Costs and Utilization Patterns Associated With Persistent Asthma: A Comparison of Texas Medicaid Patients With and Without Continuous Inhaled Corticosteroid Treatment

OBJECTIVE: To compare the change in Texas Medicaid prescription and medical payments and utilization patterns between asthma patients continuously treated with inhaled corticosteroids (SG) and asthma patients continuously treated with therapies other than inhaled corticosteroids (NSG).

DESIGN: A retrospective 1:3 matched cohort was created by analyzing Texas Medicaid database claims made between March 1996 and June 1998.

PATIENTS: Patients, regardless of age, who (1) were eligible for Medicaid benefits during an 18-month period; (2) had a diagnosis for asthma; and (3) had continuous use of asthma medications during the 18-month period.

RESULTS: Profiles for 396 patients (99 treated with inhaled corticosteroids, 297 treated with other therapies) were analyzed. Post-steroid monthly prescription payments were higher for the SG compared to the NSG, but a decrease in medical payments in the SG offset this increase, so that overall

Medicaid payments were similar between the groups. All types of medical visits (clinic, emergency department [ED], hospitalizations) increased for the NSG during the post-index phase, whereas these visits decreased for the SG patients. The number of ED visits was cut in half after the addition of inhaled corticosteroids among the SG, while the number of ED visits nearly doubled among the NSG. Contrary to findings of previous studies, in this study the patient's first inhaled corticosteroid was prescribed by a general practitioner almost 70% of the time.

CONCLUSIONS: Although prescription payments increased for the SG, the number of medical visits and their cost decreased enough to offset this increase. A decrease in medical visits, especially for acute care, may indicate better outcomes for the Medicaid patients with no increase in overall cost.

KEYWORDS: Inhaled corticosteroids, Asthma, Medicaid, Costs, Utilization

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Asthma is a disorder characterized by inflammation of the lung airways that manifests as episodes of wheezing, chest tightness, and coughing. Asthma is a common illness estimated to affect nearly 14 million individuals in the United States.¹ Asthma is the most common chronic disease in childhood, affecting nearly five million children.² Asthma prevalence varies with age, ethnicity, socioeconomic status, and urban dwelling.³ High mortality rates related to asthma occur in inner-city, high-poverty areas where high proportions of African Americans live.⁴ Annual rates of asthma mortality in the United States stabilized in the 1990s.⁵ However, asthma mortality remains higher today compared to the mortality rates recorded over the previous 20 years.⁵

In an effort to address the issue of asthma mortality in the United States, the National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health published *Guidelines for the Diagnosis and Management of Asthma: Expert Panel Report II*.⁶ In its report, the expert panel recommends the use of inhaled corticosteroids as first-line treatment for all categories of persistent asthma patients. Despite the asthma-treatment recommendations of the NHLBI, the primary factor contributing to increasing asthma morbidity and mortality is undertreatment of asthma.⁷ A recent survey of patients admitted to a Baltimore hospital with moderate to severe asthma reported that fewer than half had been prescribed inhaled anti-inflammatory therapy.⁸ Undertreatment may be explained by factors such as lack of access to ongoing medical care, inability to afford care, cultural and language barriers, and lack of patient education about the seriousness of asthma.⁹⁻¹² Multidimensional factors such as inner-city dwelling (including exposure to tobacco smoke, environmental pollution, and allergens) and family dysfunction also may contribute to the undertreatment of asthma.^{3,7,13}

Improper diagnosis and inappropriate treatment of asthma by health care providers may be related to the undertreatment of asthma as well. A number of studies have noted similar patterns between asthma treatment and classification of prescriber. Specialists have been more likely to follow the current prescribing guidelines for asthma (including the use of inhaled anti-inflammatory drugs) than general practitioners.^{12, 14-16}

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Studies also have shown higher emergency department (ED) and hospital utilization among asthma patients treated primarily by generalists versus specialists.^{14, 16, 17} The reasons for such observed disparities in treatment between generalists and specialists are unclear; however, the findings suggest that uncontrolled asthma due to inadequate management of the disease can result in increased medical resource utilization and expenses to treat morbid events. The economic consequences of asthma are substantial and can place a large burden on affected individuals, their families, the health care system, and society as a whole.

