–1992

Mary Jo Reilly, M.S.<sup>1</sup>

Kenneth D. Rosenman, M.D.<sup>1</sup>

Flint C. Watt, P.E., C.I.H.<sup>2</sup>

Donald Schill, C.I.H.<sup>3</sup>

Martha Stanbury, M.S.P.H.<sup>3</sup>

Linda S. Trimbath<sup>3</sup>

Ruth Ann Romero Jajosky, D.M.D., M.P.H.<sup>4</sup>

Karl J. Musgrave, D.V.M., M.P.H.<sup>4</sup>

Robert M. Castellan, M.D., M.P.H.<sup>4</sup>

Ki Moon Bang, Ph.D., M.P.H.<sup>4</sup>

Diana L. Ordin, M.D., M.P.H.<sup>5</sup>

<sup>1</sup>*Michigan State University, Lansing, MI*

<sup>2</sup>*Michigan Department of Public Health, Lansing, MI*

<sup>3</sup>*New Jersey Department of Health, Trenton, NJ*

<sup>4</sup>*Division of Respiratory Disease Studies,  
National Institute for Occupational Safety and Health  
(NIOSH), CDC*

<sup>5</sup>*Division of Surveillance, Hazard Evaluations, and Field Studies,  
NIOSH, CDC*

### Abstract

**Problem/Condition:** A case of occupational asthma is a sentinel health event indicating a need for preventive intervention.

**Reporting Period Covered:** 1988–1992.

**Description of Systems:** As part of the Sentinel Event Notification System for Occupational Risks (SENSOR) Program, initiated by CDC's National Institute for Occupational Safety and Health in 1987, state-based surveillance and intervention programs for occupational asthma (OA) have been under development in Michigan and New Jersey. The initial 5-year projects in these states have been completed.

**Results:** From 1988 through 1992, the SENSOR programs in these states identified a total of 535 cases of occupational asthma and related conditions. Of these 535 cases, 328 cases met the SENSOR surveillance case definition for OA. In addition, 128 cases were classified as possible OA, 42 as reactive airways dysfunction syndrome, and 37 as occupationally aggravated asthma. In both Michigan and New Jersey, manufacturing was the industrial sector with the largest proportion of cases. In Michigan, >40% of the case-patients worked in transportation equipment manufacturing. In New Jersey, 15% of case-patients worked in manufacturing of chemicals and allied products. Overall, isocyanates were the most frequently reported asthma-causing agents (19.4% of cases). Follow-up industrial hygiene sampling measured suspect agents at airborne concentrations generally below the permissible exposure limits established by the Occupational Safety and Health Administration.

**Interpretation:** In its first 5 years, the SENSOR system has led to the identification of previously unrecognized causes of occupational asthma. Overall findings indicate the need for more comprehensive control of such well-known occupational allergens as the isocyanates. In addition, SENSOR interventions have prompted improvements in protection for workers.

**Actions Taken:** Approaches to state-based surveillance and intervention for OA are being developed through newly funded 5-year SENSOR projects in four states (California, Massachusetts, Michigan, and New Jersey). The goal is to develop a model for effective state-based OA surveillance that can be applied by any state health department.

## INTRODUCTION

In 1987, 10 states were awarded 5-year cooperative agreements with CDC's National Institute for Occupational Safety and Health to implement surveillance systems for selected occupational conditions under the Sentinel Event Notification System for Occupational Risks (SENSOR) Program (1). The Michigan Department of Public Health (MDPH), in cooperation with the College of Human Medicine at Michigan State University, and the New Jersey Department of Health (NJDOH) were each awarded SENSOR cooperative agreements for occupational asthma (OA) surveillance. This report summarizes OA surveillance data collected by the Michigan and New Jersey SENSOR programs for the period 1988–1992.

