Effects of Physician-Related Factors on Adult Asthma Care, Health Status, and Quality of Life

Paul D. Blanc, MD, MSPH, Laura Trupin, MPH, Gillian Earnest, MS, Melanie San Pedro, Patricia P. Katz, PhD, Edward H. Yelin, PhD, Mark D. Eisner, MD, MPH

PURPOSE: To study the association of physician characteristics, the characteristics of their practice settings, patient mix, and reported frequency of prescribing asthma medication with patients' health status and health-related quality of life in asthma.

METHODS: We conducted a mail-back survey of physicians (n = 147) that included demographic characteristics, practice and training characteristics, and reported prescribing frequencies for common asthma treatments. We also conducted structured telephone interviews with 317 of their patients, assessing demographic characteristics, health status (as measured by the Short Form–12 [SF-12] physical component score), and asthma-specific quality of life (as measured by the Marks questionnaire).

RESULTS: In adjusted analyses, pulmonary specialists were more likely to report using leukotriene modifiers (odds ratio [OR] = 4.7; 95% confidence interval [CI]: 1.2 to 18) and theophylline (OR = 3.0; 95% CI: 1.0 to 9.0) in adult patients with asthma. Working in a practice of >75% health maintenance organization (HMO)– or preferred provider organization (PPO)–insured patients was associated with a lower likelihood of prescribing leukotriene modifiers (OR = 0.1; 95% CI: 0.01 to 0.5). Adjusting for patient demographic characteristics and steroid dependence, physician prescribing tendencies were not associated with patients' perceived health status or quality of life. Although an HMO- or PPO-predominant practice was associated with better physical health status (mean difference in SF-12 physical component score, 3.1; 95% CI: 0.05 to 6.2; $P = 0.05$), there was no statistical association with quality of life.

CONCLUSION: The characteristics of physicians, their practices, and the asthma medication prescribing strategies that they adopt are not strongly associated with patients' perceived outcomes. **Am J Med. 2003;114:581–587.** ©2003 by Excerpta Medica Inc.

There are substantial variations in the use of medical procedures and in health outcomes among contiguous geographic areas (1–3). Subsequent studies, using individual-level data, have shown that the characteristics of physicians and their practices explain some of this variation (4–8), which may affect patient outcomes (9). The demographic characteristics of physicians, reimbursement structures, and specialty training may also influence outcomes. For example, differences in communication style between male and female physicians may affect patient adherence and their perception of care (10).

Asthma in adult patients may be particularly relevant to the study of the relation among physicians, clinical management strategies, and patient-perceived outcomes. It is common, costly, and associated with substantial morbidity (11,12). Guidelines for asthma management provide a benchmark against which variation can be measured (13). Standardized measures allow the assessment of generic and asthma-specific patient-perceived outcomes.

To examine these relations, we surveyed physicians who treated adults with asthma. We ascertained their demographic characteristics, training, practice settings, and the relative frequency with which they reported prescribing various medications for asthma. We linked these survey data to patient interview data that included patient-perceived health status and asthma-specific health-related quality of life.

METHODS

Asthma Disability Subject Enrollment

Patients with asthma were enrolled from the practices of 57 pulmonary specialists and 17 allergy and immunology specialists from 1992 to 1994 and from 34 family practitioners in 1996 (14,15). Physicians were selected randomly from all certified specialists in internal medicine and pulmonology (n = 252), internal medicine and allergy and immunology (n = 40), or family practice (n = 2041) in northern California. Patient eligibility was limited to an age range of 18 to 50 years. Physicians completed a log of eligible patients.

Patients were interviewed at baseline, with follow-up interviews at 18- to 24-month intervals. Data from this study were obtained from follow-up interviews in 1998

From the Division of Occupational and Environmental Medicine (PDB, GE, MSP, MDE), the Division of Pulmonary and Critical Care Medicine (PDB, MDE), the Division of Rheumatology (LT, PPK, EHY), the Department of Medicine; Cardiovascular Research Institute (PDB); and the Institute for Health Policy Studies (PPK, EHY), University of California, San Francisco, San Francisco, California.