A study using the National Medical Expenditure Survey estimated that patients with asthma incurred \$5.1 billion in direct asthma expenditures in 1994.¹⁸ Inpatient hospitalizations accounted for the greatest proportion of total cost for asthma care (54.4%), while asthma prescription medications accounted for 15.9% of the direct asthma costs. Despite these large costs, asthma is the third-leading cause of preventable hospitalizations in the United States.¹⁹ Approximately 39% of potentially avoidable hospitalizations of children under 15 years old are due to asthma.¹⁹ Asthma accounts for 21% of potentially avoidable hospitalizations in patients 15–44 years old, and 15% of avoidable hospitalizations in patients 45–64 years old.¹⁹ The trends suggest that asthma research and intervention efforts directed at reducing hospitalizations, such as managing asthma with appropriate pharmaceuticals, could help to decrease expensive health care resource use and provide cost savings.

High asthma costs have been identified among patients of lower socioeconomic status. For example, a previous study reported that hospitalization rates for asthma increased among children covered by Medicaid or without insurance coverage.²⁰ Among children covered by Medicaid, African American children are more likely to seek ED management of asthma than to receive routine outpatient care.¹¹ Other studies also have shown an association between asthma patients covered by Medicaid and high rates of hospitalization for asthma.^{21, 22} One study found that a greater proportion of patients who experienced a potentially avoidable hospitalization were covered by Medicaid than patients with private insurance.¹⁹ These findings suggest the potential to lower total asthma-related expenditures by reducing the costs incurred among asthma patients covered by Medicaid.

Studies investigating the economic outcomes of using inhaled anti-inflammatory agents to control asthma have been conducted.^{23–37} Retrospective economic analyses of the use of inhaled anti-inflammatory medications by Medicaid recipients with asthma have produced mixed results.^{33–36} A significant limitation often encountered in using claims data to conduct asthma studies is the inability to determine the severity of illness between comparator groups. Several ways have been established to determine the comparability of patients' severity level. The recent NHLBI Workshop on Asthma Outcome Measures for Research Studies reviewed endpoints used in asthma research.³⁸

Health services utilization was described as an important proxy measure of disease morbidity, and as an independent outcome measure for asthma. In addition to utilization, Stempel measured health care costs prior to an intervention, chronic obstructive pulmonary disease (COPD) comorbid conditions, and use of beta2-agonists to control for differences in asthma severity between groups in a retrospective database study comparing the use of fluticasone to a leukotriene modifier.³⁹

Objectives

To date, few studies have been published in which retrospective data were used along a longitudinal time frame to assess the prescription and medical utilization associated with inhaled corticosteroids used continuously in patients with chronic persistent asthma. The purpose of this study is to examine the utilization patterns and economic impact of using inhaled corticosteroids in treating a population of Texas Medicaid patients with chronic asthma. This study was conducted from the perspective of the Texas Medicaid Program.

Methods

Study Population/Data Source

The study population included asthma patients, regardless of age, who (1) were continuously eligible for Texas Medicaid benefits during the study period; (2) had a diagnosis of asthma; and (3) appeared to have chronic disease as evidenced by routine and continuous asthma-related prescription or medical utilization. Texas Medicaid-paid medical and prescription claims between March 1, 1996, and June 30, 1998, were the data used for this study.

Study Design

This study used a retrospective, matched cohort research design. To obtain a sufficient sample size from the 28 months of data available, 18-month time intervals were created and then collapsed together. The 18-month time period for each patient was divided into three six-month subintervals: the pre-index period (months 1–6); the index period (months 7–12); and the post-index period (months 13–18). During months 1–6, patients could take any combination of asthma medications except inhaled corticosteroids. During month 7 an inhaled corticosteroid was added into some patients' current drug regimen, and the inhaled steroid was continued through month 18 (steroid group=SG). Patients not receiving the corticosteroid continued on any asthma drug therapy other than inhaled corticosteroids through month 18 (non-steroid group=NSG).

The categorization of the three six-month subintervals was chosen for a number of reasons. The first six months and the last six months of the 18-month period corresponded to the same calendar months of the year. For each patient, this

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reduced the possible confounding effects of seasonality sometimes found in medical-service utilization patterns. The index period was allowed to last six months to allow time for follow-up visits and dosing adjustments that the addition of the inhaled corticosteroid may necessitate. Furthermore, months 7–12 allow time for any biological pulmonary changes to occur in order to more accurately evaluate the outcome of continuous inhaled corticosteroid therapy.