## METHODS

### Case Report Ascertainment

MDPH and NJDOH actively solicit occupational disease reports from physicians, hospitals, and clinics in their respective states. Active solicitation of occupational disease reports has been undertaken in the following ways: 1) potential cases are identified through a review of hospital discharge or death certificate data files, and follow-up is conducted to determine whether the medical condition was work related; 2) state SENSOR staff periodically conduct educational outreach to physicians who have a high likelihood of encountering patients with occupational asthma (e.g., allergists, pulmonologists, occupational medicine physicians, and members of the state thoracic society) in an effort to alert them to occupational disease reporting laws in their state, to encourage them to report cases, and to educate them about the objectives and activities of the SENSOR program; and 3) state SENSOR staff members develop and distribute occupational disease newsletters to physicians in an effort to provide them with up-to-date educational material on selected occupational conditions and to provide physicians with summary information about SENSOR surveillance and intervention activities.

In 1979, legislation that mandated clinical reporting of OA became effective in Michigan. New Jersey's legislation became effective in May 1990, although reports were received earlier through a voluntary reporting mechanism. In addition, some reports of OA have been ascertained through review of medical records of hospitalized patients discharged with a diagnosis coded as a respiratory condition resulting from inhalation of chemical fumes and vapors (*International Classification of Diseases*,

9th Revision [ICD-9] 506) (2). In both Michigan and New Jersey, hospitals are required to report all such discharge diagnoses to the state health departments.

The ICD-9 classification system does not contain a specific rubric for occupational asthma. Although the ICD-9 rubric 493 represents asthma, a substantial number of asthma cases are reported through hospital discharge records without being classified as work related (approximately 11,000 from Michigan and 15,000 from New Jersey annually). A study of all ICD-9 506 hospital discharge diagnoses reported directly to the NJDOH in 1985 and 1986 revealed that 39% were secondary to occupational exposures. A similar study of 1989 and 1990 hospital discharges in Michigan demonstrated that 35% of all hospital discharges coded to the ICD-9 506 rubric were work related (3). Of the 66 work-related code 506 diagnoses identified in the New Jersey study, 20% were classified as occupational asthma as documented by a follow-up review of the hospital medical records (4). As a result, searches for hospital discharges coded 506 are routinely undertaken in New Jersey and Michigan to identify potential cases of occupational asthma.

Case-patients reported to the SENSOR programs are interviewed by health department personnel to obtain demographic and exposure information (e.g., name of employer and location of exposure), and additional medical information. For some cases, information is also obtained from review of medical records, and, in New Jersey, some reported case-patients recorded serial lung function data by using portable peak-flow meters provided by the NJDOH.

### Case Confirmation

Meeting the surveillance case definition for OA requires all three of the following criteria: a) a physician diagnosis of asthma, b) an association between symptoms of asthma and work (i.e., a particular job or process or work-related exposure), and c) exposure to an agent previously associated with asthma or evidence of an association between work exposure and either a significant decrease in lung function or increase in airways responsiveness (5). State SENSOR staff determine whether the available information for each reported case is sufficient to meet the case definition criteria.

Although not explicitly outlined in the published definition (5), if the asthmatic condition developed for the first time coincident with an acute exposure to an irritating chemical at work, the case is classified as reactive airways dysfunction syndrome (RADS) (6). If only criteria (a) and (b) of the published definition are met, the case is classified as possible OA. Finally, if a reported case of preexisting physician-diagnosed asthma became worse in association with a particular job (i.e., work-related exacerbation of symptom frequency or severity), the case is classified as occupationally aggravated asthma. The clinical signs and symptoms of occupational asthma and RADS are identical. However, RADS can occur after a single high-level exposure to an irritant gas, fume, smoke, or vapor. Onset of occupational asthma can occur after months or years of exposure to potential sensitizing agents.

### Preventive Measures

To prevent OA in coworkers, SENSOR surveillance data have been used to target workplace investigations and interventions. Investigations of work sites have included industrial hygiene evaluations to identify suspected causative agents and to assess the facility's safety and health program. They may also include interviews with workers or reviews of company records to determine whether coworkers have been

experiencing similar respiratory difficulties. On the basis of work site evaluations, recommendations are made to improve work conditions with respect to OA risk. In New Jersey, the evaluations have been conducted by industrial hygienists employed by the NJDOH. In Michigan, these evaluations are conducted by industrial hygienists from the Michigan Occupational Safety and Health Administration (MIOSHA) and may lead directly to issuance of citations for violations of health and safety codes.

