
Use of objective testing in the diagnosis of work-related asthma by physician specialty

Christy C. Curwick, MPH; David K. Bonauto, MD, MPH; and Darrin A. Adams, BS

Background: Although early and accurate diagnosis of work-related asthma is critical to avoid unnecessary medical, legal, social, and economic consequences, little is currently known about the diagnostic practices of physicians treating workers with work-related asthma.

Objective: To characterize the use of objective diagnostic testing for work-related asthma by physician specialty.

Methods: A cross-sectional, descriptive, comparative evaluation was conducted of 301 workers' compensation claimants with work-related asthma.

Results: A few claimants (36.9%) were treated by specialists in work-related asthma (allergists, pulmonologists, or occupational medicine physicians) either initially or through the course of their claim. Workers with occupational asthma were more likely to have seen a specialist than those with work-aggravated asthma (47.9% vs 23.0%; $P < .001$). Less than half of the claimants with work-related asthma (43.2%) had received an objective evaluation of pulmonary function, through either pulmonary function testing or testing for reversible airflow limitation, for the evaluation of their work-related asthma. Claimants treated by specialists were significantly more likely to have received diagnostic testing during evaluation of their disease than those treated solely by generalists (82.9% vs 20.0%; $P < .001$).

Conclusions: The results of this study point to the lack of appropriate diagnostic care received by workers with work-related asthma. Physicians who may have questions about diagnostic procedures should consider referral to a specialist. The development of referral networks for work-related asthma may be warranted and should be explored.

Ann Allergy Asthma Immunol. 2006;97:546-550.

INTRODUCTION

Guidelines for the diagnosis and management of asthma^{1,2} and work-related asthma^{3,4} have been published previously. In common among these guidelines is the key message that work-related asthma may be associated with a variety of adverse medical, legal, social, and economic consequences; therefore, early and accurate diagnosis is critical.³⁻⁵ Specifically, use of objective diagnostic testing to document reversible airflow limitation and additional testing to attribute asthma to workplace exposures are essential.^{6,7} Owing to the complexity of an appropriate diagnosis, referral to a specialist has been recommended.⁴

Currently, little is known about the diagnostic and management practices of physicians treating workers with work-related asthma. Therefore, this study was undertaken to describe the medical care received by a population of workers' compensation claimants who had filed claims for work-related asthma. Specifically, the purposes of this study are (1)

to characterize the types of physicians treating work-related asthma claimants initially and throughout the life of the claim according to specialty, (2) to describe the types of tests used by physicians in the evaluation of a patient with a work-related asthma claim, and (3) to examine differences in the receipt of objective diagnostic tests between claimants treated by work-related asthma specialists (board-certified allergists/immunologists, pulmonologists, or occupational medicine physicians) and generalists.

MATERIALS AND METHODS

Case Ascertainment

Work-related asthma cases included in this study were identified through the Washington State Department of Labor and Industries' state fund industrial insurance system between September 1, 2000, and August 31, 2005. All but the 400 largest Washington State employers and the federal government obtain workers' compensation insurance through the state fund. The state fund insures 160,000 employers and approximately two thirds of the Washington private sector workforce.

In Washington, workers and their physicians initiate a claim by submitting a Report of Industrial Injury or Occupational Disease reporting form to the Department of Labor and Industries. The reporting form contains narrative text describing the mechanism of injury or exposure, the health care provider's diagnosis, and the worker's symptoms. Work-related asthma claims were identified by using a computerized search for the word *asthma* on the reporting form.

Safety & Health Assessment & Research for Prevention (SHARP) Program, Washington State Department of Labor and Industries, Olympia, Washington.

This work was supported by cooperative agreement 5 U01 OH007292 from the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, and by the SHARP Program, Washington State Department of Labor and Industries. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of the funding agencies.

Received for publication January 31, 2006.

Accepted for publication in revised form April 29, 2006.

The state fund industrial insurance databases contain billing information generated by health care providers and hospitals. Information on medical procedures, identified by *Current Procedural Terminology* (CPT) codes,⁸ was obtained through this billing information for each work-related asthma claim. A list of CPT codes describing the appropriate objective diagnostic tests for the diagnosis of asthma was developed,^{9,10} and each claim was coded “yes” or “no” regarding whether that procedure was conducted during the course of the claim. Three groups of CPT codes for the evaluation of respiratory disorders were created (Table 1). If a claimant had at least 1 test in a group, the claim was coded “yes” regarding the presence of that group of tests. In addition, demographic information (age and sex) was obtained for each claim.

