Work-Related Asthma in the Spray-On Truck Bed Lining Industry

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Objective: *The objective of this study was to identify work-related asthma (WRA) workers' compensation claims associated with methylene diphenyl diisocyanate (MDI) exposure in the spray-on truck bed lining industry and estimate the asthma incidence rate in this industry.* ***Methods:*** *The authors conducted a descriptive study of workers' compensation claims meeting an established surveillance case definition for WRA.* ***Results:*** *Eight WRA workers' compensation claims were identified in the truck bed lining industry in Washington State for a claims incidence rate of 200 per 10,000 full-time equivalent. The medical evaluation of the cases was inadequate because none of the truck bed lining cases had medical testing to objectively link their asthma to the workplace.* ***Conclusions:*** *The rate of work-related asthma in the truck bed lining industry is excessive and suggests a need for significant intervention, including improvements in the clinical assessment provided to MDI-exposed workers.* (J Occup Environ Med. *2005;47:514–517*)

Diisocyanates are a leading cause of occupational asthma in the industrialized world. Reductions in the incidence of diisocyanate-induced occupational asthma have been attributed to the establishment of medical surveillance programs, increased physician and worker awareness of diisocyanate asthma, and workplace exposure reduction.[1] Increased knowledge of industries and occupations with high rates of work-related asthma will help focus intervention resources.

Occupational exposure to a common diisocyanate, methylene diphenyl diisocyanate (MDI), was recently characterized for workers applying spray-on truck bed liners.[2] The authors found worker overexposure to MDI exceeding state and federal regulatory limits in eight of the 13 worksites inspected. The 13 worksites inspected as a group had an average of less than six workers each and most had started spraying within the previous 4 years, indicating an emerging, small-employer industry. This report of worker overexposure to MDI, above federal and state regulatory limits, and a worker fatality in Michigan,[3] have prompted increased attention to the spray-on truck bed lining industry. The industry has been targeted for inspections by the state Occupational Safety and Health Administration (OSHA) programs in Washington and Minnesota (Doug Poeschl, personal communication, June 28, 2004) and by Federal OSHA Region VIII (Michael England, personal communication, June 24, 2004).

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We report on eight claims of work-related asthma identified from a more comprehensive review of industrial insurance records of truck bed lining employers. A claims' incidence rate for spray-on truck bed lining employers is compared with the automotive repair, services, and parking industry (Standard Industrial Classification code 75). We report on the poor clinical evaluation by healthcare providers of workers with suspected work-related asthma.

Description of the Spray-on Truck Bed Lining Process

The general process for applying spray-on truck bed linings begins with prepping the truck bed by scuffing it with an orbital sander, removal of dusts with compressed air, and subsequent cleaning of the truck bed with a volatile solvent to remove grease, oil, and water.

Specialized equipment and a handheld spray gun are then used to mix the two-part urethane components and spray the polymerizing chemicals onto the prepared truck bed. Different franchises and independent dealers have different products with slightly different appearances, textures, hardness/softness, and friction levels. In all cases, the "part A" component contains a mixture of MDI monomer and polymeric MDI–PMDI. The "part B" component varies depending on whether a polyuria or polyurethane coating is being applied. Polyuria coatings use amines as the "part B" component, whereas polyurethane coatings use polyols and/or glycols.

The spray applicator usually works alone applying the mixture in an enclosure at least large enough to contain the bed of a truck. The actual spraying typically takes 15 minutes for a standard sized pickup truck bed and tailgate; 40 to 50 pounds of urethane are applied. The coating can be applied in thicknesses from one sixteenth of an inch up to an inch for special applications. Depending on the product and process used the lining gels or hardens in 3 to 30 seconds. Complete curing can take up to 24 hours.

Materials and Methods

The Washington State Department of Labor and Industries (L&I) is the exclusive provider of workers' compensation insurance to all nonfederal employers in Washington State, except those who are self-insured (approximately the largest 400 employers) or are self-employed. L&I's databases contain medical records for claim adjudication, claim costs, and employer account information. Each workers' compensation claim is coded according to the American National Standards Institute (ANSI) Z 16.2 coding system describing the type, body part, source, and nature of the injury or illness.[4]

The names of known spray-on truck bed liner franchisers or manufacturers of spray-on polyurethane coatings were matched to account business names within the L&I administrative databases. Accounts identified with Standard Industrial Classification Major group 75—"Automotive Repair, Services and Parking" were identified as a comparison group for claims' incidence rate. Claim medical records, account information, and employee hours were extracted from the databases for all active and inactive truck bed liner accounts and SIC code 75 accounts through December 2002. The first identified hours for employment in the selected truck bed lining group in Washington State were found in 1993 and data for SIC code 75 accounts was restricted to January 1993 through December 31, 2002, for comparison purposes.