Data Extraction

The authors were unable to classify each patient's asthma according to the NHLBI criteria with the information contained in the medical claims database. Therefore, inclusion criteria were developed in an attempt to capture patients with persistent asthma. Prescription claims during each six-month subinterval were assessed to identify apparent chronic asthma patients. Patients were retained in the SG if they had at least one prescription claim per month, none of which included an inhaled corticosteroid, for a minimum of four months during the pre-index period; and they had at least one inhaled corticosteroid prescription claim per month for a minimum of four months during both the index and post-index intervals.⁴⁰ Patients who never had a prescription claim for an inhaled corticosteroid during the 18-month study period were retained in the NSG if they had at least one prescription claim per month for a minimum of four months during each six-month subinterval. Using the patient ID numbers generated from the steroid and nonsteroid groups, medical claims data for each patient were obtained. Primary *International Classification of Diseases*, Ninth Revision (ICD-9), coding was used to select asthma-related paid medical claims.⁴¹ Confirmation of each patient's disease was determined by medical services utilization. Patients were retained in the two groups only if an asthma-related paid medical claim existed during any month of the 18-month study period.

Because randomization was not possible in this study, attempts were made to control for differences between steroid and nonsteroid patients. Using age, gender, diagnosis code, and prescription and medical pre-index dollars, three nonsteroid patients were matched to each steroid patient. Although ethnicity is another factor that has been used for matching, it was not available in the database used for this study. Because asthma is more common in childhood, and the recommendations set forth in the NHLBI guidelines distinguish between treatment of adults and children, the study controlled for patient age. Patients under six years old were matched by exact age to control for any differences in NIH treatment guidelines in this age group versus treatment guidelines for children six years and older. NSG patients six years and older were matched to an SG patient within the same age decade if a match by exact age was not available. Gender was controlled for to allow for any gen-

der-specific lifestyle differences between men and women that could not be determined from the information in the database. Patients also were matched specifically for asthma-related diagnoses. Pre-index dollars were used as a proxy measure in an attempt to match for severity of illness. Finally, the ratio of a 1:3 match was based on recommendations for sample size calculations in case-control studies.⁴²

Statistical Tests

The difference between the SG and the NSG in pre-index and post-index mean monthly Medicaid payments was compared using independent groups statistical tests. One test compared prescription payments, one test compared medical utilization payments, and one test compared the combined prescription and medical payments. An alpha level of 0.05 was used to test for significance. Data were extracted from the Texas Medicaid database using Microsoft FoxPro.⁴³ Data analyses were conducted via SPSS, and SAS software.^{44, 45}

Wide variability existed in many of the payment data sets, particularly the medical claims data, as shown by the large standard deviations. Although certain nonparametric statistical tests may be used to analyze non-normally distributed data, the skewed nature of medical payments can provide erroneous results with rank-order statistics.⁴⁶ Therefore, the prescription, medical, and overall Medicaid costs were adjusted using the bootstrapping statistical technique.^{47, 48} More detailed information on the distribution parameters and the bootstrap technique used in this study has been published.⁴⁹

Results

Sample Selection

There were more than 2.8 million Texas Vendor Drug paid asthma medication claims for over 685,000 patients. Of these, nearly 59,000 patients had a prescription claim for an inhaled corticosteroid. Of these, 884 patients had no corticosteroid inhalers filled during the first six months of therapy. Only 104 steroid patients fulfilled the remaining prescription utilization inclusion criteria and also had at least one paid asthma-related medical claim. Of the original nonsteroid patients, 4,015 patients had prescription profiles that fulfilled the inclusion criteria. However, only 1,494 nonusers of inhaled corticosteroids had at least one paid asthma-related medical claim. The pre-index dollars for prescription and medical services were calculated for each patient. Using gender, age, diagnosis, and pre-index dollars, three nonsteroid patients were matched for each steroid patient. No comparison matches could be identified for five steroid patients. Therefore, after data filters were implemented, eligibility verified, and one-to-three matching completed, data for a total sample of 396 patients (99 steroid patients and 297 nonsteroid patients) were analyzed.

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TABLE 1 Distribution of Patients in the Inhaled Steroid Group by Age

Age	Steroid Group ^a n=99	Nonsteroid Group ^b n=297
	Frequency (Percent)	Frequency (Percent)
0–5	14 (14.1%)	45 (15.2%)
6–12	42 (42.4%)	119 (40.1%)
13–19	10 (10.1%)	34 (11.4%)
20–29	1 (1.0%)	4 (1.3%)
30–39	4 (4.0%)	9 (3.0%)
40–49	11 (11.1%)	27 (9.1%)
50–59	3 (3.0%)	17 (5.7%)
>60	14 (14.2%)	42 (14.1%)

^aMean age=24.4 years (SD=24.6); ^bMean age=24.0 years (SD=24.1)

Both groups consisted of 45% males and 55% females. There was no statistical difference in age between groups. A distribution of patient ages can be found in Table 1, above. Post-hoc comparisons showed that about one-fourth of the patients also had a primary diagnosis for COPD some time in the pre-index period: 18% SG and 25% NSG. Also, during the pre-index period both groups had similar utilization of asthma medications. Most patients had prescriptions for quick-relief medications (quick-acting inhaled sympathomimetics 86% SG–89% NSG and/or inhaled antimuscarinics 9% SG–11% NSG). Patients in both groups had a mix of asthma preventive medications (non-inhaled adrenals 32% SG–36% NSG; preventive inhaled sympathomimetics 10% SG–6% NSG; smooth muscle relaxants 22% SG–34% NSG; and long-acting oral sympathomimetics 16% SG–6% NSG).

