Impact of 3-Tier Pharmacy Benefit Design and Increased Consumer Cost-sharing on Drug Utilization

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Objective: To estimate responsiveness of prescription demand within 9 therapeutic classes to increased cost-sharing compared with constant cost-sharing.

Study Design: Retrospective prescription claims analysis.

Methods: Between 1999 and 2001, 3 benefit plans changed from a 2-tier to a 3-tier design (cases); 1 plan kept a 2-tier design (controls). Study subjects needed 24 months of continuous coverage and a prescription filled ≥3 months before the benefit change for a nonsteroidal anti-inflammatory agent (NSAID), a cyclooxygenase (COX-2) inhibitor, a selective serotonin reuptake inhibitor (SSRI), a tricyclic antidepressant (TCA), an angiotensin-converting enzyme (ACE) inhibitor, a calcium-channel blocker (CCB), an angiotensin-receptor blocker (ARB), a statin, or a triptan. Changes in use were compared with the Wilcoxon signed rank test. Elasticity of demand among cases was calculated.

Results: Generally, medication possession ratios decreased for cases and increased for controls between 1999 and 2000. Switch rates increased for cases and decreased for controls for all classes but CCBs. Switches to lower copayments for ACE inhibitors, statins, and triptans occurred more often for cases. Discontinuation-rate changes for cases were 2 to 8 times those for controls. Generic-substitution rates depended on availability and initial generic utilization. Elasticity of demand for drugs was generally low, –0.16 to –0.10, for asymptomatic conditions (ACE inhibitors, ARBs, CCBs, statins), and moderate, –0.60 to –0.24, for symptomatic conditions (COX-2 inhibitors, NSAIDs, triptans, SSRIs).

Conclusion: Use of retail prescription medications within 9 specific therapeutic classes decreased as copayment increased. Demand for pharmaceuticals was relatively inelastic with these copayment increases.

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Because healthcare expenditures are expected to continue to rise, health insurers continue to seek ways to slow the growth in spending by managing utilization and shifting costs to the consumers while maintaining a high level of customer satisfaction and quality outcomes. Although pharmaceutical spending accounts for only 7% of total healthcare expenditures, the rate of spending growth for prescription medications has outpaced other areas of medical care. In 2001 prescription drug expenditures rose 16%, while those for hospital care and physician services rose 8% and 9%, respectively.[1] Drug utilization review, prior authorization, generic substitution, and closed formularies are some of the methods used by providers of pharmacy benefits to stem this tide. Most common among employers are incentive-based or multitiered formularies, where consumer cost-sharing increases for products on higher tiers compared with lower tiers.

In 2000, 80% of health plans with prescription benefits offered 3-tier formularies compared with 36% of plans 2 years earlier.[2] In 2004 the average copayment for generic drugs (tier 1) was $10; preferred branded drugs (tier 2), $21; and nonpreferred branded drugs (tier 3) $33.[1] Joyce et al estimated adding a third tier for nonpreferred brands to a 2-tier plan at a copayment of $30 decreases overall drug spending by 4% among plan participants with employer-sponsored drug coverage.[3] Additional studies such as that by Huskamp et al have shown changing from a 1-tier or 2-tier plan to a 3-tier plan impacts the purchasing decisions of consumers more substantially with respect to their overall drug consumption,[4] but the impact of decreased utilization on health outcomes has not been evaluated.[4-6] Two recent studies evaluated the impact of increasing prescription drug copayments on uses of other healthcare services. Motheral and Fairman found that enrollees who were moved from a 2-tier to a 3-tier pharmacy benefit had modestly lower prescription utilization with no increase in physician office visits, emergency room visits, or hospital stays in the 11 months after the benefit change.[4] However, Goldman et al found that doubling the copayments in a 2-tier plan for antidiabetic, antiasthmatic, and antiulcerant agents resulted in a 17% increase in predicted annual emergency department visits and a 10% increase in predicted annual hospital days for persons with the respective conditions.[7]

Several studies from the 1980s and early 1990s showed that demand for prescription drugs were highly inelastic, with values between –0.33 and –0.10 for small

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absolute changes in price.[8] As out-of-pocket costs and price differentials between products on different tiers continue to rise, consumers may be more sensitive to changes in prescription drug costs than previously reported. This study uses a pre-post analysis of 3 managed care populations whose pharmacy benefits changed in mid-2000 from a 2-tier to a 3-tier design, compared with a managed care population that had no change in a 2-tier benefit design during the same time period. We evaluated changes in utilization patterns such as medication possession ratio, discontinuation rates, and switches to lower-tier products, as well as the elasticity of demand for medications in 9 major therapeutic classes.

