The Use of Objective Measures of Asthma Severity in Primary Care: A Report from ASPN

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Background. The rising incidence of and mortality from asthma have prompted the development of practice guidelines for diagnosis and management. A cornerstone of these guidelines is the use of objective measures of asthma severity: spirometry or peak expiratory flow rates. We studied the extent to which primary care clinicians used objective measures of asthma severity.

Methods. Practices affiliated with the Ambulatory Sentinel Practice Network in the United States and Canada collected data on 490 asthma-related encounters involving 439 patients. For each encounter, the practice recorded the availability of the results of spirometry, peak expiratory flow rates, oxygenation (arterial blood gas or pulse oximetry), and chest radiograph to the clinician.

Results. Objective data about asthma severity were infrequently available to ASPN clinicians at the time of the encounter. In 67.8% of encounters, there was no current or past spirometry result, in 55.1% there was no current or past peak flow measurement, and in 74.3% there was no current or past determination of oxygenation. Chest radiographs, on the other hand, were available for most (64.7%) patients. The lack of objective measures was not related to lack of access to the relevant technologies. Most practices noted easy access to spirometry (72.2% of practices), peak flow meters (72.2%), oxygenation determination (61.1%), and radiography (83.3%).

Conclusions. In this study, most primary care clinicians did not have objective data about the severity of their patients' asthma at the time of the encounter. This relative lack of objective data was not explained by lack of access to the relevant technology for determining severity. It may instead reflect the opinion of primary care physicians that such information is not necessary in the care of these patients.

Key words. Asthma; spirometry; severity of illness; practice guidelines; research; family practice; practice-based research. (*J Fam Pract 1995; 41:139-143*)

Asthma is a common illness in the United States[1] and a frequent reason for ambulatory medical visits.[2] The overall economic impact of asthma in the United States is estimated to be at least $6 billion a year, most of which is attributable to hospitalization.[3] Appropriate outpatient management can reduce the need to hospitalize patients for acute exacerbations of the disease.[4]

Practice guidelines are one proposed way to assure that medical care is appropriate[5,6] and free of unintended variation.[7] Concerned about the rising death rate from asthma,[8] an expert panel convened by the federal government issued guidelines for asthma care in 1991.[9] Among the panel's recommendations was the use of objective measures of lung function to assess the severity of the disease in asthmatic patients.

There are several available choices of objective measure. The expert panel suggested that spirometry and peak expiratory flow rates (PEFR) are the most useful of the objective measures to assess asthma severity. In contrast, chest radiography has little value in determining the degree of airway compromise[10] and is useful chiefly for excluding other chest diseases. Determination of arterial

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oxygen content invasively or noninvasively also has limited utility as an objective measure of asthma severity. The inability of pulse oximetry to detect hypercarbia restricts its usefulness as a guide for asthma treatment,[11] and arterial blood gas measurement is rarely practical in the primary care office setting.

Like many other guideline statements, the 1991 recommendations on asthma diagnosis and management represent a consensus opinion of specialists in the field. An evidence-based approach, however, generally produces guidelines of higher quality.[12] The 1991 asthma guidelines have been severely criticized both for their lack of primary care perspective and the lack of supporting evidence.[13]

Research suggests that the act of creating and publishing a guideline does not affect physician behavior.[14,15] Many explanations have been advanced, including physicians' lack of belief in the efficacy of the guideline within their own practice.[16] Because spirometry and PEFR are both old technologies, their baseline use in primary care practice, at the time when guidelines were first introduced, should reflect clinicians' level of confidence in their usefulness in the care of asthmatic patients. Alternatively, the lack of availability of tools and equipment could explain noncompliance with national guidelines. The Ambulatory Sentinel Practice Network (ASPN), therefore, studied the extent to which objective measures of lung function were available and used in the evaluation of asthmatic patients seen in primary care practices.

Methods

Study Setting

ASPN is a network of primary care practices that collaborate to conduct research about problems in primary care medicine. The network was created in 1978, and at the time of this study, included practices in 34 states and 4 Canadian provinces. In the aggregate, the practices include clinicians providing care for approximately 365,000 patients, who in turn made approximately 700,000 visits a year. ASPN's purpose, policies, and methods have been previously described.[17] The patients and problems seen in ASPN practices are similar to those of the general US population seeking care from family physicians, as reflected in the 1990 National Ambulatory Medical Care Survey.[18]