Payments

Average Medicaid payments per month for prescriptions, medical services, and total services (prescription plus medical) are listed in Table 2, page 456. There were no statistical differences between groups in average monthly payments during the pre-index period. Following bootstrapping, the change in mean monthly asthma-related prescription payments per steroid patient equaled an increase of \$56.99 (SD=\$5.69). The change in mean monthly asthma-related prescription payments per nonsteroid patient equaled an increase of \$0.80 (SD=\$2.06). The change in mean monthly payments between the SG and NSG was statistically significant ($p<0.01$). Following bootstrapping, the mean of the difference in mean monthly asthma-related medical payments per steroid patient equaled a decrease of \$52.63 (SD=\$21.08). The mean of the difference in mean monthly asthma-related medical payments per nonsteroid patient equaled an increase of \$25.82 (SD=\$15.98). The change in mean monthly payments between the steroid and nonsteroid

groups was statistically significant ($p<0.01$). After bootstrapping the data, there was no statistically significant difference in the change in mean monthly overall (prescription plus medical) asthma-related Medicaid payments between the SG and NSG. The change in mean monthly overall payments equaled an increase of \$4.37 (SD=\$22.50) and \$25.84 (SD=\$15.48) for the SG and the NSG respectively.

Types of Medical Services Utilization

Because of the significant difference in medical utilization payments, the authors categorized and examined the types of medical services used by each group (see Table 3, page 456). The number of physician office/outpatient clinic visits, inpatient hospital visits, and emergency department visits decreased between the pre-index and post-index periods in the SG. Conversely, the frequencies of similar medical visits between the pre- and post-index periods among the nonsteroid patients increased.

Medication Prescribing Patterns by Practitioner

Because so few patients met the criterion of continuous inhaled corticosteroid use, the authors were interested in the type of practitioner prescribing the inhaled corticosteroid. For the purposes of this study, three classes of prescribers were created: generalists, urgent-care providers, and specialists. Generalists consisted of those prescribers who were classified in the database as family practice, general practice, internal medicine/general, and pediatrics. Urgent-care providers were prescribers identified by physician code as having treated the patient in a hospital's ED. Specialists consisted of prescribers who were classified in the database as allergy, allergy-immunology, pulmonary disease, and pediatric-allergy practitioners.

During the pre-index period, both groups of patients were being treated by the three types of practitioners in nearly equal proportions (roughly 80% by generalists, 12% by specialists, and 8% through urgent care). Of the 80 patients within the SG who were seen by a generalist during the pre-index period, 55 (69%) were introduced to an inhaled corticosteroid by a generalist, 14 (17%) received their first inhaled corticosteroid prescription from a specialist, and 11 (14%) were introduced to inhaled corticosteroid therapy in the ED. More than 90% of those introduced to the corticosteroid by a general practitioner or a specialist continued to receive most of their asthma prescriptions from that practitioner type for the rest of the study period, whereas those who received the initial corticosteroid from an urgent care practitioner received continued therapy from a mix of practitioner types.

Within the NSG, 80% (n=236) also received most of their prescriptions during the first six-month period from a general practitioner. About 94% (n=221) continued to receive most of their prescriptions from a general practitioner throughout the next 12 months of the study period.

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TABLE 2 Mean Monthly Asthma-Related Payments per Steroid and Nonsteroid Patient Before and After the Introduction of Inhaled Corticosteroids

Group	Mean Pre-Index (SD)	Mean Post-Index (SD)	Mean Difference (SD)	Bootstrap Sample Mean Difference (SD)
Prescription Payments				
Steroid (n=99)	\$58.99 (\$56.71)	\$116.04 (\$73.56)	\$57.05 ^a (\$56.09)	\$56.99 ^b (\$5.69)
Nonsteroid (n=297)	\$53.44 (\$44.97)	\$54.56 (\$44.23)	\$1.12 (\$39.83)	\$0.80 (\$2.06)
Medical Payments				
Steroid (n=99)	\$80.68 (\$211.07)	\$27.70 (\$98.18)	-\$52.97 ^c (\$216.87)	-\$52.63 ^d (\$21.08)
Nonsteroid (n=297)	\$64.59 (\$173.91)	\$88.96 (\$268.29)	\$24.36 (\$270.57)	\$25.82 (\$15.98)
Overall Payments				
Steroid (n=99)	\$139.67 (\$214.84)	\$143.74 (\$133.04)	\$4.08 ^e (\$216.87)	\$4.37 ^f (\$22.50)
Nonsteroid (n=297)	\$118.03 (\$173.99)	\$143.51 (\$274.58)	\$25.48 (\$273.76)	\$25.84 (\$15.48)