Claims were reviewed for work-related asthma if either the injured body part was coded as the "respiratory system" (ANSI Z16.2 BP code = 850) or if both of the following criteria were met: the injured body part was coded as "multiple body systems" (ANSI Z16.2 BP code = 850) and the injury type was "inhalation of toxics" (ANSI Z16.2 type code = 181). Two physicians (D.B., A.S.) independently reviewed claim medical records within the truck bed lining accounts to determine if the claim met the following accepted epidemiologic surveillance case definition for work-related asthma: 1) a physician's diagnosis consistent with asthma; and 2) an association of symptoms (cough, wheeze, and/or shortness of breath) to the work environment.[5] Diisocyanates were required to be associated with claims in the truck bed lining industry. SIC code 75 claims were reviewed by one physician (D.B.) to determine acceptance of this epidemiologic surveillance case definition for work-related asthma.

In Washington State, employer premiums for workers' compensation insurance are based on quarterly reporting of work hours of employees. Employee work hours for truck bed liner accounts were summed and a full-time equivalent (FTE) was 2000 hours per year. A similar procedure for work hours in SIC code 75 accounts was performed. Known truck bed lining accounts were excluded from the SIC code 75 analysis.

Results

Forty-seven truck bed liner accounts were identified with 801,095 reported hours or 400.5 FTEs. Twelve claims were reviewed for work-related asthma and eight claims met the criteria for the case definition (Table 1), for a claims' incidence rate of 200 per 10,000 FTE. All claimants were male. The average age was 26.5 years old. Five claims had no preexisting asthma; two did not document a history of asthma and one reported a history of asthma. Spirometry or pulmonary function testing was performed in all claims except D and F. In one claim in which spirometry data was abnormal (claim G), a 33% increase in forced expiratory volume in 1 second (FEV_1) after an inhaled bronchodilator occurred. Claims C, E, G, and H had testing for nonspecific bronchial hyperresponsiveness (NSBH) to metha-

TABLE 1
Case Characteristics for Work-Related Asthma Resulting From Diisocyanate Exposure in the Spray-on Truck Bed Lining Industry

Claim	Age (yr)	Symptoms*	Smoking Status	Asthma History	Duration of Employment Until Symptoms	NSBH (PC20)	Total Cost†	Time Loss Days†
A	20	C, S	Current	N	NA	NA	$1250	0
B	32	C, S	NA	NA	6 yr	NA	$183	0
C	36	C, S, W	Current	Y	3 wk	25 mg/mL	$102,053	1193
D	29	S, W	Former	NA	8 mo	NA	$185	0
E	18	S, W	Former	N	2 yr	25 mg/mL	$25,162	58
F	25	S, W	NA	N	3 mo	NA	$391	0
G	22	S, W	Never	N	18 mo	5 mg/mL	$78,618	419
H	30	C, S, W	Never	N	4 mo	10 mg/mL	$31,576	391

* Symptoms temporally associated with workplace exposure: C, cough; W, wheeze; S, shortness of breath.
†Time loss data and total cost data as of February 2004. Total costs represent actual costs plus actuarially estimated future costs.
NA, not available.

choline. Only claim G had a PC20 at a level below 8 mg/mL, an accepted cutoff point for the diagnosis of asthma.[6] Claims C and E were tested 6 months after cessation of MDI exposure; claim H was tested 3 months after last exposure and had a 17% reduction in FEV_1 at 2.5 mg/mL and a 41% decline at 10 mg/mL. Claim G had NSBH while still exposed to MDI. None of the claims had testing to associate the asthma to the workplace through serial peak expiratory flow monitoring, serial nonspecific inhalational challenge, or specific inhalational challenge to MDI. Four claims (C, E, G, and H) had permanent partial disability awards. Claim costs ranged from $183 to $102,053 and time lost from work was 0 to 1193 days.