SENSOR staff in Michigan and New Jersey mail educational materials about OA to identified case-patients, employers, and unions. SENSOR staff also prepare and distribute newsletters to physicians on SENSOR-related activities and findings. In addition, New Jersey and Michigan publish annual state reports summarizing data collected through SENSOR activities.

## RESULTS

### Epidemiology

From May 1988, the date of the initial solicitation\* of physician reports, through December 1992, 230 reports were received by the NJDOH occupational asthma SENSOR program. Of the 230 reported cases, 106 (46.1%) met the surveillance case definition for OA, another 18 (7.8%) were possible OA, and 16 (7.0%) were RADS. An additional 14 (6.1%) were occupationally aggravated asthma (Table 1). The remaining 76 (33.0%) lacked evidence of either a clinical diagnosis of asthma or work-related asthma symptoms.

From January 1988 through December 1992, the MDPH received 538 reports of occupational asthma. Of these reports, 222 (41.3%) met the surveillance case definition for OA, another 110 (20.4%) were possible OA, and 26 (4.8%) were RADS. An additional 23 (4.3%) were occupationally aggravated asthma (Table 1). The remaining 157 (29.2%) lacked evidence of either a clinical diagnosis of asthma or work-related asthma symptoms. An additional 59 reports from that period are being confirmed and are not included in these data.

Physicians have provided the majority of case reports in both states. Reports from hospitals represented 20% of reports in Michigan and 6% of reports in New Jersey.

Manufacturing was the industrial sector with the greatest proportion of cases from both Michigan and New Jersey. Seventy-seven percent of case-patients reported in Michigan and 48% of case-patients reported in New Jersey were employed in some form of manufacturing. In Michigan, approximately 42% of the case-patients were employed specifically in the manufacture of transportation (e.g., automotive) equipment. In New Jersey, 15% of case-patients worked in manufacturing of chemical and allied products (Table 2).

A wide range of asthma-causing agents has been reported (Table 3). Isocyanates were the most frequently reported asthma inducers in both New Jersey and Michigan. Overall, isocyanates were associated with 19.4% of all cases. The next most frequently reported asthma-causing agents in Michigan were coolant /oil mists generated by machining operations (12.3%), aldehydes (including formaldehyde and glutaraldehyde) (3.7%), tungsten carbide/cobalt (3.7%), and epoxy resins (2.9%). In New Jersey, the

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\*The New Jersey SENSOR program conducted a mass mailing of information about the SENSOR program to approximately 1,200 physicians in the state.

**TABLE 1. Number\* of cases of occupational asthma and related conditions, by year reported — Michigan and New Jersey SENSOR programs, 1988–1992**

Year	Occupational asthma			Possible occupational asthma			Reactive airways dysfunction syndrome			Occupationally aggravated asthma			Total		
	MI	NJ	Both	MI	NJ	Both	MI	NJ	Both	MI	NJ	Both	MI	NJ	Both
1988	22	20	42	6	1	7	1	0	1	0	1	1	29	22	51
1989	43	22	65	11	1	12	5	3	8	3	0	3	62	26	88
1990	75	23	98	30	5	35	8	9	17	8	3	11	121	40	161
1991	39	30	69	31	6	37	11	3	14	8	5	13	89	44	133
1992	43	11	54	32	5	37	1	1	2	4	5	9	80	22	102
<b>Total</b>	<b>222</b>	<b>106</b>	<b>328</b>	<b>110</b>	<b>18</b>	<b>128</b>	<b>26</b>	<b>16</b>	<b>42</b>	<b>23</b>	<b>14</b>	<b>37</b>	<b>381</b>	<b>154</b>	<b>535</b>

\*Not included are 76 cases reported from New Jersey and 157 cases reported from Michigan for which evidence is lacking of either a clinical diagnosis of asthma or work-related asthma symptoms. Also excluded are an additional 59 cases from Michigan that are still being confirmed.

most frequently reported asthma-causing agents, following isocyanates, were aldehydes (9.1%), diesel exhaust (5.2%), pesticides/herbicides (5.2%), coolant /oil mists generated by machining operations (3.9%), and chlorine (3.9%).

