The Effect of Three-Tier Formulary Adoption on Medication Continuation and Spending among Elderly Retirees

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Objective. To assess the effect of three-tier formulary adoption on medication continuation and spending among elderly members of retiree health plans.

Data Sources. Pharmacy claims and enrollment data on elderly members of four retiree plans that adopted a three-tier formulary over the period July 1999 through December 2002 and two comparison plans that maintained a two-tier formulary during this period.

Study Design. We used a quasi-experimental design to compare the experience of enrollees in intervention and comparison plans. We used propensity score methods to match intervention and comparison users of each drug class and plan. We estimated repeated measures regression models for each class/plan combination for medication continuation and monthly plan, enrollee, and total spending. We estimated logit models of the probability of nonpersistent use, medication discontinuation, and medication changes.

Data Collection/Extraction Methods. We used pharmacy claims to create person-level drug utilization and spending files for the year before and year after three-tier adoption.

Principal Findings. Three-tier formulary adoption resulted in shifting of costs from plan to enrollee, with relatively small effects on medication continuation. Although implementation had little effect on continuation on average, a small minority of patients were more likely to have gaps in use and discontinue use relative to comparison patients.

Conclusions. Moderate cost sharing increases from three-tier formulary adoption had little effect on medication continuation among elderly enrolled in retiree health plans with relatively generous drug coverage.

Key Words. Formulary, three-tier, prescription drug, retiree

Incentive formularies are commonly used by private health plans in an attempt to control rising prescription drug costs. Incentive formularies provide financial incentives (i.e., lower copayments) for patients to choose drugs that are less costly to the plan. Use of these formularies also enhances a plan's bargaining

power in obtaining discounts and rebates from pharmaceutical manufacturers by offering them increased sales volume for preferred drugs (Frank 2001).

The most common type of incentive formulary is the three-tier. Three-tier formularies are used both in plans serving employed populations under age 65 as well as in the majority (58 percent) of the largest plans covering elderly retirees (Kaiser/Hewitt 2004). Also, under the new Medicare Part D drug benefit implemented in 2006, plans are permitted to use three-tier and other incentive formularies. A three-tier formulary typically requires the lowest copayment for generic drugs in tier 1, a higher copayment for brand-name drugs preferred by the plan in tier 2, and the highest copayment for brand-name drugs not preferred by the plan in tier 3.

Previous studies in nonelderly populations have found that three-tier adoption and accompanying copayment increases resulted in lower drug spending by the plan, higher drug spending by patients, and, in some cases, higher rates of medication discontinuation for chronic conditions (Motheral and Fairman 2001; Joyce et al. 2002; Huskamp et al. 2003; Rector et al. 2003; Goldman et al. 2004; Kamal-Bahl and Briesacher 2004). Other studies have found that use of drugs is lower for seniors who lack drug coverage and for those enrolled in plans with higher drug copayments than for seniors with more generous drug coverage (Federman et al. 2001; Tamblyn et al. 2001; Safran et al. 2002; Doshi, Brandt and Stuart 2004). However, little is known about the impact of three-tier formularies on medication spending and continuation in elderly populations. To examine this issue, we study the impact of three-tier formularies used by the retiree plans of four large employers.

METHODS

Study Population

We studied medication utilization by elderly enrollees (65 years and older) of four retiree plans that contract with a large pharmacy benefits manager,

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Medco Health Solutions Inc. (Medco), for the management of the drug benefit (Table 1). Each plan switched from a two-tier to a three-tier formulary during the period 1999–2002. The four plans had different cost sharing requirements both before and after three-tier adoption. Under the two-tier formularies used by each plan in the preperiod, the difference in copayments for generic and brand drugs was only \$5 or \$10. In each plan, there was a financial incentive in the form of a lower copayment per day of medication supplied for enrollees to fill prescriptions through the mail-order program rather than a retail outlet.

Three-tier adoption not only increased copayments for nonpreferred brand drugs in tier 3 but also increased copayments for preferred brand drugs in tier 2 in most cases. Although cost sharing requirements differed across plans, the formularies used by each had the same content (i.e., same assignment of drugs to tiers) (see Appendix A).

We compare the experience of elderly enrollees of these plans to that of elderly enrollees of two large retiree plans (E and F) that also contract with Medco but used a two-tier formulary and made no major pharmacy benefit changes during the study period. Use of drug utilization management tools was similar across all six plans studied and the two comparison plans were representative of Medco's retiree plan business at the time. Plans in the comparison group had similar medical coverage to the intervention plans, and there were no major changes in medical benefit design for any of the plans during the study period. This approach enabled us to control for trends in drug utilization that were unrelated to benefit changes. We studied 128,900 individuals enrolled continuously in intervention plans and 109,293 individuals enrolled continuously in comparison plans from July 1999 through December 2002.