Data Collection and Analysis

From April 20 through July 19, 1992, 38 ASPN practices collected information about patients seen for asthma using a weekly return card.[19] The weekly return card permits data capture by clinicians in "real time" without requiring retrospective chart review or reliance on codes assigned by others. Participating practices and their patient populations were representative of ASPN as a whole. Because asthma is a clinical diagnosis of exclusion that has no "gold standard,"[20] clinicians were asked to include all patients with a diagnosis of asthma and for whom asthma was at least one reason for the encounter. No attempt was made to standardize diagnostic criteria. Instead, practitioners were asked to include patients they would be willing to have coded for asthma (ICD-9 code 493.XX) and exclude patients with other respiratory disorders. Practices collected information about the sex and age of the patients; the duration of asthma in years; and whether there were available results of any of four separate objective measures of asthma (spirometry, PEFR, chest radiography, and oxygenation status as determined by the measurement of arterial blood gas or pulse oximetry). Clinicians indicated on the weekly return cards whether the patient had the test performed in the last 4 months (including on that day), more than 4 months ago, or never. The fourth response option, "unknown," was combined with the category "never" because each implied that objective data were not available to the clinician. Each practice also indicated the accessibility of each of the four measures and the frequency with which asthmatic patients visited. As in other ASPN studies based on weekly return cards, the data were collected in "real time," not as a retrospective chart review. This mechanism also permitted capture of two types of denominator information: proportion of the week in which the practice was available to its patients, and the total number of patients seen during the week.

Patient visit data were entered, edited, and analyzed using the personal computer version of the Statistical Package for the Social Sciences (SPSS/PC, Inc, Chicago, Ill). The use of objective measures was assessed individually and then in combination. Further analyses examined the factors associated with the use of these measures.

Results

Frequency Distribution and Patient Characteristics

During the study period, the 38 participating practices, 58% of which were rural, recorded 79,781 patient encounters. Clinicians enrolled 439 patients who made 490 asthma-related visits. The overall frequency of asthma-related encounters was 6.8 per 1000 encounters after adjusting age and sex to the 1980 US population. The

adjusted mean frequency of asthma encounters per practice was 9.8 per 1000, with a range of 0.4 to 84.3 per 1000. The adjusted median practice frequency was 6.9 per 1000 encounters. Three practices (all solo practitioners, two in suburban areas and one in a rural location) had frequencies greater than 20.0 per 1000 encounters, which skewed the distribution.

The mean age of patients presenting for an asthma-related visit was 35.1 years (range, 0 to 90 years), and the median age was 35.0 years. The mean duration of asthma was 7.7 years (range, 0 to 72 years). Of the 490 encounters for asthma, male patients accounted for 210 (42.9%) and female patients, 280 (57.1%). Asthma visit rates were significantly more frequent for male patients in the younger age categories, especially those younger than 14 years of age ($P<.001$).

Objective Measures

For most encounters, neither current nor past objective asthma severity data were available to the physicians: 67.8% did not have spirometry; 55.1% did not have PEFR; and 46.5% had neither. Most patients (74.3%) did not have oxygenation results. In contrast, current or past chest radiography results were more common. Only one in three asthma encounters (35.3%) occurred without the availability of chest radiograph results. One in five (19.6%) asthmatic patients had never had an objective measure of disease severity, while only 11.6% had all four types of data. Patients with one available objective measure were significantly more likely to have another test ($P<.001$).

Univariate analysis showed that age strongly influenced whether any of these objective measures were used. The younger the patient, the less likely that an objective test report was available ($P<.001$). As might be expected, univariate analysis also showed that the availability of three objective measures—spirometry, oxygenation, and chest radiography—depended on the patients' duration of asthma. The mean duration of asthma was 10.8 years in patients with spirometry results and 6.3 years in patients without spirometry; 10.9 years in patients with oxygenation determination vs 6.4 years in patients without; and 8.8 years for patients with a chest radiograph vs 5.3 years in patients without one. All mean durations of asthma were significantly different ($P<.001$).

Availability of any of the four objective measures or their combination was not associated with patient gender. Patients visiting rural practices were less likely to have oxygenation results (18.4% vs 34.1%, $P<.001$). On the other hand, patients visiting rural practices were more likely than those visiting urban practices to have had at least one of the four objective measures (83.9% vs 76.4%, $P=.037$).