### Workplace Follow-up

In Michigan, 160 facilities were inspected. In 105 of these facilities, coworkers of the index case-patient were interviewed; 72 of these interviews identified 681 coworkers who had symptoms compatible with OA. Air sampling for agents known to induce occupational asthma was conducted at 109 facilities. At 93 (85.3%) of these facilities, levels measured at the time of inspection were below the legally enforceable permissible exposure limit (PEL) established by MIOSHA.

In New Jersey, industrial hygiene evaluations have been conducted at 42 workplaces. Air sampling for suspected asthma-causing agents was performed at 22 (52.3%) of the worksites. Measured levels were below the applicable PEL at 17 (77.3%) of these workplaces. Thirty-six (85.7%) of the 42 workplaces were found to have ineffective engineering controls, 33 (78.6%) had inadequate respiratory protection programs, and 36 (85.7%) did not have adequate air-monitoring programs. For each workplace inspected, the NJDOH sent a written report, with recommendations, to the employer, employee representative(s), union(s), reported case-patient(s), local health department, and reporting physician(s).

**TABLE 2. Industries employing workers with reported cases of occupational asthma and related conditions — Michigan and New Jersey SENSOR programs, 1988–1992**

Industry (Standard Industrial Classification Code)	Michigan		New Jersey	
	No.	%	No.	%
<b>Manufacturing (20–39)</b>	<b>292</b>	<b>76.8</b>	<b>74</b>	<b>48.1</b>
Transportation Equipment—includes automobiles, boats, yachts (37)	158	41.6	5	3.2
Chemicals and Allied Products (28)	24	6.3	23	14.9
Industrial and Commercial Machinery and Computer Equipment (35)	18	4.7	3	2.0
Rubber and Miscellaneous Plastic Products (30)	19	5.0	5	3.2
Fabricated Metal Products (34)	16	4.2	3	2.0
Primary Metal Industries—includes foundries (33)	14	3.7	4	2.6
Food and Kindred Products (20)	13	3.4	5	3.2
Stone, Clay, Glass, and Concrete Products (32)	3	0.8	5	3.2
Miscellaneous Manufacturing (22–27, 29, 31, 36, 38–39)	27	7.1	21	13.6
<b>Transportation, Communications, Electric, Gas, &amp; Sanitary Services (40, 42, 44, 47, 49)</b>	<b>5</b>	<b>1.3</b>	<b>8</b>	<b>5.2</b>
<b>Wholesale and Retail Trade (50, 51, 53–55, 58, 59)</b>	<b>15</b>	<b>4.0</b>	<b>13</b>	<b>8.4</b>
<b>Services (70–89)</b>	<b>41</b>	<b>10.8</b>	<b>40</b>	<b>26.0</b>
Services (70–89, excluding 80 and 82)	19	5.0	16	10.4
Health Services (80)	15	4.0	19	12.3
Educational Services (82)	7	1.8	5	3.2
<b>Public Administration (91–93, 95, 97)</b>	<b>8</b>	<b>2.1</b>	<b>10</b>	<b>6.5</b>
<b>Construction (15, 16, 17)</b>	<b>13</b>	<b>3.4</b>	<b>5</b>	<b>3.2</b>
<b>Other Categories (10, 13, 14, 60, 63–66)</b>	<b>6</b>	<b>1.6</b>	<b>4</b>	<b>2.6</b>
<b>TOTAL</b>	<b>380*</b>	<b>100.0</b>	<b>154</b>	<b>100.0</b>

\*For one case, the industrial classification was not known.

