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Mary Jo Reilly & Kenneth D. Rosenman M.D.

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Use of Hospital Discharge Data for Surveillance of Chemical-Related Respiratory Disease

MARY JO REILLY
Michigan State University
East Lansing, Michigan
KENNETH D. ROSENMAN
Michigan State University
East Lansing, Michigan

ABSTRACT. Hospital discharge data can be useful in the identification of the more severe cases of both work- and nonwork-related chemical-related respiratory disease. The medical records of 329 patients hospitalized in Michigan in 1989 and 1990 for respiratory conditions resulting from chemical fumes and vapors (International Classification of Diseases diagnostic code 506) were reviewed to determine the location and etiology of the exposures. One-third of the discharges were work related. The most common exposures at work were to chlorine and sulfur dioxide and to industrial cleaning agents. Exposure to smoke from house fires and exposure to household cleaners were the most frequent causes of the nonwork-related discharges. Follow-up inspections at the work facilities where the hospitalized patients with work-related disease had become ill revealed that 61 of 261 (23.4%) fellow workers interviewed had new adult-onset asthma or were bothered at work by daily or weekly symptoms of shortness of breath, wheezing, or chest tightness. Nine of the 23 facilities inspected were cited for violating Occupational Safety and Health Administration standards.

HOSPITAL discharge data can be used to identify chemical-related respiratory disease associated with exposures at both work and home.[1,2] The International Classification of Diseases (ICD) diagnostic code 506 includes respiratory conditions resulting from chemical fumes and vapors.[3] As part of a surveillance system for occupational diseases, including occupational asthma, the Michigan Department of Public Health requires all acute care Michigan hospitals to report patients with a primary or secondary diagnosis of ICD code 506.0-9. This paper presents the results of a review of the work relatedness of discharges from Michigan hospitals for the ICD 506 code series for the years 1989 and 1990.

Method and materials

Under Part 56 of P.A. 368 of 1978 of the Michigan Public Health Act, hospitals are required, by law, to report any known or suspected cases of occupational diseases or workplace-aggravated health conditions to the Michigan Department of Public Health. Acute care hospitals receive letters each year that remind staff to report any individual discharged with a primary or secondary diagnosis of specified occupational disease, including the ICD 506 code series. At that time, the hospital is requested to submit the admission face sheet and the discharge summary. In 1989, there were 179 acute care hospitals in Michigan, and in 1990 there were 176 acute care hospitals.

The ICD 506 code series has the following subgroups: 506.0, bronchitis and pneumonitis resulting from fumes and vapors; 506.1, acute pulmonary edema resulting from fumes and vapors; 506.2, upper respiratory inflammation resulting from fumes and vapors; 506.3, other acute and subacute respiratory conditions resulting from fumes and vapors; 506.4, chronic respi-

ratory conditions resulting from fumes and vapors; and 506.9, unspecified respiratory conditions resulting from fumes and vapors.

Complete case reporting is validated by comparing the medical records obtained from the initial hospital request to a computerized list of yearly hospital discharges from the Michigan Hospital Association (MHA) Service Corporation's Michigan Inpatient Database. The MHA list provides medical record number, hospital, age, race, gender, date of admission, date of discharge, primary discharge, diagnosis, and up to six secondary discharge diagnoses. It does not provide information on the exposure or location where the exposure occurred. If a face sheet and discharge summary has not been received for a hospital discharge listed in the MHA Inpatient Database, the hospital is contacted and asked to submit the information on the missing patient.

Face sheets and hospital discharge summaries are reviewed by a physician who is board certified in internal medicine and in occupational medicine to identify the exposure and determine the work-relatedness of the patient's condition. Upon review of the medical charts, those patients who are suspected to have occupational asthma are interviewed. The interviewer uses a standardized questionnaire that addresses respiratory symptoms, history of respiratory disease, the workplace at which the patient became sick, and a lifetime work history. The interviewers are medical students trained in proper interviewing techniques.

If, based on physician review of the interview, occupational asthma is still suspected, an industrial hygiene inspection is conducted at the patient's work site. The work site inspections are conducted by industrial hygienists from the Michigan Occupational Safety and Health Administration (MIOSHA). During a typical inspection, air monitoring for suspected allergens is conducted, coworkers who have exposures similar to those of the index patient are administered a standardized medical questionnaire, and the facility's compliance with MIOSHA regulations is assessed.