Supported by grants from the National Institutes of Health (HL56438 and HL04201), Bethesda, Maryland, and the National Institute for Occupational Safety and Health (OH03480), Centers for Disease Control and Prevention, Atlanta, Georgia.

Requests for reprints should be addressed to Paul D. Blanc, MD, MSPH, Department of Medicine, University of California, San Francisco, 350 Parnassus Avenue, Suite 609, Box 0924, San Francisco, California 94117, or blancp@itsa.ucsf.edu.

Manuscript submitted June 28, 2002, and accepted in revised form December 10, 2002.

and 1999. For patients who were recruited from allergy or pulmonary subspecialists, this was the third follow-up interview; for those recruited from family practice specialists, this was the first follow-up interview. In total, 401 patients completed interviews.

Physician Survey Eligibility and Recruitment

As part of their structured telephone interviews, patients were asked to name and identify the practice location of the health care practitioner whom they considered to be their primary care provider for asthma. These physicians were sent a survey by mail. Physicians who did not respond to the initial mailing were contacted by mail or facsimile at least one additional time and by telephone on at least one occasion. An honorarium of $50 was provided. A physician could have been named by more than 1 patient, but could contribute only one survey response to the study.

Of the 401 patients, 32 (8%) did not name a provider. The remaining 369 patients named 197 health care practitioners, from whom we identified an eligible pool of 175 physicians (89%) (Figure). We obtained survey responses from 147 physicians (84%). Of the 369 patients who named a provider, 317 (86%) were linked to a physician who completed a survey.

Physician Demographic Factors, Training, and Practice Setting

Participating physicians were asked to complete a four-page questionnaire that ascertained demographic characteristics, years elapsed since completion of medical school, and type and extent of specialty and subspecialty training completed. Physicians also provided information on their overall patient visit volume, the proportion of patients with health maintenance organization (HMO) or preferred provider organization (PPO) reimbursement, and general primary care responsibilities. We defined three dichotomous practice measures. An HMO- or PPO-predominant practice was defined as $\geq$75% of patients in the physician's practice covered by such insurance. High-volume asthma care was defined as a patient visit volume of more than 50 patients per week, of whom $>$15% have a diagnosis of asthma, with the physician also noting that he or she provides primary care for $\geq$20% of these patients. A high asthma severity case mix was defined as $\geq$25% of persons with asthma in the practice having physician-assessed severe disease, with the physician reporting that he or she also provides in-hospital patient care for asthma.

Clinical Asthma Management Strategies

Physicians were asked to provide information about their prescribing frequencies for various medications and treatments for the adult asthma patients in their practice. The survey asked, "Among all adults with asthma in your practice, including mild, moderate, and severe cases, what proportion receive the following medications or other treatments?" In this analysis, we tested three prescribing strategies for asthma: leukotriene modifiers, because of the rapid increase in their use since their introduction into clinical practice in the last 5 years (16); theophylline-containing medications, because of the marked decrease in their use during the last 20 years (17); and inhaled long-acting beta-agonists, because this treatment is a key component of current asthma management guidelines (13). For each strategy, based on the observed distribution, we identified a cutpoint for frequent prescribing (leukotriene modifiers at 30% of patients with asthma, theophylline at 10%, and long-acting beta-agonists at 70%).

Patient Outcomes

We defined dependence on systemic corticosteroids among patients based on information noted in physicians' recruitment logs at the time of enrollment. We analyzed two outcome variables that measured general health status and asthma-specific quality of life. This analysis was based on scales with established psychometric properties: the Short Form–12 (SF-12) (18), a generic health status measure, and the Marks Asthma Quality-of-life Questionnaire, an asthma-specific measure (19,20). We used the physical component score derived from the SF-12, which measures an underlying physical dimension of health (18,21).

Statistical Analysis

All analyses were carried out with SAS (SAS Institute, Cary, North Carolina). We used a hierarchical approach to data analysis, developing a series of multivariate models to describe the relations between physician characteristics and patient attributes. In the first series of logistic regression analyses, the physician was the unit of analysis ($n = 147$) and we treated physicians' demographic and practice characteristics as independent variables. In these analyses, we treated the three prescribing strategies (frequent prescription of leukotriene modifiers, theophylline, or long-acting beta-agonists) as dependent variables. For each of these dependent variables, we performed separate multiple logistic regression analyses using the same predictive models defined a priori.