METHODS

Study Population

This study is a retrospective 2-sample cohort analysis of prescription medication utilization among managed care enrollees. The study population (cases) was made up of 3 geographically dispersed managed care plans, each of which adopted a 3-tier pharmacy benefit system in the first half of 2000 (**Table 1**). Immediately before the benefit switch, plans 1, 2, and 3 provided a traditional 2-tier prescription benefit covering generic and formulary brand products. Plans 1 and 3 mandated the new benefit for all members, whereas plan 2 adopted it only for members of a preferred provider organization. Plan 4, the control population (controls), had the same 2-tiered benefit structure as plan 2, but retained the 2-tier formulary during the evaluation period, 1999-2001. The analyses utilized enrollment data and pharmacy claims for 1999 through 2001.

For inclusion in this analysis, members were first required to have 24 months of continuous enrollment, 12 months immediately before their plan benefit change (prechange period) and 12 months after their plan benefit change (postchange period). If these members had a prescription filled during this time for medications within any of the therapeutic areas of interest, they were then assigned to 1 or both of 2 analysis groups. First, for each drug class of interest, members with a prescription filled at least 3 months before the end of the prechange period were retained for time-series analyses related to drug utilization. Second, the subset of cases with at least 2 prescriptions filled for a drug class of interest within the 3 months before the benefit change was retained for estimation of elasticity of demand.

Members were excluded from all analyses if they obtained any medications through mail-order pharmacies (5%), as there were substantial differences between copayment rate and quantity of supply between mail order and retail prescriptions. Additionally, 20% of members whose copayment for a prescription was inconsistent with their drug benefit were excluded from analysis. This group included those without a copayment recorded on their prescription claim or with a copayment amount recorded that did not match the copayment tier as reported by the health plan. The latter were excluded to attain a more accurate estimate of the impact of the copayment change on drug utilization.

Drug Classes

Several criteria were applied when selecting the drug classes under study. The population of users of medications within the drug class had to be of sufficient size to make reasonable inferences about the population at large. The drug classes also had to be used to treat a variety of chronic and acute, and symptomatic and asymptomatic conditions. Nine commonly used therapeutic classes for 5 conditions were selected for analysis: angiotensin-converting enzyme (ACE) inhibitors, calcium-channel blockers (CCBs), and angiotensin-receptor blockers (ARBs) for cardiovascular conditions; cyclooxygenase 2 (COX-2) inhibitors and nonselective nonsteroidal anti-inflammatory agents (NSAIDs) for pain; selective serotonin reuptake inhibitors (SSRIs) and tricyclic antidepressants (TCAs) for depression; 3-hydroxy-3-methylglutaryl coenzyme A reductase

Table 1. Plan Description*

Plan	Location	Enrollment	Copayment	
			Prechange Period†	Postchange Period†
1	Northeast	30 000	$5/$10	$5/$15/$25
2	South	400 000	$10/$20	$10/$20/$40
3	Southeast	200 000	$5/$10	$5/$20/$35
4 (control)	South	1 000 000	$10/$20	$10/$20

*Plans 2 and 4 had the same insurer (they are subsets of a larger insured population). Before the benefit change, they had the same benefit design. Plan 2 underwent a change in pharmacy benefit design to a 3-tier formulary after the benefit change. Plan 4 remained at a 2-tier formulary with the same copayment.
†The prechange period refers to the 12 months preceding implementation of the 3-tier benefit, and the postchange period refers to the 12 months after implementation of the 3-tier benefit.

inhibitors (statins) for lipid lowering; and serotonin 5-HT_1 receptor agonists (triptans) for migraine.