Results

There were 337 hospital discharges—177 in 1989 and 160 in 1990—with a primary or secondary discharge diagnosis with the ICD 506 diagnostic code. Patients were reported from 115 of the acute care hospitals in Michigan. The other hospitals indicated that they had no patients with the ICD-506 diagnostic code. A total of 34 discharges were not included in the analyses: 8 were discharged twice for the same exposure and were counted only once in the analyses; 9 were considered to be miscoded, based upon review of their medical charts; and 17 patients had pneumonitis resulting from aspiration of gastric contents, which would be classified more accurately as ICD-9 507.0.

Demographic and diagnostic information was available for all patients. Medical records were available for 268 (88.5%) of the 303 patients used in the analyses. Of the 11.5% for whom no medical records were available for review (n = 35), 24 were age 12 or younger and were assumed to have a non-workplace exposure. Some information was available from the MHA database for these 35 patients; the type of exposure was identified for 25 of these 35 patients through review of the secondary diagnoses, particularly when an E code was listed.

In Table 1 is shown the distribution of four-digit ICD 506 codes, by location of exposure. Two-thirds of the patients had non-workplace exposures. Medical records for five patients (ages, 18-36 y; three females) did not contain reference to the location of exposure. Four patients (age, 42-54 y; three males) for whom medical records were unavailable had no indication of their exposure location in any of the secondary diagnoses. The 506.0 and 506.3 codes were most commonly reported for both the workplace and non-workplace exposures. The 506 codes were used slightly more often as a primary diagnosis for the work-related exposures, compared with the nonwork exposures, i.e., 62% of the work-related exposures had a 506 code as the primary diagnosis and 53% of the nonwork exposures had a 506 code as the primary discharge diagnosis.

In Table 2 is listed the etiology of the workplace exposures. Chlorine gas and sulfur dioxide were the most common etiologic agents in the work-related group (n = 14 [13.6%]). Exposures from the mixing of two or more industrial cleaning agents accounted for 10 patients (9.7%); an additional 6 patients (5.8%) were exposed to a single industrial cleaning agent. Farm-work-related exposures to grain dusts, molds, and various chemicals used in farming accounted for 12 (11.7%) of the work-related patient hospitalizations.

Table 1.—Location of Exposures Associated with Respiratory Conditions Resulting from Chemical Fumes and Vapors for Patients Discharged from Acute Care Hospitals in Michigan for the Years 1989 and 1990

	Work exposure (%)		Nonwork exposure (%)	
ICD code*	No.	%	No.	%
506.0	60	32.1	127	67.9
506.1	1	8.3	11	91.7
506.2	2	50.0	2	50.0
506.3	25	41.7	35	58.3
506.4	7	36.8	23	63.2
506.9	8	66.7	4	33.3
Total	103	35.0	191	65.0

*When more than one code in the International Classification of Diseases (ICD) 506 series was reported, the first one listed was used.
†A total of 9 patients had unknown exposure locations. The medical records did not indicate the location of the exposure for 5 patients. Medical records were not available for 4 patients, and no exposure location information was indicated in any of the secondary diagnoses (for 2 of the patients, the hospital was closed; for the other 2, the hospital was unable to locate the medical records, based on the MHA information we were able to supply to the hospital).
‡Twenty-four patients for whom no medical records were available were classified as "nonwork exposures" because the patients were 12 y or younger, and 1 patient was 70 y of age.

Table 2.—Etiology of Workplace Exposures

Exposure	No. exposures	Percentage
Miscellaneous industrial chemical fumes (includes paint fumes, welding fumes plastic fumes, unspecified toxic fumes)	23	22.3
Chlorine and sulfur dioxide	14	13.6
Farm exposures (includes grain dusts, mold spores in silo, tractor fumes, chemical fertilizers)	12	11.7
Known allergens (includes isocyanates, polyurethane, epoxies)	10	9.7
Mixing of two or more industrial cleaning products	10	9.7
Solvents (includes acetone, monobutyl ether, trichloroethylene)	9	8.7
Industrial cleaning products	6	5.8
Irritants (includes tear gas, mustard gas)	6	5.8
Industrial fires	5	4.9
Oil mist and coolants	2	1.9
Metal fumes	2	1.9
Acids	1	1.0
Mineral dusts	1	1.0
Organic allergens	1	1.0
Unknown (none listed in medical records)	1	1.0
Total	103	100.0

