Medical Cost Burdens Among Nonelderly Adults With Asthma

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It is generally recognized that proper management of chronic conditions not only produces better health outcomes but can also save on costs by avoiding the use of hospital inpatient services and emergency departments (EDs). But while treatment of chronic conditions may result in long-term savings to the healthcare system, it does not necessarily result in savings to the patient. Prior research has shown that persons with chronic conditions experience higher medical cost burdens on average compared with people without chronic conditions.[1-6] In addition to a greater strain on family finances, high medical cost burdens can also result in people cutting back on or not getting needed medical care.[7-9]

For some "silent" chronic conditions, such as hypertension and diabetes, patients may reduce or decline treatment to avoid high costs without experiencing adverse health effects for years, if ever. However, for chronic conditions such as persistent asthma, patients who forgo treatment are more likely to experience short-term consequences such as asthma attacks, and potentially high out-of-pocket costs associated with ED visits and hospital inpatient stays.

Asthma is a chronic disease that can be controlled with drugs—usually suppressive medications and rescue medications used to ease the symptoms of attacks once they begin; and with self-management techniques such as environmental modification and lifestyle changes aimed at blocking the inflammation that leaves patients vulnerable to asthma attacks. Asthma ranges considerably in severity: some patients may experience only rare, mild symptoms that are easily controlled with common medications, while others may experience frequent, severe, and even life-threatening attacks requiring emergency treatment or hospitalization for advanced interventions.

Thus, asthma patients' cost burdens depend on both the costs they incur for proactive preventive care and self-treatment with rescue medications, and on the costs of addressing adverse health consequences and potential complications if

ABSTRACT

Objectives

We used the 2003-2009 Medical Expenditure Panel Survey to evaluate average annual total and out-of-pocket expenditures by nonelderly adults with asthma.

Study Design

We divided patients diagnosed with asthma into 4 groups, based on whether or not they had had an asthma attack in the previous year (a crude marker for disease severity) and whether or not they reported using treatment for their asthma.

Methods

For each group we calculated total and out-of-pocket average annual spending for hospital inpatient, hospital outpatient, emergency department, and physician office care, as well as for prescription drugs. These averages were adjusted to account for differences in respondents' overall health (presence of other comorbidities, self-reported health status, and self-reported activity limitations), sociodemographic characteristics (age, sex, race/ethnicity, income), and insurance status.

Results

We found that among the 4 groups, those who were receiving treatment but continued to experience asthma attacks had the highest total and out-of-pocket expenditures in all categories, consistent with their likely higher illness severity. However, patients who reported receiving treatment and did not experience attacks also reported relatively high adjusted total and out-of-pocket expenditures—most notably $536 per year out of pocket for prescription medications and $231 per year out of pocket for physician office visits. After adjustment, about the same proportion of patients in these 2 groups (13.5% who did not get treated and had attacks, and 13.8% who did get treated and avoided attacks) reported high financial burden.

Conclusions

Patients may experience financial challenges to appropriate self-management of asthma, even when they are able to avoid exacerbations.

Am J Manag Care. 2014;20(11):925-932

Take-Away Points

People with asthma face substantial out-of-pocket costs—even when they take medications to manage their illness. However, many choose to continue treatment despite these costs.

- People who use asthma medications are most likely to continue using medications, even if they experience high financial burden.
- Rather than giving up their medications, they may be cutting back in other areas.
- Administrators of programs to reduce the costs of asthma medications may underestimate the programs' financial impact if they look only at ongoing medication use.

they fail to manage their disease. Patients with severe asthma may believe that they have little choice but to incur the high cost of treatment, given their greater likelihood of experiencing asthma attacks (and the potentially high out-of-pocket costs of hospital inpatient and/or ED use) without such treatment; some will experience ED visits and hospitalizations even with appropriate management. Other patients, with less severe asthma, may gamble that the risk of exacerbations is lower than the costs of suppressive therapy and rescue medications.[10] Of critical concern to both clinicians and policy makers is the extent to which high medical cost burdens affect patients' decisions to continue or discontinue self-management.