Statistical Analysis

The prechange period refers to the 12 months preceding implementation of the 3-tier benefit, and the postchange period refers to the 12 months after implementation of the 3-tier benefit. Persistency outcomes such as medication adherence (as measured by medication possession ratio), switching within a drug class, and discontinuation rates were measured for both the prechange and postchange periods among both cases and controls. Net changes in persistency measures for the 2 populations then were compared by using the Wilcoxon signed rank test. Two-sided tests with an alpha of .05 were used for all study analyses to determine statistical significance.

Binary indicators were created to allow tracking of enrollees who were switched to another product within the same drug class during each 3-month interval for the 4 quarters of the prechange and postchange periods. Overall switch rates and the proportion of these enrollees with a switch from a product with a higher copayment to one with a lower copayment are presented. Switches from a brand name to a generic product also were examined when a chemically equivalent generic was available. A drug was considered to be discontinued if a patient did not fill a prescription for any drug in the same therapeutic class for at least 30 days after completion of the last prescription. Cumulative discontinuation rates for the 6- and 12-month prechange and postchange periods for the cases and the net changes at 12 months for both the cases and controls are presented.

Elasticity of Demand

To estimate elasticity of demand, the subset of cases with at least 2 claims for any medication within the selected therapeutic areas during the 3 months before the benefit change was retained. Elasticity of demand was defined as the ratio between the percent change in average monthly number of prescriptions filled and the percent change in copayment from the prechange to the postchange periods. Alternatively, elasticity of demand is the percent change in monthly prescription fills given a 1% increase in copayment. To adjust for differing lengths of time on therapy (because not all patients were on therapy for the full 24 months under study), the average monthly number of prescriptions during the prechange and postchange periods—rather than the total number of prescriptions—was used to calculate percent change in drug utilization.

Because drug classes consist of numerous products that usually require different copayments, the weighted average copayment for all products in a drug class represents the average copayment rate for each class. The prechange weighted average copayment was used to obtain the *nominal* postchange copayment. The nominal copayment is the amount that a patient would pay under the 3-tier system if he or she continued on the same drug used in the prior period. Using the nominal copayment was necessary as patients could switch to lower-copay products (within the same class) under the 3-tier system; therefore, weighted average copayment in the postchange period would not reflect the true magnitude of copayment increase.

RESULTS

Population Characteristics

Information on enrollment and pharmacy benefit design for the 4 plans is presented in Table 1. Plans 1-3 changed their pharmacy benefits from a 2-tier to a 3-tier structure with varying levels of copayment. Benefits for plan 4 and plan 2 were provided by the same insurer. Before the benefit change these 2 plans had the same benefit design; however, after the benefit change plan 4 retained its 2-tier formulary with the copayment levels unchanged ($5 tier 1 and $10 tier 2). Plan 1 was comprised of unionized employees of a single auto-industry employer and their dependents. Plans 2, 3, and 4 were comprised of employees of multiple employers in multiple industries and their dependents.

Drug Persistence

Among case patients continuing on the same medication or switching to another medication within the same drug class after the benefit design change, statistically significant but modest reductions in medication possession ratio (MPR) were observed (**Figure 1**). MPR changes ranged from a 6.8% decrease in use of NSAIDs to a 1.7% increase in use of COX-2 inhibitors. For medications related to cardiovascular conditions (ACE inhibitors, ARBs, CCBs, statins), the MPR remained over 80% at the end of the first year after the benefit change. Conversely, MPR for those with no benefit change increased for 8 of the 9 classes (range –0.1 to +6.8%). Statins showed a slight decrease (–0.1%) in MPR in the second year of the study period.