Using linear regression analyses, we studied the relation of physicians' characteristics and asthma management strategies to patient health outcomes. Patients linked to their surveyed physician constituted the unit of analysis ($n = 317$). We used the Student *t* test, the chi-squared test for trend (ordinal income and education levels), and the chi-squared test to analyze the differences between patients who were and were not included in this analysis of health outcomes.

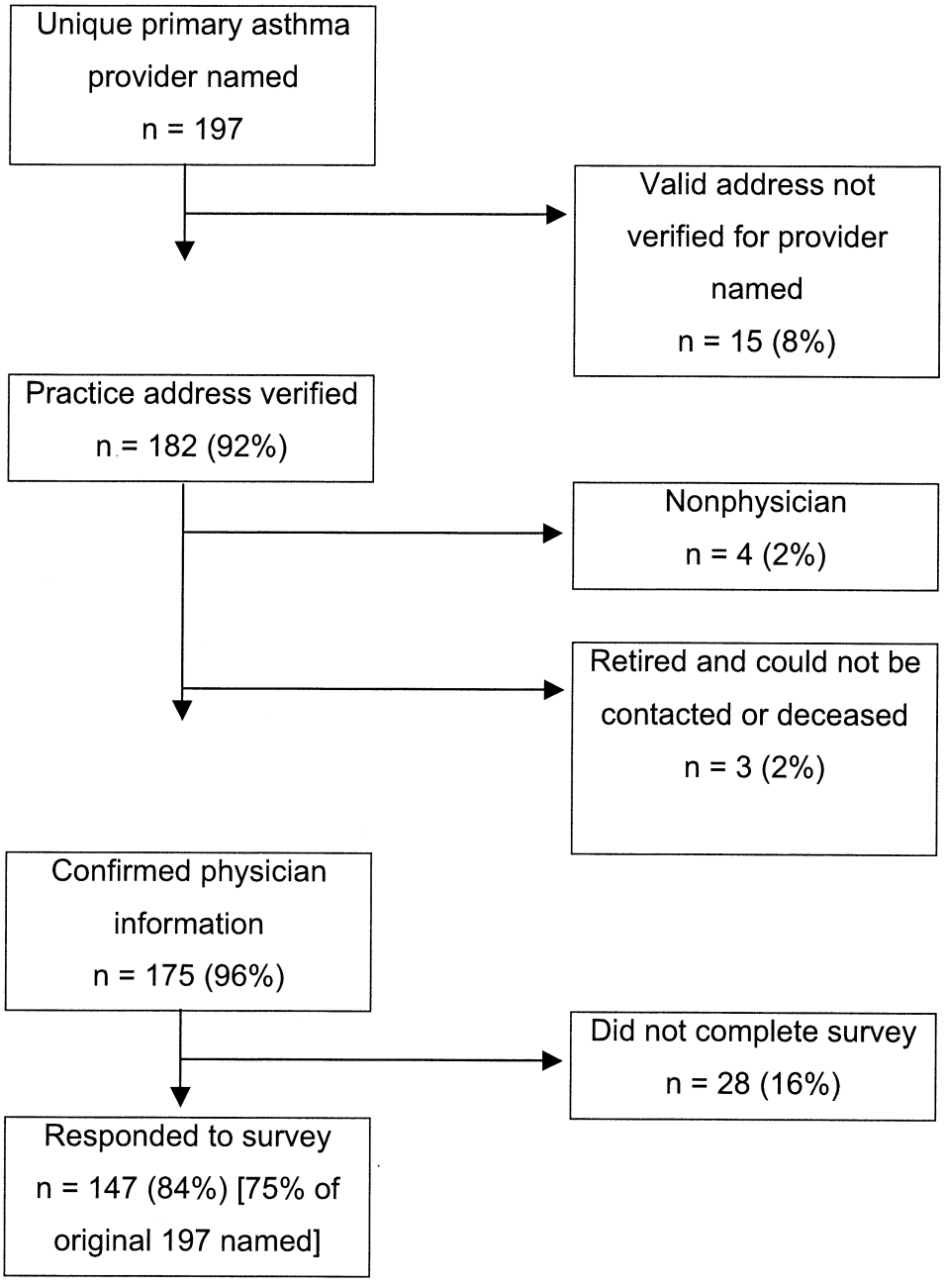

Figure 1. Physician recruitment from the 197 providers listed by study patients.