This study uses the 2003-2009 Medical Expenditure Panel Survey–Household Component (MEPS HC) to examine healthcare spending and medical cost burdens for patients who reported that they had been diagnosed with asthma. The study is guided by 3 main research questions: 1) To what extent do people with asthma experience high medical cost burdens relative to the general US population? 2) How does the extent of medical cost burden vary depending on patients' disease severity and on whether they are actively treating their asthma? 3) Do high medical cost burdens associated with the treatment of asthma lead some individuals to discontinue treatment?

METHODS

Data Source

We used data from the 2003-2009 MEPS. As described elsewhere,[11] the survey is based on a large nationally representative sample of the civilian noninstitutionalized population, and is conducted annually by the federal Agency for Healthcare Research and Quality (2009 was the latest year for which data were publicly available at the time of this study). The survey collects detailed information on healthcare expenditures, use of services, insurance coverage, sources of payment, health status, medical conditions, and other sociodemographic details on individuals and their families. Sample sizes range between 33,000 to 37,000 for each year.

The sample for this survey includes persons aged 18 to 64 years who, in response to a survey question, reported that a physician or other health provider had told them that they had asthma, confirmed that they still had asthma at the time of an in-person interview,[12] and completed a supplemental questionnaire related to their asthma care. Annual samples of nonelderly adults with asthma ranged from 1465 in 2003 to 1904 in 2009. To increase the statistical precision of estimates, samples from the 2003-2009 MEPS were pooled, yielding a total sample of 10,374 nonelderly adults with asthma. We excluded children because their healthcare utilization tends to differ substantially from that of adults. Persons 65 years and older were excluded because their higher levels of comorbidity would make it harder to see the effect of a single illness.

Outcomes

Expenditures for each medical visit or event for each sample respondent were collected during 3 rounds of survey interviews during the calendar year. Expenditures were reported separately for office-based medical provider visits; hospital inpatient, outpatient, and ED care; prescribed medicines; home healthcare; dental services; and vision aids. For each visit/event, total expenditures were reported (ie, from all payer sources), as were the amounts paid by third-party payers and out-of-pocket by the patient. To improve the quality and accuracy of expenditure reporting, the MEPS Medical Provider Component collects data from a sample of medical providers and pharmacies used by sample persons, which are used to either supplement or replace patient-reported data on expenditures.

Expenditures across all medical visits/events were aggregated and summarized at the person-level, and reported as averages. Average total expenditures and average out-of-pocket expenditures were reported separately. Spending by type of service was also reported, including hospital inpatient stays, hospital outpatient department visits, hospital ED visits, office-based medical provider visits, prescribed medicines, dental care, vision expenses, home health expenses, and other expenses (mostly relating to medical equipment purchases). Spending for hospital inpatient, outpatient, and ED visits includes both facility and physician charges. All expenditure data are inflated to reflect 2009 dollars, based on the Consumer Price Index.