^at-test based on original data ($t = 9.18$, $df = 132$, $p < 0.01$); ^bt-test based on bootstrap analysis using 150 samples ($t = 9.18$, $df = 132$, $p < 0.01$); ^ct-test based on original data ($t = -2.88$, $df = 208$, $p < 0.01$); ^dt-test based on bootstrap analysis using 150 samples ($t = -2.91$, $df = 216$, $p < 0.01$); ^et-test based on original data ($t = -0.76$, $df = 198$, $p = 0.45$); ^ft-test based on bootstrap analysis using 150 samples ($t = -0.77$, $df = 199$, $p = 0.44$)

TABLE 3 Frequency of Visits for Various Types of Medical Services Before and After the Addition of Inhaled Corticosteroids for the Steroid and Nonsteroid Groups

Type of Service	Steroid Group (n=99)			Nonsteroid Group (n=297)		
	Pre-Index	Post-Index	% change	Pre-Index	Post-Index	% change
Physician office /clinic	183 visits	165 visits	-10%	431 visits	612 visits	+42%
Emergency department visit	14 visits	6 visits	-57%	50 visits	95 visits	+90%
Hospital (inpatient) ^a	12 visits	5 visits	-58%	39 visits	42 visits	+8%

^aAverage length of hospital visit was three days for each group both before and after index dates

Discussion

Prescription Payments

The introduction and continuous use of inhaled corticosteroids resulted in higher prescription payments for the Texas Medicaid program. However, this increase in prescription payments was anticipated due to the increased utilization of these medications. The slight change in prescription payments among the nonsteroid patients following the index period suggests that therapies remained relatively constant in this group. These results may provide support for the argument that changes in other health care payments following the introduction of inhaled corticosteroids may be attributable to the steroid.

Medical Payments

The mean monthly Texas Medicaid payments for medical services decreased following the introduction of inhaled corticosteroids (and a six-month stabilization period). In contrast, asthma-

ma-related medical payments increased during the post-index period among nonsteroid patients. One reason for the results in this study may be the mechanism of action of inhaled corticosteroids and the subsequent clinical outcome. Anti-inflammatory agents treat the underlying pathophysiology of asthma. The anti-inflammatory activity of inhaled corticosteroids may lead to more favorable disease outcomes, such as fewer asthma exacerbations, compared to other anti-asthma therapies that do not exert anti-inflammatory activity. Therefore, asthma patients who use inhaled corticosteroids may gain better control of their disease and have less need for expensive medical services utilization due to uncontrolled asthma.

Overall Payments

There was no significant difference between groups in overall payments made by Texas Medicaid. The increase in Texas Medicaid prescription payments was about the same as the decrease in medical payments seen in the SG. Because prescrip-

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tion payments in the NSG increased only slightly, the overall increase in payments for this group is primarily attributable to an increase in medical expenses for these patients. These results provide evidence that treating persistent asthma patients with inhaled corticosteroids over time will not cost Texas Medicaid significantly more than if patients were not treated with inhaled corticosteroids. There actually may be a potential for significant cost savings for Texas Medicaid when inhaled corticosteroids are prescribed, due to the marked decrease in medical services utilization that resulted among the steroid patients. Other studies within a Medicaid population found a 23%–25% decrease in overall costs for patients who used inhaled corticosteroids compared to those who did not.^{35, 36}

Types of Medical Services Utilization

In order to determine more accurately the effect of inhaled corticosteroids on asthma-related medical utilization, it is important to explore how the number of medical-services visits compares between the two groups. The data in this study showed that the frequency of medical visits decreased among those patients who received add-in inhaled corticosteroid therapy, while the frequency of medical visits increased among those asthma patients who never received an inhaled corticosteroid. Some important trends that occurred in this study are noteworthy.