In SIC code 75, from 1993 through December 2002, 113 claims were reviewed for work-related asthma and 27 claims met the epidemiologic case definition for work-related asthma. For the 8625 accounts during the time period of analysis, 422,489,557 hours or 211,245 FTEs were reported. The claims incidence rate for work-related asthma was 1.7 claims per 10,000 FTE.

Discussion

We report a population-based estimate from workers' compensation data of work-related asthma incidence in an industry with overexposure to diisocyanates.[2] State-based work-related asthma surveillance systems with case definitions consistent with this study report rates by occupation up to 6.3 per 10,000 employed workers[7] and industry rates up to 1.7 per 10,000 employed workers.[8] The work-related asthma claims' rate in truck bed liner workers is 200 per 10,000 FTE and the rate for new-onset asthma is 125 per 10,000 FTE. Using SIC code 75 as a comparison industry, yields a work-related asthma claims' rate of 1.7 per 10,000 FTE.

The use of MDI in truck bed lining applications is relatively new. Industry and employer awareness of the sensitizing properties of MDI may be low. Primary efforts directed toward employer education and controlling MDI exposures through industrial hygiene methods, once initiated, likely will reduce asthma claims incidence rates. In workers with occupational asthma, early diagnosis and removal from exposure is considered an important determinant of prognosis.[9] Workers who become sensitized and continue to spray MDI may experience permanent lung disease or death.[9] Increased awareness by physicians of MDI use in this industry and the potential implementation of medical surveillance programs for diisocyanate-exposed workers may be necessary to reduce rates and promote earlier recognition of asthma in exposed workers.[1]

The U.S. medical standard of care regarding the clinical evaluation of work-related asthma is poor.[7] None of the cases in this study had testing to objectively demonstrate variability of airflow limitation in relationship to workplace exposures. Although specific bronchoprovocation challenge is of limited availability in the United States and Canada,[10] tests of serial NSBH and serial peak flow monitoring are well-documented approaches to demonstrating the work-relatedness of asthma.[6] Only one claim had NSBH testing while still at work, but a follow-up NSBH to demonstrate decreased hyperresponsiveness after cessation of exposure was not performed. Testing for NSBH after cessation of exposure, without a test of NSBH while still working, like in claims C, E, and H, limits the diagnostic use of the test. Improved clinical evaluation of workers with new-onset asthma symptoms through use of objective testing to document asthma and its relationship to work is an essential improvement physicians can make in providing appropriate care and medical advice for workers. Avoidance of significant medical costs and unnecessary medical removal from the workplace are possible benefits to the worker and employer of improved clinical assessment.

Potential limitations of this study are the underreporting of work-related illnesses to the workers' compensation system, the underrecognition of occupational disease in the medical community, and the inconsistency of medical information across claimants available within the workers' compensation claims system. These limitations likely lead to an underestimation of the rate of work-related asthma in this industry. The self-employed workers in this industry are not captured in the Washington State workers' compensation database. Independent or nonfranchise bed liner operations were not included in this study. The case definition likely leads to an overestimation of work-related asthma incidence when compared with case definitions requiring the presence of objective testing to document asthma and its work-relatedness.

The absence of specific bronchoprovocation testing to MDI in each of the cases does not allow confirmation that MDI is the causative exposure for the physician-diagnosed asthma. Other exposures such as dusts from sanding operations and volatile organic solvents (eg, methyl ethyl ketone, acetone, methanol, toluene) may lead to respiratory complaints.[11] However, it is reasonable to conclude that MDI is the likely causal exposure for asthma in these cases given that MDI is a well-documented respiratory sensitizer[12]; there are known significant MDI exposures within this industry,[2] and in all eight claims, either the worker or the healthcare provider temporally implicates isocyanate exposure to the development of asthma symptoms.

The high claims rate for work-related asthma in the truck bed lining industry relative to its comparison industry and the documented overexposures in this industry suggests the need for prevention efforts directed toward limiting MDI exposures in the truck bed lining industry. Improved recognition by physicians of the risks of work-related asthma in this industry may lead to earlier recognition and treatment of disease. Furthermore, improved clinical assessment of workers will benefit the diagnostic accuracy of a work-related asthma diagnosis.

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