Table 1. Characteristics of Asthma Population

		Receiving Treatment		Not Receiving Treatment	
	All	Had Attack in Past Year (standard error)	No Attack in Past Year (standard error)	Had Attack in Past Year (standard error)	No Attack in Past Year (standard error)
Percent of all persons with asthma	100.0	40.6	28.9	7.8	22.7
Asthma treatment					
Used acute pressure inhaler in past 3 months	58.8 (0.6)	95.0 (0.4)	84.0[a] (0.8)	0.0 (N/A)	0.0 (N/A)
Taking daily asthma medication (steroids)	29.8 (0.5)	44.1 (1.0)	47.7[a] (1.1)	0.0 (N/A)	0.0 (N/A)
Used inhaler 3+ times in past 3 months	10.2 (0.3)	19.5 (0.7)	11.2[a] (0.7)	0.0 (N/A)	0.0 (N/A)
Used steroids and inhaler 3+ times in 3 months	33.7 (0.6)	51.0 (1.0)	53.0 (1.1)	0.0 (N/A)	0.0 (N/A)
Characteristics of persons with asthma					
Average age (years)	46.2 (0.2)	46.7 (0.3)	50.1[a] (0.4)	42.8[a] (0.7)	42.4[a] (0.4)
Privately insured	36.7 (0.6)	40.4 (0.9)	35.4[a] (1.0)	33.1[a] (2.0)	34.3[a] (1.1)
Publicly insured	26.2 (0.5)	29.8 (0.8)	28.3 (0.9)	19.0[a] (1.6)	21.3[a] (0.9)
Uninsured	10.5 (0.4)	10.6 (0.6)	7.2[a] (0.5)	14.0[a] (1.5)	13.0[a] (0.8)
Male	34.8 (0.5)	30.2 (0.9)	36.7[a] (1.0)	37.1[a] (2.2)	38.1[a] (1.1)
Hispanic	9.2 (0.3)	10.0 (0.5)	8.4[a] (0.5)	9.5 (1.1)	9.0 (0.6)
Black	12.4 (0.3)	12.5 (0.5)	11.3 (0.6)	9.7[a] (1.2)	14.1 (0.7)
Asian	2.3 (0.2)	2.4 (0.3)	2.2 (0.3)	2.1 (0.6)	2.3 (0.3)
White/Other	76.1 (0.5)	75.1 (0.8)	78.1[a] (0.8)	78.7[a] (1.6)	74.6 (0.9)
Annual income <100% of poverty level	15.9 (0.4)	18.4 (0.7)	14.3[a] (0.7)	15.4 (1.5)	14.6[a] (0.7)
Annual income 100%-200% of poverty level	18.8 (0.5)	20.2 (0.8)	17.8[a] (0.8)	19.0 (1.7)	17.9[a] (0.8)
0 other chronic conditions	9.5 (0.4)	4.2 (0.4)	4.8 (0.4)	16.0[a] (1.8)	19.9[a] (0.9)
1 other chronic condition	15.1 (0.4)	12.2 (0.6)	13.4 (0.7)	17.9[a] (1.7)	19.9[a] (0.9)
2 other chronic conditions	16.1 (0.4)	15.1 (0.7)	15.4 (0.8)	19.7[a] (1.8)	17.2 (0.9)
3 or more other chronic conditions	59.3 (0.6)	68.5 (0.9)	66.4 (1.0)	46.5[a] (2.3)	43.0[a] (1.1)
Fair or poor health	27.1 (0.5)	36.0 (0.9)	26.7[a] (0.9)	21.1[a] (1.7)	17.4[a] (0.8)
Activity limitations	19.9 (0.4)	27.4 (0.8)	19.3[a] (0.8)	14.8[a] (1.4)	12.2[a] (0.7)

[a]Significantly different from reference group (persons receiving treatment who had an attack in the past year), at $P \leq .05$.
Source: 2003-2009 Medical Expenditure Panel Survey–Household Component.[14]

High medical cost burdens are defined similarly to how they were defined in previous studies using the MEPS, as the ratio of total out-of-pocket spending on health services and health insurance premiums to total family income.[13] For this measure, out-of-pocket spending is defined at the family level (ie, summed across all members in the family, typically defined as the nuclear family). Each individual is assigned the family-level burden measure. Individuals who live in families that spend more than 10% of family income on healthcare are defined as individuals with high financial burden.

Classifying Persons With Asthma

To examine differences in spending and medical cost burdens among persons with asthma, we classified the sample of persons with asthma into 4 categories based on 1) whether or not they were receiving treatment for asthma, and 2) whether or not they had an asthma attack in the past year (see Table 1 for details). Dividing respondents in this way allows for an approximation of disease severity, which is not otherwise addressed in the MEPS questionnaire. Respondents who reported experiencing asthma exacerbations despite using treatment would

be expected to have more severe disease, and therefore higher expenditures, than would respondents who did not experience exacerbations. Those who did not report exacerbations despite not using therapy would presumably have the lowest severity of all.