We analyzed factors associated with two outcome measures: the SF-12 physical component score and the Marks asthma-specific quality-of-life score. We tested models that included patient characteristics, physician characteristics, and the prescribing strategies. Because the study design led to clustering of patients by physician (median number of patients per physician, 3; range, 1 to 25 patients), to account for the potential correlation arising from this clustering, we used a mixed-model approach for this set of analyses, treating the individual physician as a random-effect modifier.

RESULTS

Most physicians were men who had been in practice for many years (Table 1); only 1 in 5 had graduated from medical school within 15 years of the survey. Pulmonary

and allergy subspecialists accounted for slightly more than half of those surveyed.

Pulmonary specialty training was associated with the likelihood of being a high-frequency prescriber for each of the medications analyzed, although this was not statistically significant for long-acting beta-agonists (Table 2). Physicians in HMO- or PPO-predominant practices were less likely to prescribe leukotrienes frequently (Table 2).

Compared with patients whose physicians did not participate in the survey, those with participating physicians were slightly older and more likely to be in higher income categories and to have health insurance (Table 3).

Patient education and income were positively related to better health status and quality of life (Table 4), whereas steroid-dependent asthma was associated with worse health status and quality of life. In contrast, the physicians' attributes had little effect on either health status or quality of life. Although patients of physicians in HMO- or PPO-predominant practices reported somewhat better health status, there was no association with quality of life.

None of the three prescribing practices was associated statistically with physical health status or quality of life (Table 4).

Table 1. Characteristics of the 147 Physicians Who Responded to the Survey

Characteristics	Number (%) or Mean ± SD
Male sex	117 (80)
Age (years)	49 ± 8
Years since medical school graduation	23 ± 8
Graduated from medical school within last 15 years	30 (20)
Specialization	
Pulmonary	55 (37)
Allergy/immunology	23 (16)
Family practice	39 (27)
Other or none	30 (20)
Practice and case-mix characteristics	
HMO- or PPO-predominant practice	45 (31)
High-volume asthma care	36 (24)
High asthma severity case mix	44 (30)

HMO = health maintenance organization; PPO = preferred provider organization.

DISCUSSION

We found that pulmonary physicians were more likely to report being high-frequency prescribers of specific asthma medications, whereas physicians in HMO- or PPO-predominant practices were less likely to be high-frequency prescribers of leukotriene inhibitors. However, these physician characteristics were not associated with patient-reported outcomes of health status or quality of life. In contrast, patient sociodemographic factors were associated with the same outcomes.

There has been considerable interest in the effects of physician specialty training on asthma outcomes, especially for allergy specialists. In an HMO-based study in Oregon, care by allergy specialists, compared with general internists, was associated with better Short Form–36 (SF-36) physical component scores, but not with better quality-of-life scores measured by the Marks scale (22). A prospective but nonrandomized study comparing newly enrolled adult patients with respiratory symptoms (but not clearly defined as asthma) who were followed by either a general internist or allergy specialist observed a one-point decline in summary SF-36 score among the generalist-treated patients and a five-point improvement in the allergist-treated group (23).

One other study has surveyed adults with asthma and their treating physicians, including pulmonary specialists, allergy specialists, and general internists (24). Taking into account patient demographic characteristics, illness severity, and quality-of-care indicators, treatment by pulmonary specialists was not associated with any difference in the SF-36 physical summary score, whereas care by an allergy specialist was associated with an almost three-point better score. This study was HMO based and did not examine other practice settings, the physician survey was limited to training and self-reported asthma expertise, and no asthma-specific quality-of-life measure was analyzed.