The conclusion of whether the change in physician and clinic visits was favorable or unfavorable to Texas Medicaid should be based upon the corresponding changes in ED visits and inpatient hospitalizations. For instance, an increase in physician and clinic visits could correspond with a decrease in ED visits and hospitalizations. Such a situation is advocated by most managed care organizations, because when patients seek less-expensive routine care the need for expensive ED and hospital care decreases. This situation also would be economically favorable to the Medicaid program. However, in this study there was a sizable increase in physician and clinic visits among nonsteroid users (42% increase) in addition to increases in ED visits and hospitalizations. Conversely, there was a slight decrease in physician and clinic visits (10% decrease) as well as a decrease in ED visits and hospitalizations in the SG. Such a trend may provide evidence that the continuous use of inhaled corticosteroids decreases the need for ED or hospital intervention of asthma exacerbations.

Another note to discuss is the change in hospitalizations between groups. A sizable decrease in hospitalizations occurred in the SG (58%) following the addition of inhaled corticosteroids, while there was a slight increase in hospitalizations (8%) in the NSG. One study found inpatient hospitalizations accounted for the greatest proportion of total cost for asthma care.¹⁸ Although hospitalizations occurred infrequently in this study (as in most studies), they result in significant costs.

The most dramatic change occurred in the number of ED vis-

its between groups. ED visits were cut in half after the addition of inhaled corticosteroids among the SG (57% decrease), while ED visits nearly doubled among the NSG (90% increase). Such a large increase in ED visits may be attributable to poorly controlled asthma. A previous study reported that certain demographic groups covered by Medicaid were more likely to seek ED management of asthma rather than routine outpatient care.¹¹

Medication Prescribing Patterns by Practitioner

The reasons for the reported trends are varied, and further research is needed to find the best interventions for changing physician health care delivery and patient behaviors. Based on the data in the database, the authors were unable to determine why a large percentage of patients with apparent persistent asthma were not treated with inhaled corticosteroids. Jatulis et al. speculated that gaps in guideline dissemination to physicians, alternate treatment options chosen by physicians, or patients simply not filling their anti-inflammatory prescriptions are possible explanations.¹² Others have speculated that such factors as financial incentives, perceived societal pressures, patient preferences and demands, and fear of malpractice may influence prescriber decision making.^{50, 51} It also has been noted that efforts to develop treatment strategies and guidelines can be hampered by the wide diversity of patients to whom the guidelines will be applied, and the absence of empirical and expert consensus on appropriate trade-offs between costs and effects.⁵¹ Although this study cannot answer why this population showed such a low rate of inhaled corticosteroid use, the types of prescribers were categorized. Although a severe asthma exacerbation might lead to intervention by an ED physician or a specialist, almost 70% of prescribers who initiated inhaled corticosteroid use in this study were general practitioners.

Study Limitations

Some limitations to this study should be considered when interpreting the results. Demographic features unique to Texas Medicaid recipients may limit generalizability to other state Medicaid programs. Restrictions in the Texas Medicaid Vendor Drug Program also should be considered; for instance, Texas imposes a three-prescription per month limit on Medicaid beneficiaries who are over 21 years old and not in a managed care or long-term setting. Some patients may have paid out-of-pocket for additional medications, and these drugs would not be listed in the Medicaid records. As Table 1 illustrates, the majority of our study patients (about two-thirds) were 21 years old or younger; we conducted a subgroup analysis of patients who did not have a three-prescription limit and found similar results. Compliance with medications cannot be measured accurately in the Texas Vendor Drug Program database. This study assumes patient compliance if a prescription was filled, although different patterns of noncompliance may produce different clinical and eco-

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nomic outcomes. The assumption of compliance in this study is not unreasonable since patients were selected only if continuous prescription utilization was verifiable. Patients who routinely filled prescriptions probably had chronic disease, and had to maintain a certain level of medication compliance to control asthma symptoms.

As in other retrospective studies investigating asthma, the researchers were unable to determine severity of illness. Another limitation is that other possible individual differences between patients could not be measured or controlled for in a retrospective study. If these differences are related to a patient's treatment behaviors or a prescriber's selection of drug therapy, a selection bias may be present. The potential for selection bias is common in studies using retrospective claims databases. Cohort-matching and regression are common methods used to reduce this limitation. Because we had so few steroid patients, we had ample nonsteroid patients to use for matching on age, gender, primary diagnosis, and costs. Post-hoc analysis indicates that patients in the pre-index period were also similar in the percentage with comorbidities, the types of medical visits used, and the types of asthma medications used. Those in the SG may have had more severe asthma or a morbid event that triggered inhaled corticosteroid use, but we did not assess costs until six months after this index date.

Finally, it should be noted that only 99 patients met the inhaled corticosteroid utilization criteria for inclusion in the study. The small number of steroid patients is attributable in part to the strict inclusion criteria imposed by the researchers. However, the authors felt that such criteria were necessary to demonstrate the effects of *continuous* inhaled corticosteroid use not previously demonstrated in the literature.