Data

We analyzed eligibility data and pharmacy claims for the four intervention and two comparison plans. We focused on seven drug classes used commonly by the elderly to treat chronic conditions, four used to treat cardiovascular conditions (angiotensin-converting enzyme [ACE] inhibitors, angiotensin-receptor blockers [ARBs], calcium channel blockers [CCBs], and 3-hydroxy-3-methyl-glutaryl coenzyme A reductase inhibitors [statins]) and three used to treat other types of conditions (proton pump inhibitors [PPIs], selective serotonin reuptake inhibitors [SSRIs], and nonsteroidal anti-inflammatory drugs [NSAIDs]).

Table 1: Description of Plans and Continuously Enrolled Populations

	Intervention Plans				Comparison Plans	
	Plan A	Plan B	Plan C	Plan D	Plan E	Plan F
Industry	State government	State government	Petroleum	Retail	Technology	Manufacturing
# continuously enrolled 65+	31,311	47,108	11,929	38,552	49,395	59,898
Benefit design	Pre: \$5/\$15 retail \$5/\$15 mail Post: \$5/\$20/\$35 retail \$10/\$40/\$70 mail	Pre: \$5/\$10 retail \$5/\$5 mail Post: \$5/\$15/\$30 retail \$10/\$25/\$45 mail	Pre: \$10/\$20 retail \$7/\$15 mail Post: \$7/\$20/\$30 retail \$10/\$30/\$45 mail	Pre: \$15/\$20 retail \$20/\$25 mail Post: \$15/\$20/\$35 retail \$20/\$30/\$45 mail	\$5/\$10 retail \$8/\$15 mail	\$4/\$12 retail \$7/\$15 mail
Date of change	9/1/00	2/1/01	1/1/01	1/1/02	—	—
Mean age*	73.05 (6.20)	74.70 (6.49)	74.22 (6.25)	74.72 (6.15)	72.90 (5.81)	74.10 (6.27)
% female*	56.25	58.45	54.36	62.85	55.42	56.52
% spouse*	19.83	25.22	30.32	27.95	28.92	30.61
Risk index [†] *	27.32 (13.73)	24.73 (13.16)	24.06 (12.57)	22.90 (12.99)	22.88 (13.10)	24.32 (12.60)
% with any mail-order use [‡] *	23.90	64.09	75.43	75.66	35.81	51.81
Median and interquartile	\$38,563 (med)	\$48,946 (med)	\$48,439 (med)	\$45,472 (med)	\$47,099 (med)	\$46,291 (med)
range of income for zip	\$14,945 (IR)	\$22,491 (IR)	\$24,623 (IR)	\$18,498 (IR)	\$19,079 (IR)	\$18,244 (IR)
code of residence						

**p*-value < .001.[†]Risk index and mail/retail use are measured over the 1-year period from 10/1/1999 through 9/30/2000.

Age is measured as of 10/1/1999.

Note: The typical prescription filled through a retail outlet included 30 days supply while the typical prescription filled through the mail-order program included 90 days supply. Thus, enrollees had a financial incentive to use the mail-order program in each plan.

med, median; IR, interquartile range.

Statistical Analysis

To assess the effect of three-tier adoption on medication utilization and spending, we created user cohorts for each drug class. Users of a particular class were identified as individuals who filled at least one prescription for any drugs in the class during the 90 days before three-tier adoption. To ensure that we identified individuals who used medications in a particular class on an ongoing (instead of a one-time only) basis, we tested an alternative definition of a user as someone who filled at least two 30-day prescriptions in the year before three-tier adoption with at least 1 day's supply available in the 45 days before adoption. Results for all models were similar so we present results only for the former definition. We considered an enrollee who filled a 90-day mail-order prescription to have used the drug for the subsequent 3 months, with spending spread out over the 3-month period.

Matched Samples. We created matched samples of intervention and comparison users for each intervention plan and drug class using propensity score methods to address the potential nonequivalence of the intervention and comparison groups (Rosenbaum and Rubin 1983). We developed a score for each user that represented his or her propensity to receive pharmacy benefits from the intervention plan compared with the relevant comparison plan using a logistic regression model. The model included age, gender, employee (versus spouse), preperiod medication continuation as measured by the medication possession ratio (MPR, i.e., the number of unique days that one or more medications in the class was available to the patient in the year before three-tier adoption divided by 360), the proportion of prescriptions filled through the mail-order program in the year before adoption, median household income for the zip code of residence, and a risk index. The risk index flags comorbidities as indicated by use of medications for selected clinical conditions in the year before adoption and approximates total health care spending. The risk index uses an approach similar to that of the Chronic Disease Score developed by Clark et al. (1995) but uses updated weights developed at Medco to reflect current medication use patterns. We then matched (without replacement) each intervention user to the comparison user with the closest estimated propensity to receive benefits from the intervention plan within a specified range expected to reduce observed differences between groups by at least 90 percent (Rosenbaum and Rubin 1985).