Analysis

For the first part of the analysis, we calculated total and out-of-pocket spending overall and for several subcategories: spending on physician services, outpatient services, inpatient services, and prescription drugs. Because differences in spending and medical cost burdens among asthma patients may reflect other health and patient characteristics, estimates of spending and medical cost burdens are based on regression-adjusted means that control for differences in other factors that are known to affect healthcare utilization and costs, including the number of comorbidities, self-reported health status, and difficulties with activities of daily living, as well as age, race and ethnicity, education, income, insurance status, and smoking status. Adjusted means and percentages are computed using Ordinary Least Squares regression analyses, with each of the spending variables as dependent variables, and a 4-category asthma severity/treatment variable as the primary independent variable (see columns in Table 1 and Table 2 for specification of the 4 categories). Other independent "control" variables include those mentioned above, and are specified based on the categories shown in Table 1. Adjusted estimates of spending for the 4 asthma categories are derived from the regressions based on the coefficients for these categories.

For the second part of the analysis, we examined the percent of asthma patients receiving treatment who discontinued this treatment, and the association between medical cost burdens and the subsequent decision to discontinue treatment. For this part of the analysis, we used the MEPS 2-year panel sample. The MEPS uses a rotating panel design that permits representative estimates for a 2-year period.[14-16] A new cohort of households is initiated each year and interviewed 5 times to collect 2 calendar years of data.[17] Thus, this part of the analysis combines the 2-year panel samples for the years 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008, and 2008-2009. For asthma patients receiving treatment in Year 1 of the panel sample, we computed the percentage that continued or discontinued treatment in Year 2. For asthma patients not receiving treatment in Year 1, we computed the percentage that started using treatment in Year 2.

A logistic regression analysis was conducted to examine whether medical cost burdens and other factors present in Year 1 influenced patient decisions to continue or start treatment for asthma in Year 2. The sample for the regression analysis included all nonelderly adult patients with asthma included in the panel samples between 2003 and 2009. The dependent variable is whether the patient received treatment in Year 2. The main independent variable is a measure of medical cost burdens in Year 1 (included as a categorical variable to capture any nonlinear effects). Because treatment and asthma severity in Year 1 will be correlated with both Year 1 medical cost burdens and Year 2 treatment, controls for Year 1 treatment and Year 1 asthma attack are included. Year 2 asthma attack is also included as a control because it is likely to be correlated with treatment in both Year 1 and Year 2. Baseline measures (Year 1) of patient health, demographic, economic, and insurance coverage variables that are likely to be correlated with both Year 1 spending and Year 2 treatment are also added as controls.

RESULTS

Characteristics of Persons With Asthma

Based on the MEPS, 7% of adults aged 18 to 64 years reported that they have persistent asthma. More than two-thirds of these were taking suppressive or rescue medications to control their asthma (see Table 1). Most of those taking medications (or 40.6% of all persons with asthma) had experienced an asthma attack in the prior year. Most of those receiving treatment had used a rescue inhaler in the past 3 months, while less than one-third were taking steroids to prevent flare-ups. About one-third reported that they had asthma but were not receiving asthma treatment, and most of these had not had an asthma attack in the past year. Overall, about 29% used treatment and were successfully avoiding asthma attacks, and about 8% were forgoing treatment and experiencing attacks.

In general, those receiving treatment for asthma had worse overall health, more comorbidities, and greater activity limitations compared with those not receiving treatment, and those receiving treatment who had an asthma attack had the worst health among all persons with asthma.

Persons receiving treatment and who had an asthma attack were somewhat more likely to be poor (18.4%) compared with other persons with asthma, but persons receiving treatment were less likely to be uninsured compared with those not receiving treatment, largely because they were more likely to have public coverage.