Conclusion

This study provides evidence that the introduction of inhaled corticosteroid therapy, followed by continuous inhaled corticosteroid use, results in lower asthma-related medical expenditures and utilization for patients with chronic asthma compared to chronic asthma patients who did not use inhaled corticosteroids. Future asthma research using national databases (to increase generalizability) should include medical claims that contain clinical laboratory values so that asthma severity levels can be determined for each patient to ensure similarity between steroid and nonsteroid groups. Finally, medical utilization may serve as a proxy for morbidity, but true outcome measures such as quality of life also should be assessed.

References

1. Surveillance for asthma—United States, 1960–1995. *MMWR* 1998; 47(SS-1): 1–27.
2. Adams PF, Marano MA. Current estimates from the National Health Interview Survey, 1994. *Vital Health Stat* 1995; 10: 94.
3. Lang DM. Trends in US asthma mortality: Good news and bad news. *Ann Allergy Asthma Immunol* 1997; 78(4): 333–37.
4. Lang DM, Polansky M. Patterns of asthma mortality in Philadelphia: 1969–1991. *N Engl J Med* 1994; 331: 1542–47.
5. Sly RM, O'Donnell R. Stabilization of asthma mortality. *Ann Allergy Asthma Immunol* 1997; 78(4): 347–54.
6. Expert Panel Report II: Guidelines for diagnosis and management of asthma. Bethesda, MD: National Heart, Lung, and Blood Institute, 1997.
7. Weiss KB, Gergen PJ, Wagener DK. Breathing better or wheezing worse? The changing epidemiology of asthma morbidity and mortality. *Ann Rev Publ Health* 1993; 14: 491–513.
8. Hartert TV, et al. Inadequate outpatient medical therapy for patients with asthma admitted to two urban hospitals. *Amer J Med* 1996; 100: 386–94.
9. Wing JS. Asthma in the inner city—a growing public health concern in the United States. *J Asthma* 1993; 32: 427–30.
10. Wood PR, et al. Hispanic children with asthma: morbidity. *Pediatrics* 1993; 91: 62–69.
11. Lozano P, Connell FA, Koepsell TD. Use of health services by African-American children with asthma on Medicaid. *JAMA* 1995; 274: 469–73.
12. Jatulis DE, et al. Preventive pharmacologic therapy among asthmatics: five years after publication of guidelines. *Ann Allergy Asthma Immunol* 1998; 81: 82–88.
13. Weiss KB, Gergen PJ, Crain EF. Inner-city asthma: The epidemiology of an emerging US public health concern. *Chest* 1992; 101(suppl): 426S–29S.
14. Vollmer WM, et al. Specialty differences in the management of asthma. *Arch Intern Med* 1997; 157: 1201–18.
15. Kelloway JS, Wyatt RA, Adlis SA. Comparison of patients' compliance with prescribed oral and inhaled asthma medications. *Arch Intern Med* 1994; 154: 1349–53.
16. Stempel DA, Carlson AM, Buchner DA. Asthma: Benchmarking for quality improvement. *Ann Allergy Asthma Immunol* 1997; 79: 517–24.
17. Friday GA, et al. Profile of children requiring emergency treatment for asthma. *Ann Allergy Asthma Immunol* 1997; 78: 221–24.
18. Smith DH, et al. A national estimate of the economic costs of asthma. *Am J Respir Crit Care Med* 1997; 156(3): 787–93.
19. Pappas G, et al. Potentially avoidable hospitalizations: inequalities in rates between US socioeconomic groups. *Am J Public Health* 1997; 87: 81–86.
20. Gergen PJ, Weiss KB. Changing patterns of asthma hospitalization among children: 1979 to 1987. *JAMA* 1990; 264: 1688–92.
21. Wisow LS, et al. Poverty, race, and hospitalization for childhood asthma. *Am J Public Health* 1988; 78: 777–82.
22. Carr W, Zeitel L, Weiss KB. Variations in asthma hospitalizations and deaths in New York City. *Am J Public Health* 1992; 82: 59–65.
23. Adelroth E, Thompson S. Advantages of high-dose inhaled budesonide. *Lancet* 1988; 1(8583): 476.
24. Campbell LM, et al. A comparison of the cost-effectiveness of budesonide 400 $\geq$ g/day and 800 $\geq$ g/day in the management of mild to moderate asthma in general practice. *Br J Med Econ* 1993; 6: 67–74.
25. Connett GJ, Lenney W, McConshie SM. The cost-effectiveness of budesonide in severe asthmatics aged one to three years. *Br J Med Econ* 1993; 6: 127–34.
26. Rutten-van Molken MPMH, Van Doorslaer EKA, Jansen MCC et al. Cost-effectiveness of inhaled corticosteroid plus bronchodilator therapy versus bronchodilator monotherapy in children with asthma. *PharmacoEconomics* 1993; 4: 257–70.
27. Rutten-van Molken MPMH, et al. Costs and effects of inhaled corticosteroids and bronchodilators in asthma and chronic obstructive pulmonary dis-