Table 3.—Etiology of Nonworkplace Exposures

Exposure	No. exposures	Percentage
Fires (includes house fires, car fires, unspecified	46	26.9
Ingestion and aspiration (includes lamp oil, kerosene, lighter fluid, and gasoline)	31	18.1
Mixing of two or more household products	22	12.9
Household cleaning products	19	11.1
Miscellaneous fumes (includes paint, unspecified chemicals, freon, welding)	13	7.6
Chlorine	7	4.1
Solvents (includes paint thinner, hydrocarbons)	7	4.1
Drug abuse	7	4.1
Known allergens (includes epoxies, polyurethane, animal dander)	5	2.9
Metal fumes	4	2.3
Malfunctioning furnace	4	2.3
Fuels (includes gasoline, lighter fluids)	3	1.8
Pesticides	2	1.2
Irritants (calcium chloride)	1	0.6
Unknown*	20	
Total	191	100.0

*There were no medical records available for review for 7 patients (6 ≤ 12 y, 1 age 70 y), and no secondary diagnoses described the exposure. No exposure was indicated in the medical records for 13 patients.

In Table 3 is described the etiology of the nonwork exposures. Smoke inhalation, primarily from house fires, constituted the highest percentage of patients (26.9%) in the nonwork group. Exposures to household cleaning products, either from fumes from a single cleaning agent or from the improper mixing of two or more products, accounted for 41 (24%) of the nonwork patient hospitalizations. Ingestion and aspiration of petroleum products, including lamp oil, kerosene, and lighter fluid, accounted for 31 (18.1%) of the nonwork hospitalizations; 30 of the 31 patients were under the age of 3 y, and 1 patient was 23 y old.

The demographic characteristics of patients, by location of exposure, are presented in Table 4. There were more males in both the work and nonwork groups (76% of the work group and 60% of the nonwork group were males). The majority of patients were white. The mean age in both groups was similar, with the work-related group averaging 39 y and the nonwork-related group averaging 38 y. Five children (1 aged 14 y and 4 aged 16 y) were among those exposed in the workplace. Three of the 5 children were exposed to cleaning agents at work; 2 of those 3 were hospitalized after mixing cleaners. Of the 2 remaining children, 1 had a farm-related exposure and the other was exposed to chlorine gas.

Also presented in Table 4 is smoking status, by location of exposure. There were more current smokers among the work-related patients, i.e., 48%, compared with 26% of the nonwork patients. However, more than 30% of the work group and almost 42% of the nonwork group did not mention smoking status on their admission face sheet or discharge summary.

Table 4.—Demographic Characteristics of Patients, by Location of Exposure

	Work exposure (%)		Nonwork exposure (%)	
	No.	%	No.	%
Male	78	75.7	115	60.2
Female	25	24.3	76	39.8
Race				
Black	13	13.8	40	22.3
White	81	86.2	138	77.1
Other	0		1	0.6
Unknown	9		12	
Age (y)				
< 6	0	0	39	20.4
6–12	0	0	9	4.7
13–16	5	4.9	7	3.7
17–39	57	55.3	46	24.1
40–65	35	34.0	48	25.1
66+	6	5.8	42	22.0
Average (± *SD*)	38.9	(±15.8)	37.9	(±27.1)
Range	14–92	0–96		
Smoking status				
Current	34	47.9	29	26.1
Exsmoker	16	22.5	11	9.9
Nonsmoker	21	29.6	71	64.0
Unknown	32		80	

Seventy-six patients from the work-related exposure group were interviewed, using a standardized questionnaire. Medical records and interviews revealed 37 patients as having occupational asthma, including 9 cases of Reactive Airways Dysfunction Syndrome (RADS), and 4 cases of pre-existing asthma aggravated by a workplace exposure. Follow-up MIOSHA inspections at 23 of the patients' workplaces were conducted. Air monitoring for the suspected allergen was conducted in 13 of the workplaces; 3 facilities had exposures above the National Institute for Occupational Safety and Health (NIOSH) recommended levels, and 2 of those facilities had exposures that exceeded the enforceable Michigan OSHA permissible exposure levels (Table 5). In addition to citations being issued to 2 plants for violations of the air standards, another 7 plants received citations for violations of other OSHA standards, including noise and hazard communication standards.