Table 2. Total and Out-of-Pocket Spending for Asthma Patients

	All	Receiving Treatment		Not Receiving Treatment	
		Had Attack in Past Year (SE)	No Attack in Past Year (SE)	Had Attack in Past Year (SE)	No Attack in Past Year (SE)
Total spending ($)	7850 (70)	9155 (119)	8514[a] (120)	6342[a,b] (244)	5835[a] (121)
Out-of-pocket spending ($)	1181 (8)	1307 (13)	1279 (14)	1029[a,b] (32)	952[a] (16)
% with high financial burden	16.3 (0.4)	20.6(0.8)	17.6[a] (0.7)	15.3[a,b] (1.4)	13.4[a] (0.6)
Prescription drug costs ($)	2192 (21)	2590 (35)	2395[a] (35)	1731[a,b] (70)	1579[a] (36)
Hospital spending (facility and doctor) ($)	2145 (23)	2556 (41)	2349[a] (41)	1653[a,b] (76)	1520[a] (39)
Outpatient spending (facility and doctor) ($)	653 (5)	743 (9)	718[a] (9)	534[a,b] (20)	497[a] (10)
ED spending (facility and doctor) ($)	259 (2)	303 (3)	263[a] (3)	222[a,b] (7)	207[a] (3)
Office-based spending ($)	1677 (13)	1895 (21)	1836 (22)	1395[a,b] (48)	1298[a] (25)
OOP prescription drug costs ($)	622 (5)	720 (9)	679[a] (9)	512[a,b] (19)	462[a] (10)
OOP hospital spending (facility and doctor) ($)	62 (1)	69 (1)	65[a] (1)	56[a,b] (2)	51[a] (1)
OOP outpatient spending (facility and doctor) ($)	39 (0)	42 (1)	42 (1)	35[a,b] (1)	32[a] (1)
OOP ED spending (facility and doctor) ($)	24 (0)	27 (0)	23 (0)	25[a,b] (1)	23 (0)
OOP office-based spending ($)	209 (2)	220 (2)	224 (3)	195[a,b] (6)	182[a] (3)

[a]Significantly different from reference group (persons receiving treatment who had an attack in past year), at $P \leq .05$.
[b]Significantly different from reference group (persons receiving treatment who did not have an attack in past year), at $P \leq .05$.
ED indicates emergency department; OOP, out-of-pocket.
Source: 2003-2009 Medical Expenditure Panel Survey – Household Component.

Spending for Persons With Asthma

Both total spending and out-of-pocket spending were higher for the 2 groups receiving treatment compared with those not receiving treatment. Among persons receiving treatment, those who had an asthma attack had slightly higher total annual spending ($9155) compared with those with no asthma attack ($8514). Overall, about 16% of persons with asthma report a high medical cost burden, defined as paying more than 10% of their income for out-of-pocket expenses associated with health insurance premiums and health services. Not surprisingly, the proportion with high medical cost burdens is highest among those receiving treatment, especially among those who received treatment and had an asthma attack (20.6%). Those not receiving treatment had lower medical cost burdens compared with those receiving treatment, even if they had an asthma attack in the past year. Of note, medical cost burdens are higher among those receiving treatment who do not experience an asthma attack (17.6%) than among those not receiving treatment who do experience an asthma attack, which suggests that there are no downstream savings for individuals who are more proactive with their treatment. Out-of-pocket costs for prescription drugs, inpatient hospital care, and outpatient care are also higher for those receiving treatment compared with those not receiving treatment. While out-of-pocket spending on ED care is significantly higher for respondents who did not use treatment and did experience attacks, the absolute amount is small ($25, compared with $23 for those who reported using treatment and avoiding attacks).

Continuity of Treatment

About 80% of those receiving asthma treatment in Year 1 of the MEPS panel continued with treatment in Year 2 (Table 3). Most who received treatment and had an attack in Year 1 had similar experiences in Year 2 (60%). About one-third of those not receiving treatment in Year 1 started receiving treatment in Year 2, regardless of whether they experienced an attack in Year 1.