Other physician-related factors that may be related to asthma-related health status or quality of life have received little attention. A recent study of physicians' "participatory decision making" (based on patients' reports) found that lower participatory decision-making scores were associated with poorer SF-36 physical component scores and poorer asthma-specific quality of life, but there was no consistent gradient of effect (25). In terms of patient-related determinants of perceived health status, our findings are similar to an analysis of adults with asthma in a Michigan HMO. In that study, sex, education, income, and illness severity were all significant predictors of physical health status. Physician-related factors were not included in that analysis (26).

Our study had several limitations. We did not assess the efficacy of specific intervention strategies, as might be done in a controlled trial; however, clinical trials are not useful for studying the complex and interactive nature of patient and physician characteristics. We did not review medical records, and surveyed physicians may have underreported or overreported certain practices. The

Table 2. Associations between Physician and Practice Characteristics and Reported Prescribing Practices

	Frequent Prescribing of:		
	Long-Acting Beta-Agonists	Leukotriene Modifiers	Theophylline Medications
Factors	Odds Ratio (95% Confidence Interval)*		
Physician characteristics			
>15 years since medical school graduation	0.5 (0.1–1.8)	0.3 (0.1–1.1)	0.8 (0.3–2.5)
Female sex	0.4 (0.1–1.9)	0.7 (0.1–3.4)	0.4 (0.1–1.3)
Specialization			
Pulmonary subspecialty†	2.0 (0.6–7.4)	4.7 (1.2–18)	3.0 (1.0–9.0)
Allergy subspecialty†	3.4 (0.8–15)	1.3 (0.1–14)	0.4 (0.1–1.7)
Practice and case-mix characteristics			
HMO- or PPO-predominant practice	0.4 (0.1–1.3)	0.1 (0.01–0.5)	1.5 (0.6–3.8)
High-volume asthma care	2.1 (0.8–5.4)	0.5 (0.2–1.5)	1.2 (0.5–2.8)
High asthma severity case mix	1.7 (0.6–5.6)	2.1 (0.6–6.8)	0.8 (0.1–1.7)

* An odds ratio >1 indicates that the characteristic was associated with a greater likelihood of being a high-frequency prescriber of the particular medication class.
† Compared with all other physicians.
HMO = health maintenance organization; PPO = preferred provider organization.

patients in our study may not be representative of all those with asthma in the practices that we surveyed. Moreover, we did not link patients to individual therapies. Although family practitioners were well represented in our sample, we had relatively few general internists. Our response rate of 84% is excellent in comparison to most physician surveys and minimizes the likelihood of meaningful selection effects at this level (27). Finally, all our patients lived in California, and our results may not apply to other geographic areas.

Prescribing habits in asthma have changed markedly, with an increase in the use of long-acting beta-agonists and inhaled steroids and a reduction in the use of theophylline and related methylxanthines. More recently, there has been a rapid increase in the use of leukotriene modifiers (16,17). Thus, asthma should be an ideal condition to study the link between practice variation and patient outcomes. Yet, we found that differences in asthma-specific prescribing tendencies do not explain much of the variability in patient-perceived health status and quality

Table 3. Characteristics of Patients with Asthma For Whom Physician Surveys Were and Were Not Available

	Subjects with Physician Survey (n = 317)	Subjects without Physician Survey (n = 84)	*P* Value
Characteristics	Number (%), Mean ± SD, or Median (25th–75th Percentile)		
Female sex	224 (71)	61 (73)	0.83
Age (years)	45 ± 7.5	42 ± 8.0	<0.001
Non-Hispanic white	236 (75)	54 (64)	0.09
Education			0.08
High school	62 (20)	24 (29)	
Some college	117 (37)	30 (36)	
College graduate	138 (44)	30 (36)	
Annual household income			0.02
<$20,000	58 (18)	23 (27)	
$20,000 to $39,999	47 (15)	12 (14)	
$40,000 to $74,999	105 (33)	32 (38)	
≥$75,000	107 (34)	17 (20)	
Any health insurance	308 (97)	77 (92)	0.05
SF-12 physical component score	46 ± 12	46 ± 12	0.94
Quality-of-life score	12 (5–23)	12 (6–23)	0.80
Steroid dependent at study entry	45 (14)	9 (11)	0.52

SF-12 = Short Form–12.