**TABLE 3. Occupational agents associated with reported cases of occupational asthma and related conditions — Michigan and New Jersey SENSOR programs, 1988–1992**

Agent	Michigan		New Jersey		Total	
	No.	(%)	No.	(%)	No.	(%)
Isocyanates*	88	23.1	16	10.4	104	19.4
Coolant /oil mists from machining operations†	47	12.3	6	3.9	53	9.9
Aldehydes§	14	3.7	14	9.1	28	5.2
Epoxy resins	11	2.9	5	3.2	16	3.0
Tungsten carbide/cobalt	14	3.7	1	0.6	15	2.8
Acrylates	9	2.7	4	2.6	13	2.4
Chlorine	7	1.8	6	3.9	13	2.4
Acids	7	1.8	3	1.9	10	1.9
Diesel exhaust	2	0.5	8	5.2	10	1.9
Smoke/fumes, unspecified	10	2.6	0	0.0	10	1.9
Welding fumes	7	1.8	3	1.9	10	1.9
Pesticides/herbicides¶	1	0.3	8	5.2	9	1.7
Styrene	8	2.1	1	0.6	9	1.7
Amines**	5	1.3	3	1.9	8	1.5
Flour dust	5	1.3	2	1.3	7	1.3
Wood dust	3	0.8	4	2.6	7	1.3
Nondiesel exhaust	5	1.3	1	0.6	6	1.1
Phthalic anhydride	2	0.5	4	2.6	6	1.1
Chromium	5	1.3	0	0.0	5	0.9
Animals††	1	0.3	3	1.9	4	0.7
Benzalkonium chloride	0	0.0	4	2.6	4	0.7
Dusts, unspecified	0	0.0	4	2.6	4	0.7
Grain dust	4	1.0	0	0.0	4	0.7
Irritants, unspecified	0	0.0	4	2.6	4	0.7
Printing inks	4	1.0	0	0.0	4	0.7
Rose hips	4	1.0	0	0.0	4	0.7
Sodium hydroxide	4	1.0	0	0.0	4	0.7
Soldering agents/fumes§§	2	0.5	2	1.3	4	0.7
Ammonia	2	0.5	1	0.6	3	0.6
Enzymes	2	0.5	1	0.6	3	0.6
Latex/rubber	1	0.3	2	1.3	3	0.6
Mold	0	0.0	3	1.9	3	0.6
Sulfite	1	0.3	2	1.3	3	0.6
Cotton dust	0	0.0	2	1.3	2	0.4
Fibrous glass	0	0.0	2	1.3	2	0.4
Fluorocarbons¶¶	1	0.3	1	0.6	2	0.4
Furfural	0	0.0	2	1.3	2	0.4
Platinum salts	0	0.0	2	1.3	2	0.4
Sodium hypochlorite	0	0.0	2	1.3	2	0.4
Other agents***	5	1.3	19	12.3	24	4.5
Unidentified agents†††	100	26.2	9	5.8	109	20.4
<b>Total</b>	<b>381</b>	<b>100.0</b>	<b>154</b>	<b>100.0</b>	<b>535</b>	<b>100.0</b>

\* Such as hexamethylene diisocyanate, toluene diisocyanate, and methylbisphenyl isocyanate.

† Such as oils used in drilling and grinding operations.

§ Such as formaldehyde and glutaraldehyde.

¶ Such as malathion and pyrethrins.

\*\* Such as ethylenediamine and monoethanolamine.

†† Such as rats, mice, and bloodworms.

§§ Such as colophony.

¶¶ Such as chlorofluorocarbons and brominated fluorocarbons.

\*\*\* Includes one reported occurrence of each of the following agents: acetone, ammonium chloride, cigarette smoke, degreaser, ethanol, ethylene oxide, green coffee bean dust, gum arabic, hydrogen bromide, methylethyl ketone, morphine, ninhydrin, penicillin, perlite, persulfate, plastic fumes, radiographic developer, sodium benzoate, solvent unspecified, theatrical fog, toluene, trichloroethylene, vinyl acetate, and xylene.

††† Includes unidentified agents associated with cases reported in Michigan in the following industries/processes/settings: 64 manufacturing industry, 24 office-related, three pickle industry, two meat wrappers, two gas and oil refining, two construction industry, two cosmetology, and one photographic processing laboratory.