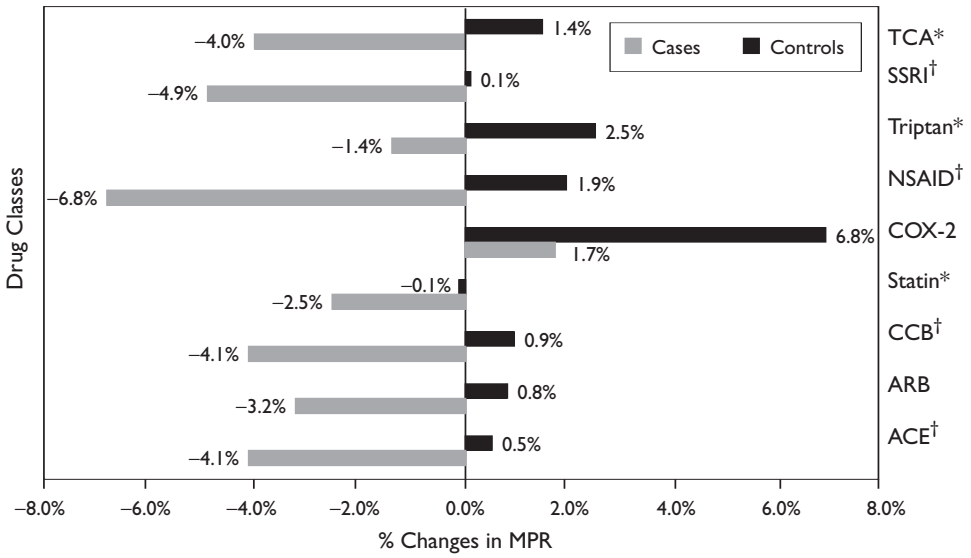
Cases had statistically significant changes in MPR compared with controls in all but the ARB and COX-2 classes. Differences in MPR for ARBs were greater for the cases than for controls (–3.2% and +0.8%, respectively; $P > .05$). MPR changes within the COX-2 class were the only instance where MPR increased for the cases (+1.7%) and where the difference was greater for the controls (+6.8%) between the prechange and

postchange periods. This difference, however, was not statistically significant.

During the evaluation period, availability of generic medications was limited to ACEs, CCBs, NSAIDs, and TCAs. Changes in generic substitution rate for ACEs and CCBs were greater among the cases than among the controls. Substitution rates increased among both study populations for ACE inhibitors (5.5% cases and 4.1% controls). Among those on CCBs, generic substitution decreased for controls (–3.7%) and increased for cases (+2.7%) in the year subsequent to the benefit change. As most cases and controls taking NSAIDs or TCAs were already on generic formulations before any benefit change, patients in both groups experienced few switches (near 0%) from branded to generic medications.

Overall within-class switch rates are presented in **Table 2.** Case patients switched products an average of 1.5 times more after the benefit change compared with before the

Figure 1. Net Change in 12 Month Medication Possession Ratios Between the Prechange and Postchange Periods



*P <.05; †P < .01.
ACE indicates angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; CCB, calcium-channel blocker; COX-2, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory agent; SSRI, selective serotonin reuptake inhibitor; statin, 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor; TCA, tricyclic antidepressant; triptan, serotonin 5-HT_1 receptor agonist.

Table 2. Within-class Drug Switch Rates

	Controls, %			Cases, %			
Drug Class	Prechange Period*	Postchange Period*	Net Change	Prechange Period*	Postchange Period*	Net Change	*P* Value for Net Change Difference†
ACE inhibitors	2.6	7.1	4.5	7.0	13.3	6.3	.1909
ARBs	1.4	1.0	–0.4	2.0	4.3	2.3	.3223
CCBs	12.8	19.5	6.7	12.1	17.1	5.0	.0005
Statins	4.1	3.6	–0.5	4.2	8.0	3.8	.0010
COX-2 inhibitors	8.9	5.7	–3.2	5.6	9.6	4.0	.0522
NSAIDs	10.7	10.6	–0.1	9.3	14.1	4.8	.0107
Triptans	10.7	9.4	–1.3	12.0	19.5	7.5	.0244
SSRIs	5.3	4.9	–0.4	6.3	8.0	1.7	.1353
TCAs	3.6	2.9	–0.7	8.2	8.8	0.6	.9460