Coworkers were administered a standardized health questionnaire at 14 of the facilities inspected. Twenty-three percent of the 261 coworkers interviewed reported either new-onset asthma subsequent to beginning work at the facility or symptoms consistent with occupational asthma. The OSHA Injury and Illness Log was also reviewed at all 23 facilities. Sixty-eight individuals in 4 of the plants were reported on the OSHA Log as having occupational asthma (Table 6).

Discussion

Kipen et al.[1] reported that the ICD 506 code was a useful discharge diagnosis with which to identify occupational disease. In New Jersey, 39% of the patients with a discharge diagnosis that included the ICD 506 code were secondary to occupational exposures, although they were only able to obtain information from 76% of the hospitals for 506 code discharges for 1985 and 1986. The Michigan experience is similar, with 35% of hospitalizations secondary to exposures in the workplace. Our percentages are based on almost complete reporting by hospitals (99.4%). Whereas the majority of the discharges in the ICD 506 code series were related to non-workplace exposures (65%), the series is useful to identify cases of workplace disease, especially for the codes 506.0 and 506.3.

We have used the 506 ICD codes as part of our surveillance system for work-related asthma because occupational asthma has no distinct ICD code. Based on review of the hospital discharge summaries, interviews were conducted with 76 patients who had workplace exposures and who were suspected of having asthma. After review of the interviews and medical records, 37 of the 76 (49%) patients met the NIOSH case criteria for occupational asthma.[4] The identification of an index patient through hospital discharge data can lead to the identification of a work site where other workers are ill or at risk of becoming ill. The MIOSHA inspectors at the workplaces where the exposures occurred found high percentages of symptomatic individuals (Table 6) and resulted in citations in 9 of 23 (39%) facilities (Table 5). Corrective action can be taken at the workplace after an investigation is conducted. Similar success in identifying workplace hazards has been reported through the follow-up of hospital discharge data for patients with silicosis.[5]

Hospital discharge data can also be a useful intervention tool for public health efforts directed toward non-workplace exposures. A large percentage (24%) of the non-workplace exposures involved household cleaning agents. Almost 13% of the nonwork hospitalizations resulted from the improper mixing of household chemicals (most often cleaning products containing ammonia and bleach) and another 11% resulted from the use of a single cleaning agent.

The discharge system also proved to be useful in identifying problems that occurred in children. Eighteen percent of patients in the nonwork group were infants who swallowed kerosene, lamp oil, or lighter fluid. Five children (1 age 14 y, 4 age 16 y) were exposed at work;

Table 5.—Results of 23 Michigan OSHA Inspections* for Patients with Workplace Exposures

Air sampling	Number	Percentage
NIOSH standard		
Above NIOSH standard	3	13.0
Below NIOSH standard	10	43.5
Did not sample	10	43.5
MIOSHA standard		
Above MIOSHA standard	2	8.7
Below MIOSHA standard	11	47.8
Did not sample	10	43.5

Notes: Citations were issued to 9 of the 23 facilities for violations of MIOSHA standards. In addition to the two citations for violations of the air standard, other types of citations included violations of the noise, hazard communication, and respirator standards.
*Industrial hygiene inspections are only conducted if the patient has occupational asthma. Currently, 7 inspections are planned., Five facilities were closed. No follow up is planned for 40 facilities.

Table 6.—Symptoms Consistent with Occupational Asthma among Fellow Workers of Patients with Workplace Exposures

	No. people	No. plants	Percentage
New onset asthma or daily or weekly shortness of breath, wheezing or chest tightness	61	9	64.3*
OSHA Log	68	4	17.4†

*Denominator used was the 14 facilities where interviews with fellow-workers were conducted. A total of 261 fellow workes were interviewed in the 14 plants (23.4% reported respiratory symptoms).
†Denominator used was the 23 facilities where the OSHA Log was reviewed.

2 mixed cleaning agents and 1 was exposed to a single cleaner. Of the remaining 2 children, 1 had a farm-related exposure and 1 was exposed to chlorine.

Hospital discharge data are readily available in the majority of states. It is a relatively inexpensive source of data that can be used in a state and/or national surveillance system.[6] It is useful for identifying the more severe dust- and chemical-related respiratory conditions that occur at both work and at home. The information on work exposures can be useful in directing workplace industrial hygiene inspections. The information could also be useful in directing community education and intervention efforts, as well as for guiding regulatory action by the Consumer Product Safety Commission.

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Requests for reprints should be sent to: Kenneth D. Rosenman, M.D., Michigan State University, 117 West Fee Hall, East Lansing, MI 48824-1316.

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