Identifying Physician Specialty

For each claim, all physicians providing medical services were identified by a provider identification number unique to the Washington State industrial insurance system. Physicians’ board certifications were identified using the American Board of Medical Specialties online board certification database.¹¹ The American Board of Medical Specialties database was searched manually using physician name and address as matching variables. All certifications were recorded for each physician. For the purposes of this study, physicians were classified as work-related asthma specialists if they were board certified in allergy/immunology, pulmonary medicine, or occupational medicine; all other physicians were classified as generalists. Cases were coded into 2 groups: those treated by at least 1 work-related asthma specialist (these claimants could have also been treated by generalists) and those treated only by generalists. In addition, the group of claimants treated

by a specialist was also subdivided into 2 groups: those treated only by a specialist (including treatment by multiple specialists) and those treated by specialists and generalists.

Interviews

Guidelines for conducting state-based work-related asthma surveillance under the Sentinel Event Notification System for Occupational Risks (SENSOR) model have been published previously.¹² The guidelines include a surveillance case definition, which relies on a physician’s diagnosis of asthma and a temporal association of symptoms to work, and criteria for classifying cases into occupational asthma with latency, occupational asthma without latency, and work-aggravated asthma.¹² For this study, claimants were interviewed to determine whether they met the SENSOR case definition and to classify cases using the SENSOR criteria. Verbal informed consent was obtained from all the individuals who participated in the interviews, and the study was approved by the Washington State institutional review board.

Between October 1, 2001, and August 31, 2005, interviews were attempted with 512 workers with work-related asthma identified through the state fund workers’ compensation system. Telephone numbers were missing or later determined to be incorrect or disconnected for 68 workers. Of the 444 remaining workers, 318 completed interviews, for a response rate of 72%. Seventeen of these workers were removed from the analysis because too little information was available in the claim record to accurately identify and classify treating physicians or the medical tests obtained. Therefore, 301 claims were included in the final data set for analysis. The 301 study participants were more likely to be female than nonrespondents (61% vs 50%; $P = .02$ by χ^2 test) and were slightly older (mean age, 41 vs 39 years; $P = .03$ by Mann-Whitney test). In addition, the average monthly wages of nonrespondents were higher than those of respondents (\$2,525 vs \$2,287; $P = .02$ by Mann-Whitney test). Respondents and nonrespondents did not differ significantly with respect to whether they lived in eastern Washington (the more rural area of the state) or western Washington. Data were analyzed using a software program (SPSS version 12.0.1 for Windows; SPSS Inc, Chicago, IL). χ^2 Tests or Fisher exact tests were used to examine differences in the receipt of objective diagnostic tests by physician specialty.

RESULTS

Of the 301 work-related asthma claimants, 165 were classified as having occupational asthma (134 with latency and 31 without latency) and 135 as having work-aggravated asthma; 1 worker could not be classified according to asthma type. Those with work-aggravated asthma were more likely to be female than those with occupational asthma (68.9% vs 53.3%; $P = .006$). The median age of claimants was 43 years, and this did not differ by asthma type.

A total of 111 claimants (36.9%) had been treated by 1 or more work-related asthma specialist(s) during the course of their claim; 60 (19.9%) had seen a pulmonologist, 43 (14.3%)

Table 1. Work-Related Asthma Claimants Receiving Objective Testing

Type of test	Claimants, No. (%) (N = 301)
Group 1: tests for reversible airflow limitation	82 (27.2)
Bronchospasm evaluation	68 (22.6)
Prolonged postexposure bronchospasm evaluation	25 (8.3)
Bronchial challenge testing	21 (7.0)
Group 2: tests for pulmonary function (includes group 1)	130 (43.2)
Spirometry	88 (29.2)
Functional residual capacity/volume	41 (13.6)
Respiratory flow volume loop	32 (10.6)
Plethysmography	16 (5.3)
Thoracic gas volume	15 (5.0)
Resistance to airflow evaluation	11 (3.7)
Total vital capacity	10 (3.3)
Maximum breathing capacity	3 (1.0)
Group 3: tests for allergic sensitization	45 (15.0)
Percutaneous tests	28 (9.3)
Allergen specific IgE testing	20 (6.6)
Intracutaneous tests	2 (0.7)
Any test	130 (43.2)

had seen an occupational medicine physician, and 41 (13.6%) had seen an allergist. The proportion of workers with occupational asthma who had seen a specialist (79/165, or 47.9%) was significantly higher than the proportion with work-aggravated asthma who had seen a specialist (31/135, or 23.0%) ($P < .001$).