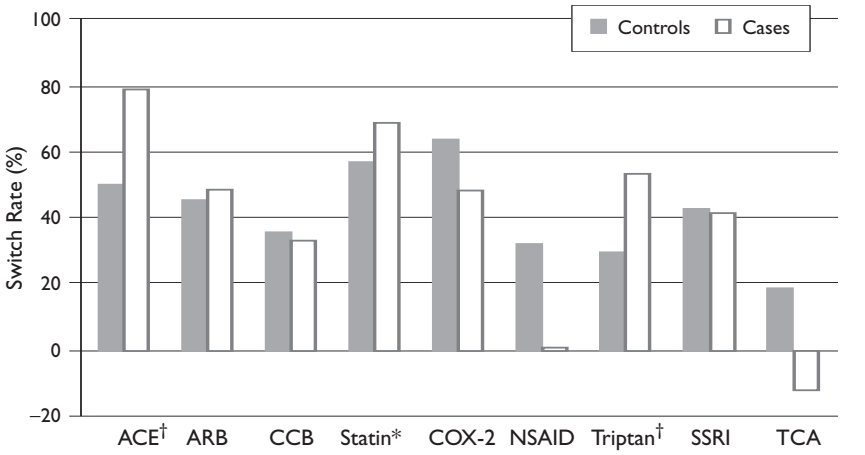
ACE indicates angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; CCB, calcium-channel blocker; COX-2, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory agent; SSRI, selective serotonin reuptake inhibitor; statin, 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor; TCA, tricyclic antidepressant; triptan, serotonin 5-HT_1 receptor agonist.
*The prechange period refers to the 12 months preceding implementation of the 3-tier benefit, and the postchange period refers to the 12 months after implementation of the 3-tier benefit.
†*P* values were obtained using the Wilcoxon signed rank test on the group level within each drug class.

benefit change and more than controls after the benefit change for 8 of the 9 drug classes evaluated. This also held true for the change in switch rates across the 2 evaluation periods. However, only 3 of these differences after the benefit change reached statistical significance: statins (+3.8% cases vs –0.5% controls; P = .001), NSAIDs (+4.8% cases vs -0.1% controls; P = .011), and triptans (+7.5% cases vs –1.3%; P = .024). Differences in switch rate for the cases compared with the controls for the COX-2 class approached statistical significance (+4.0% cases vs –3.2%; P = .052).

Of those who switched products within a drug class, a significantly greater proportion of cases than controls switched to a product associated with a lower copayment after the benefit change for ACEs, statins, and triptans (**Figure 2**). Switch-rate changes to products with lower copayments were nearly equal among the study populations for ARBs, CCBs, and SSRIs, whereas the changes for NSAIDs and TCAs were greater among controls. These differences, however, did not reach statistical significance.

Cumulative discontinuation rates for equivalent 6- and 12-month periods before and after the benefit change for cases are presented in **Table 3.** For most of the drug classes, discontinuation rates increased substantially in the first 6 months after the copayment change compared with the same time frame in the previous year. Over the 1-year period after the benefit change, the majority of discontinuations for the case

Figure 2. Overall Within-class Switch Rates for the Prechange and Postchange Periods



*P <.05; †P <.01.
ACE indicates angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; CCB, calcium-channel blocker; COX-2, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory agent; SSRI, selective serotonin reuptake inhibitor; statin, 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor; TCA, tricyclic antidepressant; triptan, serotonin 5-HT_1 receptor agonist.

Table 3. Cumulative Discontinuation Rates Before and After the Benefit Change

Drug Class	Cases, %				Net Change at 12 Months, %		*P* Value for Net Change Difference*
	6 Months Prechange	6 Months Postchange	12 Months Prechange	12 Months Postchange	Controls	Cases	
ACE inhibitors	16.9	31.5	24.9	48.7	4.3	23.8	.0001
ARBs	16.9	36.2	28.4	54.1	7.2	25.7	.0005
CCBs	17.0	27.8	25.0	43.5	5.6	18.5	.1189
Statins	24.2	31.1	36.1	49.0	6.6	12.9	.0425
COX-2 inhibitors	58.8	59.7	72.2	76.3	2.2	4.1	.5417
NSAIDs	60.4	70.2	67.3	76.6	1.1	9.3	.3575
Triptans	56.8	56.3	66.7	65.3	2.8	–1.4	.7334
SSRIs	29.6	43.7	43.8	60.8	6.3	17.0	.0001
TCAs	25.4	35.6	36.1	55.6	4.0	19.5	.0009