Table 4 shows the results of a multivariate regression describing the association between medical cost burdens in Year 1 and the likelihood of being treated for asthma in Year 2, after controlling for differences in Year 1 treatment, severity, and other characteristics of patients. In general, the results show that issues related to health are much more important than economic factors in determining whether asthma patients continued or started receiving treatment in Year 2. The effects of high medical cost burdens in Year 1 on treatment in Year 2 are inconclusive. Compared with those with low medical cost burdens,

Table 3. Changes in Disease and Treatment Patterns From Year 1 to Year 2

Year 1	% With Treatment, Attack in Y2 (SE)	% With Treatment, No Attack in Y2 (SE)	% With No Treatment, Attack in Y2(SE)	% With No Treatment, No Attack in Y2 (SE)
Treatment, attack	60.0 (1.7)	22.0[a] (1.4)	5.3[a] (0.8)	11.6[a] (1.2)
Treatment, no attack	24.5[a] (1.8)	53.3 (2.2)	1.7[a] (0.5)	20.4[a] (1.8)
No treatment, attack	24.3 (3.6)	11.9[a] (2.4)	20.7 (3.6)	43.0[a] (4.1)
No treatment, no attack	13.9[a] (1.6)	17.4[a] (1.8)	10.5[a] (1.5)	58.0 (2.4)

[a]Significantly different from reference group, remaining in same treatment and attack group in years 1 and 2 (indicated in gray for each corresponding row), at $P \leq .05$.
Y2 indicates year 2.
Source: 2003-2009 Medical Expenditure Panel Survey—Household Component (2-year panel samples).

Table 4. Multivariate Logistic Regression Analysis of the Likelihood of Being Treated for Asthma in Year 2

Variable	Coefficient	SE
Intercept	0.239[b]	0.036
Out-of-pocket spending as a percentage of family income in Year 1		
0-5% (reference)	—	—
>5-10%	–0.249[a]	0.115
>10-20%	0.086	0.139
>20%	0.066	0.83
Treatment for asthma in Year 1	0.411[b]	0.019
Had asthma attack in Year 1	–0.047[a]	0.018
Had asthma attack in Year 2	0.265[b]	0.017
Baseline (Year 1) characteristics		
Age 18-44 y (compared with 45-64 y)	–0.062[b]	0.017
Male	0.015	0.017
Race/ethnicity		
White, non-Hispanic (reference)	—	—
Black, non-Hispanic	0.005	0.024
Hispanic	–0.026	0.029
Asian	0.011	0.056
Annual family income (relative to poverty)		
<100% of poverty	0.014	0.03
100-199% of poverty	–0.037	0.026
200-399% of poverty	–0.017	0.02
400% of poverty or higher (reference)	—	—
Insurance coverage		
Private, employer coverage (reference)	—	—
Private, nongroup	–0.0002	0.045
Public	0.042	0.027
Uninsured	0.009	0.028
Number of comorbid chronic conditions		
None (reference)	—	—
1	0.04	0.034
2	0.09[a]	0.035
3 or more	0.124[b]	0.033
Fair or poor health	–0.007	0.022
Limited in daily activities	–0.009	0.026
Currently a smoker	–0.044[a]	0.019

[a]Indicates that the coefficient is significant at the $P < .05$ level.
[b]Indicates that the coefficient is significant at the $P < .0001$ level.

those who spend between 5% and 10% of their income on healthcare in Year 1 are less likely to have treatment in Year 2. However, those whose spending exceeds 10% of income in Year 1 are no more or less likely to be treated in Year 2 compared with those with lower spending levels. Other economic variables, such as insurance coverage and family income relative to poverty, also did not have statistically significant associations with receiving treatment for asthma in Year 2. Whether people received treatment for asthma in Year 2 was much more strongly associated with age (older rather than younger), having multiple comorbidities, and having an asthma attack in Year 2. People who smoked were less likely to receive treatment in Year 2.