Repeated Measures Analyses of MPR and Spending. To estimate changes in MPR and spending resulting from three-tier adoption, we fit separate repeated measures regression models for each plan/class matched sample using generalized estimating equations (GEE) which use robust variance estimators to account for potential misspecification of the error structure and to account for the multiple observations on each individual. Postperiod MPR was defined as the proportion of days a drug in the class was available during the year after three-tier adoption and excluded patients with zero refills. (The postperiod MPR is a measure of medication continuation among those with at least some postperiod use; patients who had filled no prescriptions in the postperiod are captured in the discontinuation measure described below.) We studied three measures of monthly drug class spending in the year after adoption: plan, enrollee, and total (plan plus enrollee) spending. Because our monthly spending data within classes of drugs were only moderately skewed (for example the mean and median enrollee spending for ACE inhibitors were \$196 and \$180, respectively), for ease of interpretation we did not transform the spending measures.

The key independent variables were: a dummy variable indicating whether the individual was in the intervention group, a dummy variable indicating whether the observation occurred after three-tier adoption ("post"), and an interaction of the intervention and postvariables. Age, gender, employee, the proportion of prescriptions filled through the mail-order program in the year before adoption, the risk index, preperiod MPR (cost models only), average monthly spending on the drug class in the preperiod (MPR models only), and interactions of each of these variables with the postvariable were also included. As a robustness check, we also estimated GEE models of monthly MPR and log-transformed drug class expenditures among users of the class for a 20 percent random sample of continuously enrolled elderly members (not just the matched samples).

Logistic Regression Models of Nonpersistent Use, Discontinuation, and Medication Changes. To address whether patients were refilling their medications in a timely fashion without significant gaps in treatment days, we estimated logistic regression models of the impact of three-tier adoption on nonpersistence of use. The nonpersistence measure was defined as the proportion of individuals who experienced at least one episode of having no medication within a particular class for a minimum of 90 days in the year after three-tier adoption and includes individuals who stopped filling prescriptions

entirely during the 1-year postperiod. For consistency, this measure was calculated for each class, although the clinical significance of individuals experiencing greater than a 90-day gap varies by class (e.g., in many cases, 90-day gaps in use of NSAIDs and PPIs will not be as clinically relevant as 90-day gaps in use of ACE inhibitors or statins). To isolate the proportion of patients who discontinued use entirely, we estimated similar models of the probability of discontinuation, defined as filling no prescriptions in a particular class or another class that is typically used to treat the same therapeutic condition in the year after adoption. For example, individuals who discontinued SSRI use in the year after three-tier adoption but filled a prescription for another antidepressant during the postperiod were not considered “discontinuers.”

To assess whether financial incentives to choose particular medications led enrollees to change drugs, we estimated models of the effect of three-tier adoption on the proportion of preperiod users of medications subsequently assigned to tier 3 (i.e., those who faced the largest copayment increase) who changed to a lower-tier medication in the same class in the year after three-tier adoption. For all three types of models, independent variables were age, gender, employee, intervention group, the proportion of prescriptions filled through the mail-order program in the preperiod, the risk index, and preperiod MPR. To aid in interpretation of each model’s results, adjusted probabilities were calculated using the results. No adjustments to the nominal α were made to correct for multiple tests across drug classes.

RESULTS

Our sample is predominantly female with a mean age in the mid-70s (Table 1). Use of mail order varies across plans, with three-quarters of Plans C and D enrollees filling at least one mail-order prescription compared with just one-quarter of Plan A enrollees. Propensity score matching of preperiod users in each class reduced the standardized differences between the intervention and comparison enrollees for all variables used in the matching process to <2 percent.

Drug Utilization

MPR. Preperiod MPRs were fairly high overall for both the intervention and comparison groups, which suggests that medication compliance was relatively high in our sample (Table 2). Preperiod MPRs were highest for

Table 2: Change in Adjusted Medication Possession Ratio (MPR) in Matched Samples after Three-Tier Adoption