Fewer than half of the work-related asthma claimants (43.2%) underwent a pulmonary function test (Table 1). Claimants treated by specialists were significantly more likely to have received objective testing during evaluation of their disease than those treated solely by generalists (82.9% vs 20.0%; $P < .001$). The use of objective testing in the evaluation of work-related asthma by physician specialty is given in Table 2, including comparisons between those treated by a given specialty group and those not treated by that group.

Of the 111 claimants treated by specialists, 29 were treated exclusively by specialists, and the remaining 82 received treatment from both specialists and generalists. This subset of 29 claimants was also significantly more likely to have received pulmonary function testing than those treated solely by generalists (58.6% vs 20.0%; $P < .001$). Likewise, this difference was observed for tests for reversible airflow lim-

itation ($P < .001$) and tests for allergic sensitization ($P = .049$).

DISCUSSION

Previously published studies^{13,14} comparing medical care practices and outcomes between specialists and generalists suggest that specialists provide better quality of care than generalists. Studies that have specifically looked at the quality of care provided to asthmatic patients suggest that asthma specialists (allergists and pulmonologists) have greater knowledge of appropriate diagnostic techniques¹⁵ and use spirometry in the diagnosis of asthma more frequently¹⁶ than generalists. Survey results from 2,700 physicians treating adult asthmatic patients¹⁷ suggest that spirometry was almost always used in the diagnosis of asthma by pulmonologists and allergists/immunologists (95%), followed by occupational health specialists (82%), but was reportedly used less often by internal medicine physicians (57%) and family practitioners (51%). Other researchers^{18,19} have demonstrated that asthmatic patients treated by specialists receive care that is more consistent with national asthma management guidelines.

Table 2. Claimants Treated by Physician Specialty Groups Receiving Objective Testing by Work-Related Asthma Type*

	Group 1: tests for reversible airflow limitation	Group 2: group 1 + pulmonary function tests	Group 3: tests for allergic sensitization
Occupational asthma†			
Pulmonologists (n = 47)	38 (80.9)‡	47 (100.0)‡	16 (34.0)§
Allergists (n = 25)	20 (80.0)‡	24 (96.0)‡	18 (72.0)‡
Occupational medicine (n = 30)	16 (53.3)¶	21 (70.0)¶	10 (33.3)¶
Any specialist (n = 79)	55 (69.6)‡	69 (87.3)‡	30 (38.0)‡
Generalists (n = 86)	6 (7.0)	18 (20.9)	2 (2.3)
Subtotal (n = 165)	61 (37.0)	87 (52.7)	32 (19.4)
Work-aggravated asthma			
Pulmonologists (n = 12)	10 (83.3)‡	10 (83.3)‡	4 (33.3)¶
Allergists (n = 15)	9 (60.0)‡	12 (80.0)‡	9 (60.0)‡
Occupational medicine (n = 12)	3 (25.0)	7 (58.3)¶	2 (16.7)
Any specialist (n = 31)	15 (48.4)‡	22 (71.0)‡	10 (32.3)‡
Generalists (n = 104)	5 (4.8)	20 (19.2)	2 (1.9)
Subtotal (n = 135)	20 (14.8)	42 (31.1)	12 (8.9)
All work-related asthma			
Pulmonologists (n = 60)	49 (81.7)‡	58 (96.7)‡	21 (35.0)‡
Allergists (n = 41)	30 (73.2)‡	37 (90.2)‡	28 (68.3)‡
Occupational medicine (n = 43)	20 (46.5)§	29 (67.4)§	13 (30.2)§
Any specialist (n = 111)	71 (64.0)‡	92 (82.9)‡	41 (36.9)‡
Generalists (n = 190)	11 (5.8)	38 (20.0)	4 (2.1)
Subtotal (n = 301)	82 (27.2)	130 (43.2)	45 (15.0)

* Data are given as number (percentage). Specialty groups and test groups are not mutually exclusive. χ^2 Tests or Fisher exact tests were used for differences between those treated by a given specialty group and those not treated by that group for each test type and work-related asthma type.

† Occupational asthma claimants include those with and without latency.

