

Work-Related Asthma Mortality, Michigan 2003-2023

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Clinical Significance

Mortality from work-related asthma is rare but preventable. Guidelines recommend that clinicians assess the possibility that work is a causal or an aggravating factor in all adults with asthma. Prompt removal from exposures that trigger asthma symptoms is indicated to prevent death and reduce morbidity and the need for medication.

Abstract

Objective: To identify causes and factors associated with work-related asthma.

Methods: There were 13 work-related asthma (WRA) deaths identified over 21 years in state-wide lung disease surveillance system.

Results: The deceased ranged from 19 to 77. Eight had new-onset, and five had aggravated WRA. Five deaths from exposure to isocyanates, two to welding fumes, two to food products, and one death each from exposure to secondhand cigarette smoke, milk tank cleaning agents, chemicals used in construction, and molding machine release spray.

Conclusions: Even when health care practioners note that work is a trigger of a patient's asthma, there is typically a delay in the recognition and action to address the workplace exposure(s). A WRA death is the ultimate consequence of a practioner's delay in not addressing work exposure(s) as an asthma trigger.

Key Words: work-related asthma, mortality,

Learning Outcomes

- All adults with asthma should be assessed whether there are workplace causes or triggers of their asthma.
- Prompt removal from exposures that cause or aggravate asthma symptoms is indicated to prevent asthma mortality.

ACCEPTED

Introduction

Despite the prevalence of asthma in the United States, only a small percentage, 0.017% of individuals with asthma, die from asthma each year¹. The rate of death from asthma is higher with increasing age, among women and among Blacks¹. The asthma mortality data for Michigan is very similar to the national data². In 2020, among the estimated 860,000 individuals with asthma in Michigan, there were 132 deaths from asthma (0.015%)². Despite the small number of deaths from asthma, these deaths are preventable tragedies, given the effective treatment available for asthma.

There is a 2002 review of 11 work-related asthma deaths reported in the world medical literature³. In this new manuscript, we summarize the work-related asthma deaths identified in Michigan from 2003 through 2023.

Methods

Case Identification

Since 1988, Michigan has had a multisource surveillance system funded by the National Institute for Occupational Safety and Health (NIOSH) for the identification of work-related asthma. Components of this system are reports from healthcare providers, hospital discharge records, workers' compensation (WC) claims, ambulance runs, the State's poison center (PC), and death certificates. For deaths, the major source of asthma deaths at work is the requirement that employers report any suspected work-related death to the state within eight hours of the death (MIOSHA-STD-1501, Part 11, R 408.22139, Rule 1139). The legal authority to identify and collect information on work-related asthma cases is the Michigan Public Health Code (Article

368, Part 56, P.A. 1978, as amended), which requires healthcare providers, hospitals, clinics, and employers to report known or suspected cases of occupational diseases to the state.

Case Definition

After a case report is received, records are reviewed to determine if a case meets agreed upon surveillance criteria⁴: 1) physician diagnosis of asthma, and 2) onset of respiratory symptoms associated with a job that resolved or improved away from work, plus any one of the following: (a) Workplace exposure to an agent or process previously associated with occupational asthma or (b) Significant work-related changes in forced expiratory volume in one second (FEV 1) or peak expiratory flow (PEFR) or (3) Significant work-related changes in airways responsiveness as measured by nonspecific inhalation challenge or (4) Positive response to inhalation provocation testing⁴.

Case Confirmation

To supplement medical records, an attempt is made with a letter and follow up phone calls to administer a standardized telephone questionnaire to the next-of-kin listed on the death certificate. Information on the questionnaire included: sex; race; ethnicity; age; cigarette use (current, ever, or never smoked [five or more packs of cigarettes or 12 ounces of tobacco in a lifetime was used to define ever smoked]); WC status; prior asthma and allergies; family allergies; history of: respiratory symptom development and persistence, asthma medication, and medical treatment for asthma; and lifetime work and exposure history (exposure to agents associated with asthma, exposure to spills or leaks).

The XXX [Anonymized by request from JOEM] Human Research Protection Program approved this investigation with waiver of informed consent.

Results

From 2003 - 2023, we identified 13 work-related asthma deaths (Table 1). The decedents ranged in age from 19 to 77. Five were men. Nine worked in manufacturing, and one each worked in construction, agriculture, food services, and automotive repair. Five were associated with exposure to isocyanates, two to welding fumes, two to food products, and one death each was associated with exposure to secondhand cigarette smoke, milk tank cleaning agents, chemicals used in construction, and mold machine release spray. Eight of the decedents had new onset work-related asthma (the four-isocyanate related, one pickle manufacturing, one plastic injection molding, one welding fumes and one plastic/rubber manufacturing death) and five of the decedents had preexisting asthma prior to the work exposure where they died. The time from asthma diagnosis to death ranged from one to 37 years (average 8.7 years), and from the work exposure to death from one to 22 years (average 7.6 years). For five individuals, where spirometry results could be obtained, the results from the test done closest to their time of death were; two were normal ($FEV_1 > 80\%$ predicted), and three decreased ($FEV_1 < 95\%$ lower limit of normal). Case reports about two of these deaths have previously been published ⁵⁻⁶.