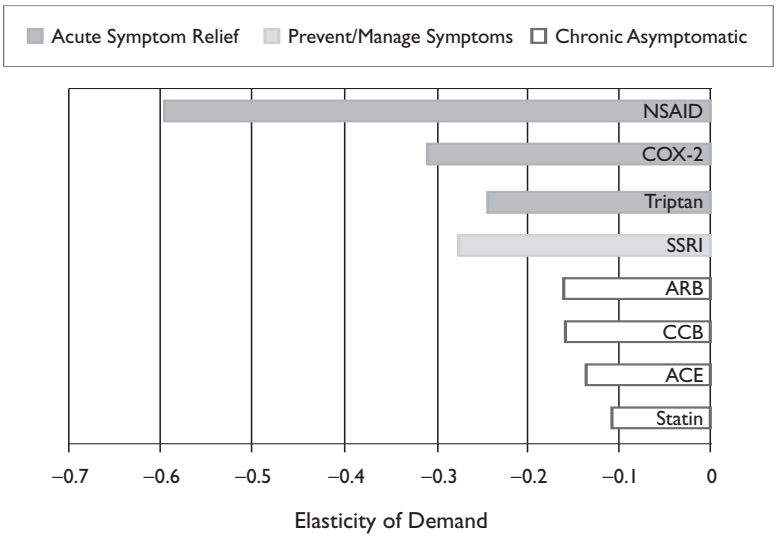
ACE indicates angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; CCB, calcium-channel blocker; COX-2, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory agent; SSRI, selective serotonin reuptake inhibitor; statin, 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor; TCA, tricyclic antidepressant; triptan, serotonin 5-HT_1 receptor agonist.
*P values were obtained using the Wilcoxon signed rank test on the group level within each drug class.

Table 4. Elasticity of Demand by Drug Class for Cases

Drug Class	Sample Population (n)	Monthly Prescription Fills per Person Prechange Period*	Monthly Prescription Fills per Person Postchange Period*	Average Copayment per Prescription Prechange Period*	Average Copayment per Prescription Postchange Period*	Elasticity
ACE inhibitors	996	0.921	0.814	$11.12	$20.56	–0.1369
ARBs	361	0.910	0.763	$11.50	$23.10	–0.1599
CCBs	1169	0.923	0.827	$10.17	$16.88	–0.1575
Statins	1512	0.892	0.815	$11.32	$20.69	–0.1045
COX-2 inhibitors	534	0.886	0.538	$11.87	$27.12	–0.3055
NSAIDs	377	0.929	0.582	$8.75	$14.22	–0.5971
Triptans	134	1.254	1.087	$12.12	$18.73	–0.2447
SSRIs	1179	0.917	0.729	$11.63	$20.28	–0.2747
TCAs	328	0.971	0.787	$6.60	$7.68	–1.1520

ACE indicates angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; CCB, calcium-channel blocker; COX-2, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory agent; SSRI, selective serotonin reuptake inhibitor; statin, 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor; TCA, tricyclic antidepressant; triptan, serotonin 5-HT_1 receptor agonist.
*The prechange period refers to the 12 months preceding implementation of the 3-tier benefit, and the postchange period refers to the 12 months after implementation of the 3-tier benefit.

Figure 3. Elasticity of Demand* for 8 of the 9 Drug Classes Evaluated



*Elasticity of demand is defined as the percent change in number of monthly prescription fills given a 1% increase in copayment.
ACE indicates angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; CCB, calcium-channel blocker; COX-2, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory agent; SSRI, selective serotonin reuptake inhibitor; statin, 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor; TCA, tricyclic antidepressant; triptan, serotonin 5-HT_1 receptor agonist.

population occurred in the first 6 months. The greatest changes in discontinuation rates were among patients taking ARBs, with a 25.7% net increase, and ACE inhibitors, with a 23.8% increase. The lowest net changes were among users of COX-2 inhibitors (+4.1%) and triptans (–1.4%). Controls also had increased discontinuation rates after the benefit change; however, all were less than 10%. Changes in discontinuation rates ranged from 1.1% among controls taking statins to 7.2% among controls taking ARBs. The net changes in discontinuation rates were greater for cases than controls in every drug class except triptans. For five of the classes—ACE inhibitors, ARBs, statins, SSRIs, and TCAs—the differences between the groups were statistically significant.