‡ $P < .001$.

§ $P < .01$.

¶ $P < .05$.

The present study uses the administrative records of a workers' compensation insurer to compare the diagnostic practices of generalists and specialists treating patients with work-related asthma. These results are consistent with others^{16,17} in that patients with work-related asthma treated by specialists were more likely to have received objective diagnostic testing. However, only 20.0% of the claimants treated solely by generalists in this study received any sort of pulmonary function testing, suggesting that generalist physicians' self-reported use of spirometry of greater than 50% may be overestimated.¹⁷

Furthermore, this study highlights the lack of appropriate diagnostic care received by workers with work-related asthma. More than 70% of the cases in this study lacked any kind of test for reversible airflow limitation. This is troubling considering the findings from Malo and colleagues⁶ indicating that a diagnosis based solely on clinical history had a positive predictive value of 63%. Although claimants who were treated by work-related asthma specialists (particularly allergists and pulmonologists) were more likely to have received objective testing during evaluation of their disease, these workers made up only a third of all study participants. This is in alignment with an estimate from California based on self-reported information obtained during patient interviews that 29% of work-related asthma cases were initially evaluated by physicians specializing in occupational medicine, pulmonology, or allergy.²⁰

There are several potential limitations to this study. First, because the cases were identified through workers' compensation data, the underrecognition and underreporting of occupational illness, the exclusion of self-employed and federal workers, and the exclusion of workers employed by self-insured companies to the state fund workers' compensation system may add a potential selection bias to the population of work-related asthma claimants. However, because workers are eligible to choose their own physician for initiation and evaluation of a workers' compensation claim in Washington State, we would generally expect similar medical care practices among physicians treating the worker population not captured in this analysis.

Respondents in this study differed from nonrespondents regarding age, sex, and average monthly wages, indicating that the study sample may not be representative of the overall population of work-related asthma claimants. Nonetheless, we are unaware of any studies that have found these variables to be significantly associated with physician selection preferences or receipt of diagnostic testing for work-related asthma. Furthermore, there was no difference between respondents and nonrespondents in whether they lived in the more urban or rural part of the state, a variable expected to impact access to specialty care.

Through the use of workers' compensation billing data, we accessed information on the treating physicians and on the actual medical services provided. Although the availability of this objective information (rather than relying on self-report)^{16,17} is a major strength of the study, the data are not

available in such a way as to directly link the services provided with the ordering physician. Therefore, although the study found that claimants who were treated by specialists were significantly more likely to have received objective diagnostic testing, we cannot definitively conclude that the specialists were the ones who had ordered the tests. However, this study also showed that workers treated exclusively by specialists were significantly more likely to have had diagnostic testing compared with those treated exclusively by generalists, thereby supporting the conclusion that specialists are more likely to order such tests.

It is possible that some claimants may have received treatment, including medical tests, from physicians who did not submit bills for reimbursement through the state fund workers' compensation system. Thus, the possibility exists for some misclassification regarding the presence or absence of specialist treatment and objective testing. This is apt to be rare, however, because the motivation to receive reimbursement for services provided is likely high. Furthermore, we are unaware of any systematic differences in the Washington State workers' compensation data between specialists and generalists with respect to billing practices that may have affected the results of this study.

An additional limitation of this study was the lack of information on asthma severity. Eisner and colleagues²¹ stressed the importance of controlling for asthma severity when assessing the association between physician specialty and patient outcomes. Although we did not have information on work-related asthma severity, information on asthma type was available and was used as a potential indicator measure for diagnostic complexity. As expected, individuals with occupational asthma were significantly more likely to have been treated by specialists than those with work-aggravated asthma; however, the finding that claimants treated by specialists were more likely to have had objective testing remained when asthma type was controlled for.

The results of this study demonstrate that (1) few work-related asthma claimants were treated by specialists during the evaluation or management of their disease, (2) most claimants did not receive their diagnosis of work-related asthma based on the results of objective testing, and (3) claimants who received care from a specialist during the course of their claim were significantly more likely to have had objective diagnostic testing. In light of the critical need for the timely and accurate diagnosis of work-related asthma, physicians who may have questions about appropriate diagnostic procedures should consider referral to a specialist. The development of referral networks, potentially through the administrative oversight of the workers' compensation insurer, for work-related asthma and other occupational pulmonary diseases may be warranted and should be explored.