Case Report

Michigan Case #5 had 18 medical encounters from the time he hired in at a company, which manufactured adhesives from isocyanates until he died four years later at the age of 50. His medical encounters included four medical exams provided by the company, five urgent care

visits, seven visits to his primary care physician and two visits to a pulmonary specialist. He had hired in at the age of 45. He had no personal or family history of allergies or asthma per his family and medical records. He had smoked cigarettes since the age of 16. At the time of hire his FEV1 was normal (3.75 L , 95% of predicted), a year later 3.60, 96% of predicted, two years after hire it had decreased to 3.27, 87% of predicted and after his third year of work (two months before his death) his FEV1 was 2.58 L, 73% of predicted (a 1.17 liter decrease in his FEV1 from the time of hire). This employee first sought medical care at an Urgent Care Facility six months after beginning work. The impression from that encounter was “acute bronchitis with mild bronchospasm.” On subsequent visits to the Urgent Care Facility his symptoms were noted to occur at work. After the third urgent care visit, he was referred to a primary care doctor. The primary care doctor diagnosed him with asthma and prescribed Advair. On subsequent visits the primary care doctor noted: “was exposed to chemical at work again” and “exposed to isocyanate.” The primary care doctor did not refer the patient to a pulmonologist until after his seventh encounter with the patient, repeated prescription of oral steroids for exacerbations related to work and the patient asked for assistance because his breathing became so bad while working. The patient had two visits with the pulmonologist. The pulmonologist documented the patient had hyperreactivity with a 12% improvement in his FEV1 with a bronchodilator. He had no evidence of COPD with a normal diffusing capacity and the absence of air trapping on lung volumes. At his second visit the pulmonologist indicated “it is going to become necessary for them to try and minimize his exposure to isocyanates” and scheduled him for a return visit in two months. The patient died before returning to see the pulmonologist⁷.

Discussion

Despite ongoing improvement in medical treatment for asthma, individuals continue to die from work-related asthma. This new report summarizes the 13 work-related asthma deaths identified over 20 years in the Michigan surveillance system for work-related lung disease. Demographics of the deaths in Michigan are similar to those in the report from 2002, which summarized 11 work-related asthma deaths in the world medical literature from 1958-2002. Although isocyanates were the most common exposure associated with a work-related asthma death, other exposures differed between the two time periods. In the 2002 report, exposures associated with a work-related asthma death were isocyanates in three cases, bicycloheptadine dibromide in two cases, green coffee dust in two cases, and one case each from flour, printing sprays containing gum arabic, papain dust and shark cartilage³. Where reported, the latency between initial occupational exposure and onset of work-related asthma ranged between 1½ and 15 years and the interval between onset of work-related asthma symptoms and death ranged between 2 and 20 years. The respective Michigan data were one to 22 years and one to 37 years.

More recently, a death from asthma in the emerging cannabis growing industry has been reported from Massachusetts⁸.

None of the exposures associated with the work-related asthma deaths has a comprehensive OSHA standard that requires worker education and/or medical surveillance. Only isocyanates and welding fume have OSHA permissible exposure limits (PELs). Some European countries do have air standards to protect against other causes of work-related asthma (e.g., flour dust). In the United States all the other substances associated with work-related asthma deaths would either

have no air standard or be regulated as a nuisance dust, which would not be protective against the development of work-related asthma.

Where treatment medical records prior to death were available, a common pattern was the health care provider noted a work-related issue but took no action to address the work-related exposure component (e, g., writing a medical restriction, removing the person from the workplace). In the case report, the primary care physician did not address the work-related exposure until the patient said, “he couldn’t take it anymore.” At that point, the primary care physician made a referral to a pulmonary physician. Besides being a factor in work-related asthma deaths, more commonly this lack of attention to work-related exposures by the health care provider presumably to the increased morbidity of work-related asthma compared to non-work-related asthma⁹⁻¹⁰.

An American College of Chest Physician Consensus Statement concluded that “The substantial prevalence of WRA supports consideration of the diagnosis in all who present with new-onset or worsening asthma,...”¹¹. A work-related asthma death highlights the ultimate consequence of not considering the potential of work as a trigger for an adult patient’s asthma.