Most ASPN practices had access to objective measurement technology. Spirometry and peak expiratory flow meters were each available in 72.2% of practices, and practices reported easy access to oxygenation determination (61.1%) and chest radiography (83.3%). Access to the equipment, however, did not predict their use in these patients. We performed stepwise logistic regression to predict the factors that influence the use of at least one objective measure of asthma severity. Only two variables influenced the availability of objective measures: age and visitation pattern. Older patients were slightly more likely (odds ratio [OR}=1.04; 95% confidence interval [CI], 1.02 to 1.06) to have an objective measurement. Patients who visited the practice at least every 4 months were much more likely (OR=4.06; 95% CI, 2.00 to 8.10) to have at least one objective measure recorded. When only the use of spirometry or peak flow was the outcome variable, age (OR=1.03) and access to peak flow technology (OR=1.97) were significant predictors. Visiting the practice at least every 4 months did not predict that results would be recorded for either of these more useful objective measures.

Discussion

Patients often cannot determine the severity of their own asthma, even when flow rates are significantly reduced.[21] Likewise, physicians do poorly at estimating their asthmatic patients' peak flow rates.[22] By the time wheezing is audible through a stethoscope, peak flow rates have already declined at least 25%.[23] When neither patients nor physicians can accurately judge the severity of asthma, delays in treatment occur that may be a cause of asthma-related morbidity and mortality.[24] Overall asthma morbidity among primary care patients is correlated with abnormal spirometry and peak flow measurements.[25] As a result, national guidelines strongly recommend that all asthmatic patients undergo periodic peak flow or spirometric measurement.[26] Yet, the primary care clinicians in our sample were unlikely to use spirometry and PEFR, the measures most closely correlated with severity. Their decisions were not constrained because they lacked access to the relevant technology. It is clear that the practitioners in our study did not implement the 1991 expert panel guideline. The relationship between guideline dissemination and impact is known to be imperfect.[27] It is possible that severity of illness played a role in clinicians' decisions about objective measures. Possibly the asthmatics cared for in participating practices were healthy enough that clinicians may have consciously chosen not to use objec-

tive measures. Further studies of guideline implementation should include severity measures, although what constitutes a good severity measure for asthma remains controversial.[28]

Our study suggests that if primary care clinicians agree with the national guidelines, there is room for improvement in their compliance with these guidelines. On the other hand, there is no consensus regarding the necessity for routine monitoring of airflow obstruction. Some investigators suggest that patient self-report is as efficacious as PEFR in detecting asthma exacerbations.[29] Patient self-report also correlates well with one important outcome: long-term decline in spirometry values.[30] The impact of PEFR monitoring by patients on outcomes is unknown.[31]

This report suggests that the relevance of the asthma guideline to primary care is uncertain and that the consequences of achieving compliance with it in primary care are unknown. Deficiencies in knowledge about these guidelines and the consequences of noncompliance could be corrected by expanding research in primary care and incorporating the findings into the national discussion about practice guidelines.[32] Our study suggests feasible areas for examination that could identify barriers to the implementation of guidelines in practice. A survey of physician opinion, for example, might focus on why PEFRs are so infrequently used, given the simplicity and availability of the method. Are there knowledge gaps, memory gaps, or issues of patient compliance? Is cost a factor? Do objective measures of asthma severity lose out to competing priorities?[33] Do practitioners believe that the guidelines apply to their own patients in their own local practice environments?[34] Or are there other factors, unique to a physician-patient visit, that affect physicians' decisions about the use of objective measures of asthma, as with other forms of testing?[35] A logical follow-up to our study would compare the consequences, if any, of usual asthma care and practice in compliance with the national guidelines.