Elasticity of Demand

Elasticity of demand for each drug class across the 3 plans is shown in **Table 4** and **Figure 3.** Cases experienced increases in average copayments ranging from 16% for TCAs to 129% for COX-2 inhibitors. Overall, the highest elasticities were seen among drug classes with the lowest prices before the benefit change (TCAs and NSAIDs). Elasticity of demand for drugs treating primarily asymptomatic conditions (ACE inhibitors, ARBs, CCBs, statins) was relatively low, ranging from –0.16 to –0.10. Elasticities for ACEs (–0.14), ARBs (–0.16), and CCBs (–0.15) were similar in magnitude; statins had the lowest elasticity (–0.10). Responses to price increases were greatest for prescription medica-

tions treating symptomatic conditions. The elasticity of demand for the 5 other drug classes evaluated ranged from –0.60 for NSAIDs to –0.24 for triptans. Price sensitivity for NSAIDs was nearly twice that of COX-2 inhibitors (–0.60 vs –0.31). Among antidepressants, the elasticity of demand for TCAs was the greatest at –1.15 and nearly 4 times greater than that for SSRIs (–0.27). Among these 3 plans, elasticities of demand within each drug class did not differ even after adjusting for plan differences in age and sex (data not shown).

DISCUSSION

This is 1 of a small number of studies that have examined patterns of drug utilization and consumer price sensitivity across a broad range of drug classes used to treat a variety of asymptomatic and symptomatic conditions. In this study we examined how drug utilization changed after prescription drug benefit plans changed from 2-tier to 3-tier designs. Utilization patterns were compared with those of an insured cohort experiencing no change to their 2-tier benefit over the same time period. Overall, those experiencing an increase in tiers and copayments responded differently than those with no change in either tiers or copayments. Increases in both groups appear to be related to decreased medication possession ratios, increased switching to generics and other lower priced alternatives within the same drug class, and increased rates of discontinuation products within a drug class.

Consistent with findings in other published studies, the impact on medication adherence rates for patients who elected to continue on their medication after a benefit change appeared to be small, with overall compliance rates of more than 80% for majority of therapeutic classes examined.[4-6] However, we also saw a negative impact on medication possession ratios for those with a change in benefit compared with a small increase in possession ratios for those with no benefit change. The increases in copayment also promoted a greater rate of switching to lower cost alternatives within a therapeutic class where available; the rate of switching depended on the type and number of alternatives available. Drug classes with generic or branded alternatives with lower copayments that are equivalent or similar to the brand name product taken (eg, ACE inhibitors, CCBs) had higher rates of switching than classes without those therapeutic options (eg, ARBs, COX-2 inhibitors, statins).

Faced with an increase in copayment and tiers, up to one fourth of patients discontinued their medication within the first 6 months after the benefit change rather than switch to another medication in the same drug class, with the rates differing by therapeutic class. Those faced with no benefit change also had an increase in discontinuation rates during the same time period. However, there was no more than a 7.2% increase over the previous time period and little variation by therapeutic class. As adverse clinical consequences of medication discontinuation may be severe, it is important to identify patients with true treatment discontinuation as opposed to patients who switched to an alternative drug class to treat the same condition.

As summarized by the elasticity-of-demand estimates for each drug class, this study demonstrates that patients respond differently to an increase in their out-of-pocket costs for prescription medications depending on the condition being treated, the absolute price increase, and the availability of treatment alternatives. Similar results were found by Goldman et al in an analysis that simulated the doubling of copayments in a 2-tier benefit plan.[7] Patients were most sensitive to copayment increases for NSAIDs, which included COX-2 inhibitors. Our patient population was most sensitive to copayment increases for NSAIDs specifically, followed by increases for COX-2 inhibitors. Price sensitivity for NSAIDs was nearly twice that of COX-2 inhibitors (–0.60 vs –0.31), due in part to the many lower priced prescription and over-the-counter options available within the NSAID class. Among persons taking antihypertensives, patients in both our study and the one by Goldman et al were found to be among those least responsive to rising copayments. In the study by Goldman et al, moderate sensitivity was estimated for patients taking antihyperlipidemics (including statins) and lower sensitivity was estimated for patients taking antidepressants. Our patient population was moderately sensitive to copayment increases for SSRIs to treat depression and least sensitive to statins. The elasticity of demand for TCAs (utilized to treat depression) estimated in our study is falsely high due to the relatively small increase in copayment for this drug class and the fact that the majority of patients were on generics prior to the benefit change. With the exception of the antidepressant results, when Goldman et al modeled utilization changes among those with a diagnosis corresponding to the treatment of interest, they observed patterns of sensitivity to copayment increases similar to the results presented here.