Table 4. Factors Associated with Physical Health Status and Asthma-Specific Quality of Life (n = 317 Patients)

Factors	SF-12 Physical Component Score* Mean Difference (95% Confidence Interval)	*P* Value	Quality-of-life Score* Mean Difference (95% Confidence Interval)	*P* Value
Patient characteristics				
Female sex	–3.5 (–0.9 to –6.2)	<0.01	2.8 (–0.8 to 6.4)	0.13
High school or less†	–3.8 (–0.5 to –7.1)	0.02	2.5 (–1.9 to 7.0)	0.27
Some college†	–5.4 (–2.7 to –8.1)	<0.01	6.2 (2.6 to 9.9)	<0.01
Annual family income of $20,000 to $39,999‡	3.0 (–1.1 to 7.3)	0.15	−5.3 (–10.3 to 0.3)	0.06
Annual family income of $40,000 to $74,999‡	3.8 (0.3 to 7.3)	0.03	–6.0 (–10.7 to –1.2)	0.01
Annual family income ≥$75,000‡	5.1 (1.5 to 8.7)	<0.01	−5.6 (−10.4 to −0.7)	0.02
Steroid-dependent asthma	–8.9 (–5.5 to –12.3)	<0.01	7.6 (3.0 to 12.2)	<0.01
Physician characteristics				
Female sex	1.3 (–2.0 to 4.7)	0.44	–2.7 (–7.2 to 1.9)	0.25
>15 years since medical school graduation	0.9 (–4.1 to 5.1)	0.7	–3.0 (–8.7 to 2.7)	0.30
Pulmonary subspecialist§	0.4 (–3.3 to 4.2)	0.8	0.4 (–4.6 to 5.5)	0.9
Allergy subspecialist§	0.3 (–3.4 to 4.0)	0.9	0.3 (–4.8 to 5.1)	0.9
HMO- or PPO-predominant practice	3.1 (0.05 to 6.2)	0.05	–0.6 (–4.8 to 3.5)	0.8
High-volume asthma care	1.6 (–1.4 to 4.5)	0.29	0.1 (–3.8 to 4.1)	>0.9
High asthma severity case mix	–1.7 (–4.9 to 1.5)	0.30	–2.4 (–6.8 to 1.9)	0.27
Frequent long-acting beta-agonist prescriber	0.5 (–2.8 to 3.8)	0.8	1.5 (–3.0 to 6.0)	0.5
Frequent leukotriene-modifier prescriber	–0.9 (–4.6 to 2.9)	0.7	2.7 (–2.4 to 7.7)	0.3
Frequent theophylline prescriber	–0.8 (–3.8 to 2.1)	0.6	–0.6 (–4.6 to 3.4)	0.8

* The numbers represent the mean difference between those with a given characteristic and those without that characteristic (e.g., female vs. male patients). Negative numbers indicate worse physical functioning (SF-12 scores), but better quality of life. Adjusted for age, race, and health insurance status.

† Compared with college graduates.

‡ Compared with annual income <$20,000.

§ Compared with all other physicians.

SF-12 = Short Form–12.

of life, nor do other physician-related individual or practice-level attributes appear to affect these outcomes.

ACKNOWLEDGMENT

The authors thank Stephen Shiboski, PhD, for his input and review of the statistical modeling used in this analysis.