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United States

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References

1. Evans R III, Mullally DI, Wilson RW, et al. National trends in the morbidity and mortality of asthma in the US. Prevalence, hospitalization, and death from asthma over two decades. Chest 1987; 91(6 suppl):65S–74S.
2. Bryant E, Shimizu I. Sample design, sampling variance, and estimation procedures for the National Ambulatory Medical Care Survey. Vital and Health Statistics, Series 2, No. 108. National Center for Health Statistics, publication No. (PHS) 88–1382, 1988.
3. Weiss KB, Gergen PJ, Hodgson TA. An economic evaluation of asthma in the United States. N Engl J Med 1992; 326:862–6.
4. Mayo PH, Richman J, Harris JW. Results of a program to reduce admissions for adult asthma. Ann Intern Med 1990; 112:864–71.
5. Woolf SH. Practice guidelines: a new reality in medicine, I: recent developments. Arch Intern Med 1990; 150:1811–8.
6. Audet AM, Greenfield S, Field M. Medical practice guidelines: current activities and future directions. Ann Intern Med 1990; 113:709–14.
7. Berwick DM. Controlling variation in health care: a consultation from Walter Shewart. Med Care 1991; 29:1212–25.
8. Centers for Disease Control. Asthma—United States, 1980–1987. MMWR 1990; 39:493–7.
9. National Asthma Education Program Panel Report. Guidelines for the diagnosis and management of asthma. US Department of Health and Human Services, Public Health Service, National Institutes of Health, publication No. 91-3042, 1991.
10. Gillies JD, Reed MH, Simons FE. Radiology assessment of severity of acute asthma in children. J Can Assoc Radiol 1980; 31:45–7.
11. McFadden ER, Lyons HA. Arterial blood gas tension in asthma. N Engl J Med 1968; 278:1027–32.
12. Woolf SH. Practice guidelines, a new reality in medicine, II: methods of developing guidelines. Arch Intern Med 1992; 152:946–52.
13. Berg AO, Moy JG. Guidelines for the diagnosis and management of asthma. J Am Board Fam Pract 1992; 5:629–34.
14. Kosecoff J, Kanouse DE, Rogers WH, McCloskey L, Winslow CM, Brook RH. Effects of the National Institutes of Health Consensus Development Program on physician practice. JAMA 1987; 258: 2708–13.
15. Lomas J, Anderson GM, Domnick-Pierre K, Vayda E, Enkin MW, Hannah WJ. Do practice guidelines guide practice? The effect of a consensus statement on the practice of physicians. N Engl J Med 1989; 321:1306–11.
16. Greer AL. The state of the art versus the state of the science: the

diffusion of new medical technologies into practice. Int J Tech Assess Health Care 1988; 4:5–26.
17. Green LA, Wood M, Becker L, et al. The Ambulatory Sentinel Practice Network: purpose, methods, and policies. J Fam Pract 1984; 18:275–80.
18. Green LA, Miller RS, Reed FM, Iverson DC, Barley GE. How representative of typical practice are practice-based research networks? A report from ASPN. Arch Fam Med 1993; 2:939–49.
19. Green LA. The weekly return as a practical instrument for data collection in office-based research: a report from ASPN. Fam Med 1988; 29:182–4.
20. Fraser RG, Paré JAP, Fraser RS, Genereux GP. Diagnosis of diseases of the chest. 3rd ed. Philadelphia, Pa: WB Saunders, 1990: 2019.
21. Cross D, Nelson HS. The role of the peak flow meter in the diagnosis and management of asthma. J Allergy Clin Immunol 1991; 87:120–8.
22. Shim CS, Williams MH. Evaluation of severity of asthma: patients versus physicians. Am J Med 1980; 68:11–13.
23. Shim CS, Williams H. Relationship of wheezing to the severity of obstruction in asthma. Arch Intern Med 1983; 143:890–2.
24. Sears MR. Increasing asthma mortality: fact or artifact? J Allergy Clin Immunol 1988; 82:957–60.
25. Jones KP, Bain DJ, Middleton M, Mullee MA. Correlates of asthma morbidity in primary care. BMJ 1992; 304:361–4.
26. Sheffer AL, Taggart VS. The National Asthma Education Program: expert panel report guidelines for the diagnosis and management of asthma. Med Care 1993; 31(suppl):MS20–28.
27. Lomas J. Words without action? The production, dissemination, and impact of consensus recommendations. Ann Rev Public Health 1991; 12:41–65.
28. O'Connor GT, Weiss ST. Clinical and symptom measures. Am J Respir Crit Care Med 1994; 149:S21–8.
29. Malo J-L, L'Archevêque J, Trudeau C, D'Aquino C, Cartier A. Should we monitor peak expiratory flow rates or record symptoms with a simple diary in the management of asthma? J Allergy Clin Immunol 1993; 91:702–9.
30. Kauffman K, Annes I. Validity of subjective assessment of respiratory health status changes. Am Rev Resp Dis 1992; 145:A539.
31. Clark NM, Evans D, Mellins RB. Patient use of peak flow monitoring. Am Rev Resp Dis 1992; 145:722–5.
32. Jackson MN, Nutting PA. Clinical guidelines development: opportunities for family physicians. J Fam Pract 1991; 33:129–32.
33. Jaén CR, Stange KC, Nutting PA. Competing demands of primary care: a model for the delivery of clinical preventive services. J Fam Pract 1994; 38:166–71.
34. Greer AL. The two cultures of biomedicine: can there be consensus? JAMA 1987; 258:2739–40.
35. Conry CM, Main DS, Miller RS, Iverson DC, Calonge BN. Factors influencing mammogram ordering at the time of the office visit. J Fam Pract 1993; 37:356–60.