There are several limitations to this analysis, many related to the use of administrative claims data for health services research. The copayment field for some claims did not match the payment required by the pharmacy benefit plan, probably due to grandfathering of benefit for some chronic users; deleting these claims

from the analysis has an unknown impact on the results. The number of such claims was small; therefore, we believe the impact on our results should have been minimal. Second, discontinuation rates may have been overestimated for NSAIDs and COX-2 inhibitors, as well as ACE inhibitors and ARBs, because analyses were conducted within a drug class and patients may have been switched to a product in an alternative but related prescription drug class for treatment of the same condition. In addition, for some classes (eg, triptans, NSAIDs), patients may have switched to an over-the-counter treatment or an alternative therapy. Any biases, however, should be similar for both study groups; therefore, the impact on our results should have been minimal. The study also was limited solely to users of retail pharmacies; enrollees using either mail-order and retail pharmacies or mail-order pharmacies exclusively were not examined. For elasticity of demand, enrollees were required to have 2 or more prescriptions within the selected therapeutic class before the benefit change. This was done to exclude enrollees who may have discontinued because of problems with tolerance or whose condition may have been resolved. Therefore, we believe our elasticity estimates are conservative but still high. Lastly, because patients are likely to utilize multiple drugs concurrently, elasticity-of-demand calculations may reflect increased sensitivity to the change in total copayment burden rather than the price increase of individual prescriptions.

It is reassuring that patients who choose to continue their medications appear adherent to them. Additionally, evaluation of the patterns of elasticity leads to conclusions similar to those of Goldman et al; patients appear to make some rational decisions regarding medication purchases and trade-offs. The results show patients are more price sensitive to medications used to treat primarily symptomatic conditions such as pain (chronic or acute), migraine, and asthma. These patients have more alternative therapies available to them, including over-the-counter options. Additionally, they may feel they can self-monitor their condition and best decide when treatment is necessary. How successful these patients are needs to be evaluated. Alternatively, patients appear less sensitive to price changes among treatments for more "silent" conditions such as hypertension and hyperlipidemia.

This study has shown that demand for pharmaceuticals in these populations was moderately inelastic and varied by drug class. Elasticities for primarily chronic, asymptomatic treatments were lower than those for primarily acute symptomatic treatments. Of greatest concern is the cohort of patients who choose to discontinue medications following an increase in copayment. Our findings and those of other published studies report discontinuation rates as high as 25% following an increase in copayment regardless of the magnitude of the increase. We further demonstrated a discontinuation rate of less than 10% when copayment remains constant. Therefore, copayment increases may lead to an additional 15% of patients or more discontinuing their medication. Further research to examine patterns of patients switching among therapeutic classes is necessary to fully capture the impact of increases in copayments. Additional studies are needed to determine why patients make particular decisions regarding which products to pay more for and which to discontinue. Additionally, the potential impact of discontinuation on health outcomes and healthcare utilization (eg, emergency department visits, hospitalizations) needs to be quantified.

Modest increases in prescription copayments have been shown to have a negative impact on consumers' medication-purchasing decisions. These increases may lead to pill splitting or other reduced-dosing methods, increased time between refills, and increased medication discontinuation, particularly for symptomatic medications, but also for classes of prescription medications used for long-term disease prevention. Shifting larger proportions of prescription costs to consumers may lead to unintended consequences such as increasing morbidity, mortality, and costs in other areas of the healthcare system.

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