REFERENCES

1. National Asthma Education and Prevention Program. *Expert Panel Report 2: Guidelines for the Diagnosis and Management*

-
- of Asthma. Bethesda, MD: US Dept of Health and Human Services; 1997. DHHS (NIH) publication 97-4051.
2. National Asthma Education and Prevention Program. *Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma: Update on Selected Topics 2002*. Bethesda, MD: US Dept of Health and Human Services; 2003. DHHS (NIH) publication 02-074.
 3. American Thoracic Society. Guidelines for assessing and managing asthma risk at work, school, and recreation. *Am J Respir Crit Care Med*. 2004;169:873-881.
 4. Nicholson PJ, Cullinan P, Newman Taylor AJ, Burge PS, Boyle C. Evidence based guidelines for the prevention, identification, and management of occupational asthma. *Occup Environ Med*. 2005;62:290-299.
 5. Montanaro A. Prognosis of occupational asthma. *Ann Allergy Asthma Immunol*. 1999;83:203-206.
 6. Malo J-L, Ghezzi H, L'Archeveque J, Lagier F, Perrin B, Cartier A. Is the clinical history a satisfactory means of diagnosing occupational asthma? *Am Rev Respir Dis*. 1991;143:528-532.
 7. Anees W. Use of pulmonary function tests in the diagnosis of occupational asthma. *Ann Allergy Asthma Immunol*. 2003;90:47-51.
 8. American Medical Association. *Current Procedural Terminology (CPT) 2003: Professional Edition*. Chicago, IL: AMA Press; 2002.
 9. Tarlo SM, Chan-Yeung M. Occupational asthma. In: Rosenstock L, Cullen MR, Brodtkin CA, Redlich CA, eds. *Textbook of Clinical Occupational and Environmental Medicine*. 2nd ed. Philadelphia, PA: Elsevier Saunders; 2005:297-302.
 10. Tan RA, Spector SL. Diagnostic testing in occupational asthma. *Ann Allergy Asthma Immunol*. 1999;83:587-592.
 11. American Board of Medical Specialties. Who's certified database. Available at: <http://www.abms.org/newsearch.asp>. Accessed November 2005.
 12. Jajosky RAR, Harrison R, Reinisch F, et al. Surveillance of work-related asthma in selected U.S. states using surveillance guidelines for state health departments: California, Massachusetts, Michigan, and New Jersey, 1993-1995. *MMWR CDC Surveill Summ*. 1999;48:1-20.
 13. Harrold LR, Field TS, Gurwitz JH. Knowledge, patterns of care, and outcomes of care for generalists and specialists. *J Gen Intern Med*. 1999;14:499-511.
 14. Donohoe MT. Comparing generalist and specialty care: discrepancies, deficiencies, and excesses. *Arch Intern Med*. 1998;158:1596-1608.
 15. Doerschug KC, Peterson MW, Dayton CS, Kline JN. Asthma guidelines: an assessment of physician understanding and practices. *Am J Respir Crit Care Med*. 1999;159:1735-1741.
 16. Janson S, Weiss K. A national survey of asthma knowledge and practices among specialists and primary care physicians. *J Asthma*. 2004;41:343-348.
 17. Wolle JM, Cwi J. Physicians' prevention-related practice behaviors in treating adult patients with asthma: results of a national survey. *J Asthma*. 1995;32:131-140.
 18. Laforest L, Van Ganse E, Devouassoux G, et al. Management of asthma in patients supervised by primary care physicians or by specialists. *Eur Respir J*. 2006;27:42-50.
 19. Wu AW, Young Y, Skinner EA, et al. Quality of care and outcomes of adults with asthma treated by specialists and generalists in managed care. *Arch Intern Med*. 2001;161:2554-2560.
 20. Roberts JL, Janson S, Gillen M, Flattery J, Harrison R. Processes of care for individuals with work related asthma: treatment characteristics and impact of asthma on work. *AAOHN J*. 2004;52:327-337.
 21. Eisner MD, Katz PP, Yelin EH, Henke J, Smith S, Blanc PD. Assessment of asthma severity in adults with asthma treated by family practitioners, allergists, and pulmonologists. *Med Care*. 1998;36:1567-1577.
- Requests for reprints should be addressed to:*
Christy Curwick, MPH
SHARP Program
Washington State Department of Labor and Industries
PO Box 44330
Olympia, WA 98504-4330
E-mail: cure235@lni.wa.gov
-