References

1. CDC. Most Recent Asthma Death Data. (https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm).
2. CDC. Most Recent Asthma State or Territorial Death Data. (https://www.cdc.gov/asthma/most_recent_data_states.htm)
3. Ortega HG, Kreiss K, Schill DP, Weissman DN. Fatal asthma from powdering shark cartilage and review of fatal occupational asthma literature. *Am J Ind Med* 2002;42:50-54.
4. Matte TD, Hoffman RE, Rosenman KD, Stanbury M. Surveillance of Occupational Asthma under the SENSOR Model. *Chest* 1990;95:173s-178s.
5. Chester DA, Hanna EA, Pickelman BG, Rosenman KD. Asthma Death after Spraying Polyurethane. Truck Bedliner. *Am J Ind Med* 2005;48:78-84.
6. Stanbury M, Chester D, Hanna EA, Rosenman KD. How Many Deaths Will It Take? A Death from Asthma Associated with Work-Related Environmental Tobacco Smoke. *Am J Ind Med* 2008;51:111- 116.
7. Project SENSOR NEWS. Asthma Mortality. <https://oem.msu.edu/images/newsletter/ProjectSensor/v19n3.pdf>. Accessed 2/14/25.
8. Weaver VM, Hua JT, Fitzsimmons KM, Laing JR, Farah W, Hart A, Braegger TJ, Reid M, Weissman DN. Fatal Occupational Asthma in Cannabis Production — Massachusetts, 2022. *MMWR* 2023;72:1257–1261
9. Knoeller GE, Mazurek JM, Moorman JE. Characteristics associated with healthcare professional diagnosis of work-related asthma among individuals who describe their asthma as being caused or made worse by workplace exposures. *J Occup Environ Med* 2012;54:485–490.

10. Lemiere C, Forget A, Dufour MH, et al. Characteristics and medical resource use of asthmatic subjects with and without work-related asthma. *J Allergy Clin Immunol* 2007;120:1354–1359
11. Tarlo SM, Balmes J, Balkissoon JR, et al. Diagnosis and Management of Work-Related Asthma: American College of Chest Physicians Consensus Statement. *Chest* 2008;134;1-41

Table 1. Summary of 13 Work-Related Asthma Deaths, Michigan 2003-2023

Case #	Year	Age of Death	Sex	Race	Hisp · Ethn ·	Exposure	Industry/ Occupation	Asthma Type	Years with Asthma	FEV1 Before Death	Cigarette Smoking Status (packs/day, Years)	Years from Exposure to WRA	Years from WRA to Death
1	2003	45	M	W	No	Isocyanates	Auto Repair & Detailing/Truck Bed Liner Sprayer	OA	1	None	Current (2, Unk)	<1*	1
2	2004	19	F	B	No	Cigarette Smoke	Restaurant/Waitress	A	16	None	Never	N/A	<1
3	2004	75	F	W	No	Chlorine, Phosphoric & HCL Acid	Agriculture/Farmer Cleaning Milk Tanks	A	Unk	84% of P	Never	N/A	Unk
4	2005	50	M	W	No	Isocyanates	Adhesive Manufacturing/Production	OA	4	97% of P	Current (1, 34 y)	< 1	3
5	2006	77	F	W	No	Toluene Diisocyanate	Auto Seat Manufacturing/ Machine Operator	OA	26	33% of P	Ex (age 18-25, 2 cigs/day)	22	26
6	2007	54	M	W	No	Welding Fumes, Chemicals	Plastic Auto Parts Manufacturing/Welder	A	37	36% of P	Ex (2, age 12-48)	< 1	37
7	2013	67	F	W	No	Molding Machine Release Spray	Rubber/Plastic Parts Manufacturing Machine Operator	OA	16	59% of P	Current (60)	1	14
8	2013	21	M	B	No	Construction	Construction/Laborer	A	Child	None	unknown	<3	<3
9	2015	43	M	W	No	Isocyanates	Rubber/Plastic Parts Manufacturing Casting Machine Operator.	OA	1	None	Ex (unk, age 33-38)	21	1
10	2019	50	F	W	No	Pickle Processing Brine, Capsaicin	Pickle Manufacturing	OA	3	None	Current (34 y)	13	2
11	2022	31	M	B	No	Cereal Dust	Cereal Manufacturing	A	19	None	Current (3-4 cigs/day, 9y)	<1	<1
12	2023	52	M	B	No	Plastic Injection Molding Fumes	Polyurethane Foam Manufacturing/Mold Machine Operator	OA	Unk	None	Ex (age 15-16)	Unk	Unk
13	2023	44	M	B	No	Welding Fumes	Automotive Parts Manufacturing/Welding Technician	OA	Unk	None	Current (unk)	1	< 1

OA = new onset work-related asthma, A= work-aggravated asthma, % of P = Percent of predicted, N/A = not applicable, Unk = unknown

*Worked at a previous job applying isocyanate bedliners

Study highlights that work-related asthma (WRA) deaths occur across many industries and exposures. Employers, health care providers and employees can prevent these deaths.

**13 WRA Deaths in Michigan:
2003-2023**

- Manufacturing, agriculture, food service, auto repair
- Isocyanates, plant material, welding fume, mold machine release spray, plastic fumes



To reduce WRA morbidity and deaths, employers and employees need to be aware of respiratory hazards at work

- Training
- Medical Screening Program with prompt evaluation of symptomatic workers

37% of adult asthma is work-related:

- Health Care Providers should promptly advise and write work restrictions for adults with WRA



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