Limitations

Our study has several limitations. First, MEPS relies on respondents' self-report of their illness. This limitation is mitigated to some extent by the use of standard questions on asthma and other medical conditions used in surveys by the CDC.[18] MEPS also uses a short recall period (typically, 3 to 6 months) to augment reliability of utilization and expenditure data,[17] and MEPS findings on healthcare utilization and prescription use have been validated in prior studies.[17,19] Also, follow-up surveys to medical providers (including pharmacists) are used by the MEPS to verify and edit medical expenditure information reported by survey respondents. A study of Medicare beneficiaries who responded to the MEPS suggest that these respondents tend to report hospitalizations accurately, but underreport ED and outpatient visits across all respondent groups.[20] However, Medicare beneficiaries might be expected to have more outpatient and ED visits compared with the younger respondents in our study, making individual visits less likely to stand out in their recollection.

Because MEPS only asks whether a respondent uses particular medications, rather than how often, we cannot assess whether respondents were taking all doses of all recommended medications, or were only partially adherent. Patients who adhere only partly to medication regimens may experience most of the costs but few of the benefits. Finally, it is difficult to fully adjust for differences in severity of asthma and overall health status.

CONCLUSIONS

Respondents who reported using treatment had higher out-of-pocket spending than respondents who did not use treatment—even respondents who, without treatment, experienced asthma attacks. Furthermore, individuals do not appear to discontinue their treatment if they incur very high financial burdens. These findings persist even after adjustment for the presence of comorbidities and disability. While it is difficult to control fully for the severity of respondents' illness, these results suggest that respondents who engage in appropriate self-management may still incur substantial out-of-pocket costs, and are not necessarily saving on potentially higher out-of-pocket spending by reducing complications and asthma attacks.

DISCUSSION

Healthcare providers and policy makers encourage patients to pursue self-management of their chronic illnesses, including adherence to recommended medications. Our results suggest that respondents who used medications were more likely to be in families for whom medical costs posed a high financial burden, although this burden did not appear to influence their likelihood of continuing to use medications. That patients are willing to incur high out-of-pocket costs (relative to their income) does not necessarily mean that such costs are affordable, as they may cut back in other areas or incur substantial debt. Prior research has shown that a large percentage of people with high out-of-pocket costs have problems paying their medical bills, and as a result they often cut back on other necessities, put off major purchases, withdraw money from savings, or incur debt.[21]

In this sense, asthma patients may differ from patients with other chronic diseases, such as hypertension or hyperlipidemia, who do not necessarily face immediate consequences of failing to adhere to treatment. By contrast, asthma patients who do not adhere to treatment face the very real and short-term threat of an asthma attack or other exacerbations, and may therefore place a high priority on maintaining their treatment. These patients might benefit from value-based strategies in which medications recommended for the self-management of chronic illness are offered through extremely generous cost-sharing arrangements. But because cost-sharing interventions are often judged by their effects on healthcare spending and utilization in the targeted clinical areas rather than by their broader health effects or their effects on other areas of a patient's life, patients' apparent willingness to continue using medication even in the face of high financial burden may understate the effects of such interventions.

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Source of Funding: This study was supported by the Commonwealth Fund.

Author Disclosures: Dr Carrier contributed to this research prior to her employment at CMS. Views expressed are the authors' own and do not necessarily represent the opinions or policies of CMS or HHS. Drs Carrier and Cunningham report no conflicts of interest.

Authorship Information: Concept and design (EC, PC); acquisition of data (EC, PC); analysis and interpretation of data (EC, PC); drafting of the manuscript (EC, PC); critical revision of the manuscript for important intellectual content (EC, PC); statistical revision (EC, PC); obtaining funding (PC); administrative, technical, or logistic support (EC, PC); and supervision (PC).

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