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- ease. *Am J Respir Crit Care Med* 1995; 151: 975–82.
28. Perera BJ. Efficacy and cost effectiveness of inhaled steroids in asthma in a developing country. *Arch Dis Child* 1995; 72(4): 312–25.
29. Booth PC, Wells NE, Morrison AK. Comparison of the cost effectiveness of alternative prophylactic therapies in childhood asthma. *Pharmacoeconomics* 1996; 10: 262–68.
30. Gerdtham UG, et al. Impact of inhaled corticosteroids on acute asthma hospitalizations in Sweden 1978–1991. *Med Care* 1996; 34(12): 1188–98.
31. Barner JC. Study of an HMO asthma population. *APhA Annual Meeting* 1996; 143(Mar): 16.
32. Donahue JG, et al. Inhaled steroids and the risk of hospitalization for asthma. *JAMA* 1997; 277(11): 887–91.
33. Motheral BM, Kozma CM. Assessing the economic influence of asthma inhaler therapy in the South Carolina Medicaid population. *APhA Annual Meeting* 1995; 142(Mar): 152.
34. Laumann JM, Bjornson DC. Treatment of Medicaid patients with asthma: comparison with treatment guidelines using disease-based drug utilization review methodology. *Ann Pharmacotherapy* 1998; 32(12): 1290–94.
35. Balkrishnan R, Norwood GJ, Anderson A. Outcomes and cost benefits associated with the introduction of inhaled corticosteroid therapy in a Medicaid population of asthmatic patients. *Clin Ther* 1998; 20(3): 567–80.
36. Balkrishnan R, Norwood GJ, Anderson A. Effects of inhaled corticosteroid therapy introduction in asthmatic Medicaid-enrolled children. *Drug Benefit Trends* 1998; 10(10): 37–40.
37. Ozminkowski RJ, et al. Cost implications for the use of inhaled anti-inflammatory medications in the treatment of asthma. *Pharmacoeconomics* 2000; 18(3): 253–64.
38. National Asthma Education and Prevention Program Task Force on the Cost Effectiveness, Quality of Care, and Financing of Asthma Care, Bethesda, MD: National Heart, Lung and Blood Institute, 1996; NIH Publication No. 55–807.
39. Stempel DA, et al. One-year claims analysis comparing inhaled fluticasone propionate with zafirlukast for the treatment of asthma. *J Allergy Clin Immunol* 2001; 107: 94–98.
40. Suissa S, et al. Low-dose inhaled corticosteroids and the prevention of death from asthma. *New Engl J. Med* 2000; 343(5): 332–36.
41. International classification of diseases, 9th revision. Los Angeles: PMIC 1995.
42. Strom BL. *Pharmacoepidemiology*. New York: John Wiley and Sons; 1994: 33.
43. Microsoft FoxPro User's Guide, Version 5. Redmond, WA: Microsoft Corporation, 1993.
44. SPSS 8.0 for Windows. Chicago: SPSS Inc., 1998.
45. SAS Language and Procedures, Usage 2, Version 6, Second Edition. Cary, NC: SAS Institute Inc., 1991.
46. Desgagne A, et al. The use of the bootstrap statistical method for the pharmacoeconomic cost analysis of skewed data. *Pharmacoeconomics* 1998; 13(pt 1): 487–97.
47. Efron B, Tibshirami RJ. *An introduction to the bootstrap*. New York: Chapman and Hall, 1993.
48. Obenchain RL. Resampling and multiplicity in cost-effectiveness inference. *J Biopharm Stats* 1999; 9(4): 563–82.
49. Rascati KL, Smith MJ, Neilands T. Dealing with skewed data: An example using asthma-related costs of Medicaid clients. *Clin Therapeutics* 2001; 23(3): 481–98.
50. Goldman L. Changing physicians' behavior: The pot and the kettle. *N Engl J. Med* 1990; 322(21): 1524–25.
51. Epstein AM. Changing physician behavior: Increasing challenges for the 1990s. *Arch Intern Med* 1991; 151: 2147–49.