NJDOH also conducted repeat industrial hygiene evaluations at 14 previously inspected workplaces. The findings of these follow-up investigations generally indicated a high degree of compliance with recommendations made at earlier visits. Ten (71.4%) of the reinspected workplaces had attempted to improve the control of exposures to agents known to cause asthma, even though air sampling conducted at the initial inspection had indicated exposures lower than the enforceable PELs. Five (35.7%) workplaces had improved their worker training/hazard communication programs. Although compliance with recommendations to install new local exhaust ventilation systems was low (only one workplace out of six), most likely because of the high initial cost of such systems, six (42.8%) of the workplaces had taken actions to improve existing local exhaust ventilation systems. One common method for dealing with OA involved secondary prevention through administrative controls (e.g., affected workers were physically removed from exposure to the offending agent by reassignment and/or relocation).

## DISCUSSION

OA is a disease characterized by variable airflow limitation and/or airway hyperresponsiveness resulting from an occupational exposure (7). OA may develop and become clinically evident in three general ways: 1) after a variable period of symptomless exposure to a sensitizing agent; 2) immediately following a single intense exposure to a known irritant—as in the case of RADS, the clinical signs and symptoms of which are identical to those of asthma; and 3) after a variable period of repeated exposures to lower doses of irritants. Studies of the natural history of OA indicate that, although many affected workers show clinical improvement when they are removed from the causative agent, most may continue to have episodes of asthma even after they are no longer exposed to the etiologic agent. Persistence of asthma appears to be related to the duration of continued occupational exposure following onset of the disease—which underscores the importance of controlling workplace exposures, seeking prompt diagnosis if asthma symptoms develop, and implementing preventive measures after a worker develops symptoms suggestive of asthma (8). Overall, more than 15% of asthma among adults may be attributable to workplace exposures (9,10); among certain worker groups, this proportion may be much higher. Thus, the occurrence of a case of OA is a sentinel health event indicating the need for public health intervention.

Hundreds of substances have been associated with OA, including isocyanates, anhydrides, epoxy resins, and certain animal proteins and plant products (11,12). Occupational exposure to many of these sensitizing agents is not specifically regulated by the Occupational Safety and Health Administration (OSHA). For those agents that do have mandated exposure limits (e.g., isocyanates), the limits are based on the irritant or other toxic properties of the chemical and are often not low enough to preclude sensitization of exposed workers or to prevent asthmatic reactions in workers who have already become sensitized. In addition, routine intermittent exposure monitoring—used to monitor compliance—is more likely to detect usual or typical concentrations of workplace agents than to measure occasional peak concentrations, which can result from spills or other unplanned exposures associated with activities such as maintenance and cleaning. Unplanned peak exposures are particularly likely to elicit severe asthmatic reactions in previously sensitized workers.

Although the SENSOR system was not designed to be a comprehensive surveillance system that would ascertain all cases of occupational asthma, SENSOR surveillance for OA has led to the identification of previously unrecognized causes of OA (13,14). Other notable results regarding state-based OA surveillance have been described (5,15–17). SENSOR surveillance for OA has played a critical role in setting priorities for public health actions, and findings have documented the need for more comprehensive control of such well-known occupational allergens as the isocyanates.

The use of OA surveillance data to target workplace inspections has proved beneficial. Industrial hygiene follow-up of workplaces where OA cases have occurred has identified substantial numbers of symptomatic coworkers and inadequacies in engineering controls and work practices. These findings have led to preventive measures by OSHA, health departments, and employers, even when documented worker exposures do not exceed a legally enforceable PEL.

Further development and refinement of this OA surveillance and intervention model are being supported by the second cycle of SENSOR cooperative agreements, which, since 1993, has funded OA projects in four states (California, Massachusetts, Michigan, and New Jersey). The goal of these projects is the development of a feasible, generalizable OA surveillance system appropriate for adoption by all interested state and territorial health departments.

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**Surveillance for Smoking-Attributable  
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