REFERENCES

1. Wennberg JE. Dealing with medical practice variations: a proposal for action. *Health Aff (Millwood).* 1984;3:6–32.
2. Folland S, Stano M. Small area variations: a critical review of propositions, methods, and evidence. *Med Care Rev.* 1990;47:419–465.
3. Parchman ML. Small area variation analysis: a tool for primary care research. *Fam Med.* 1995;27:272–276.
4. Henke CJ, Epstein WV. Practice variation in rheumatologists' encounters with their patients who have rheumatoid arthritis. *Med Care.* 1991;29:799–812.
5. Greenfield S, Nelson EC, Zubkoff M, et al. Variations in resource utilization among medical specialties and systems of care. Results from the Medical Outcomes Study. *JAMA.* 1992;267:1624–1630.
6. Gosden T, Forland F, Kristiansen IS, et al. Impact of payment on behavior of primary care physicians: a systematic review. *J Health Serv Res Pol.* 2001;6:44–55.
7. Westert GP, Groenewegen PP. Medical practice variations: changing the theoretical approach. *Scand J Public Health.* 1999;27:173–180.
8. Davis P, Gribben B, Scott A, Lay-Yee R. The "supply hypothesis" and medical practice variation in primary care: testing economic and clinical models of inter-practitioner variation. *Soc Sci Med.* 2000;50:407–418.
9. Casparie AF. The ambiguous relationship between practice variation and appropriateness of care: an agenda for further research. *Health Pol.* 1996;35:247–265.
10. Roter DL, Hall JA, Aoki Y. Physician gender effects in medical communication: a meta-analytic review. *JAMA.* 2002;288:756–764.
11. Mannino DM, Homa DM, Pertowski CA, et al. Surveillance for asthma–United States, 1960-1995. *MMWR Morb Mortal Wkly Rep.* 1998;47(suppl):S1–S27.
12. Jonson B. Measuring the economic burden of asthma. In: Weiss KB, Buist AS, Sullivan SD, eds. *Asthma's Impact on Society.* New York, New York: Marcel Dekker, Inc; 2000:251–267.
13. National Institutes of Health. National Heart, Lung, and Blood Institute. *Expert Panel Report 2. Guidelines of the Diagnosis and Management of Asthma.* Bethesda, Maryland: U.S. Department of Health and Human Services; 1997. NIH publication 97-4051.
14. Blanc PD, Cisternas M, Smith S, Yelin E. Asthma, employment status, and disability among adults treated by pulmonary and allergy specialists [published correction appears in *Chest.* 2000;118:564]. *Chest.* 1999;109:688–696.

15. 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 [published correction appears in *Med Care.* 2000;38:880–885]. *Med Care*. 1998;36:1567–1577.
16. Terr AI, Bloch DA. Trends in asthma therapy in the United States 1965-1992. *Ann Allergy Asthma Immunol.* 1996;76:273–281.
17. National Institute for Health Care Management Research Educational Foundation. *Prescription Drug Expenditures in 2000: The Upward Trend Continues*. Washington, D.C.: National Institute for Health Care Management Research Educational Foundation; 2001.
18. Ware JY, Kosiniski M, Keller SD. *How to Score the SF-12 Health Survey.* 2nd ed. Boston, Massachusetts: The Health Institute, New England Medical Center; 1995.
19. Marks GB, Dunn SM, Woodcock AJ. A scale for the measurement of quality of life in adults with asthma. *J Clin Epidemiol.* 1992;45:461–472.
20. Katz PP, Eisner MD, Henke J, et al. The Marks asthma quality of life questionnaire: further validation and examination of responsiveness to change [published correction appears in *J Clin Epidemiol.* 2000;54:104–107]. *J Clin Epidemiol.* 1999;52:667–675.
21. Gandek B, Ware JE, Aaronson NK, et al. Cross-validation of item selection and scoring for the SF-12 health survey in nine countries. *J Clin Epidemiol.* 1998;51:1171–1178.
22. Vollmer WM, O'Hallaren M, Ettinger KM, et al. Specialty differences in the management of asthma: a cross-sectional assessment of allergists' patients and generalists' patients in a large HMO. *Arch Intern Med.* 1997;157:1201–1208.
23. Kanter LJ, Siegel CJ, Snyder CF, Pelletier EM, Buchner DA, Goss TF. Impact of respiratory symptoms on health-related quality of life and medical resource utilization of patients treated by allergy specialists and primary care providers. *Ann Allergy Asthma Immunol.* 2002;89:139–147.
24. 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.
25. Adams RJ, Smith BJ, Ruffin RE. Impact of the physician's participatory style on asthma outcomes and patient satisfaction. *Ann Allergy Asthma Immunol.* 2001;86:263–271.
26. Erickson SR, Christian RD Jr, Kirking DM, Halman LJ. Relation between patient and disease characteristics and health-related quality of life in adults with asthma. *Respir Care.* 2002;96:450–460.
27. Kellerman SE, Herold J. Physician response to surveys. A review of the literature. *Am J Prev Med.* 2001;20:61–67.