All Matched Enrollees					
Class/Plan	Intervention		Comparison		Difference
	Pre	Post	Pre	Post	
ACE inhibitors					
A (<i>n</i> = 3,918)	0.7695	0.7810	0.7775	0.7994	− 0.0104
B (<i>n</i> = 6,400)	0.7979	0.8021	0.8090	0.8240	− 0.0108 ⁺
C (<i>n</i> = 1,805)	0.8119	0.8354	0.8322	0.8359	0.0198 ⁺
D (<i>n</i> = 4,116)	0.7965	0.8070	0.7988	0.8074	0.0019
Statins					
A (<i>n</i> = 6,402)	0.7786	0.7969	0.7836	0.8239	− 0.0220*
B (<i>n</i> = 9,344)	0.8037	0.8021	0.8132	0.8273	− 0.0157*
C (<i>n</i> = 2,798)	0.8315	0.8428	0.8498	0.8434	0.0177*
D (<i>n</i> = 5,904)	0.7999	0.8153	0.8029	0.8135	0.0048
PPIs					
A (<i>n</i> = 3,153)	0.6788	0.7053	0.6998	0.7607	− 0.0344*
B (<i>n</i> = 4,316)	0.6902	0.7173	0.7130	0.7710	− 0.0309*
C (<i>n</i> = 1,277)	0.7166	0.7820	0.7475	0.7935	0.0192 ⁺
D (<i>n</i> = 2,748)	0.6748	0.7495	0.6976	0.7594	0.0129
SSRIs					
A (<i>n</i> = 1,648)	0.7017	0.7055	0.7053	0.7342	− 0.0251*
B (<i>n</i> = 2,495)	0.6914	0.7185	0.7186	0.7435	0.0022
C (<i>n</i> = 643)	0.7248	0.7680	0.7587	0.7446	0.0573*
D (<i>n</i> = 1,454)	0.6651	0.7343	0.6719	0.7418	− 0.0007
ARBs					
A (<i>n</i> = 1,671)	0.7371	0.8012	0.7376	0.8244	− 0.0227*
B (<i>n</i> = 2,802)	0.7440	0.8111	0.7741	0.8343	0.0069
C (<i>n</i> = 842)	0.7792	0.8379	0.8041	0.8449	0.0179
D (<i>n</i> = 2,051)	0.7540	0.8178	0.7728	0.8273	0.0093
CCBs					
A (<i>n</i> = 5,025)	0.7975	0.8143	0.8052	0.8226	− 0.0006
B (<i>n</i> = 6,482)	0.8304	0.8135	0.8351	0.8343	− 0.0165*
C (<i>n</i> = 2,035)	0.8525	0.8505	0.8584	0.8397	0.0167 ⁺
D (<i>n</i> = 4,196)	0.8358	0.8276	0.8258	0.8188	− 0.0012
NSAIDs					
A (<i>n</i> = 1,374)	0.5773	0.5444	0.5904	0.5444	0.0131
B (<i>n</i> = 1,831)	0.5983	0.5700	0.5838	0.5591	− 0.0036
C (<i>n</i> = 510)	0.6322	0.6228	0.6379	0.5936	0.0349
D (<i>n</i> = 956)	0.5616	0.5816	0.5480	0.5427	0.0253

Adjusted for age, gender, employee/spouse status, risk index, the proportion of prescriptions filled through the mail order program in the preperiod, and average monthly spending in the drug class in the preperiod.

* $p < .01$ (based on Wald's tests).

⁺ $p < .05$ (based on Wald's tests).

ACE, angiotensin-converting-enzyme; PPI, proton pump inhibitor; SSRI, selective serotonin reuptake inhibitor; ARB, angiotensin-receptor blocker; CCB, calcium channel blocker; NSAID, nonsteroidal anti-inflammatory drug.

the drug classes used to treat cardiovascular conditions (ACE inhibitors, ARBs, CCBs, and statins), ranging from 0.74 to 0.86. The ratios were somewhat lower for NSAIDs, PPIs, and SSRIs.

Depending on the plan and class, we found either no effects or small effects (from -0.03 to 0.06 , $p \leq .05$) of three-tier adoption on average MPR among those with some postperiod use, relative to matched comparison groups (Table 2). Although most statistically significant effects were negative, some were positive, although also small in magnitude (e.g., MPR for Plan C ACE inhibitor use increased by 0.02 , $p \leq .05$). A similar pattern of results was found for the subset of patients using tier 3 drugs in the preperiod (results not shown). Results from the GEE models for the 20 percent random sample were similar to those from the matched samples.

Nonpersistent Use. For ACE inhibitors, ARBs, CCBs, and statins, approximately 11–18 percent of preperiod intervention users experienced a gap > 90 days in the postperiod, depending on the plan (Table 3). The rate of nonpersistent use was somewhat higher for NSAIDs, PPIs, and SSRIs. Plan A intervention users were significantly more likely to have nonpersistent use in the postperiod for all classes except NSAIDs, relative to comparison users. For example, the adjusted probability of nonpersistent use for Plan A ACE inhibitor users was 18.4 percent, compared with 15.3 percent for the comparison group ($p \leq .01$). Plan B intervention users were significantly more likely to have nonpersistent use of ACE inhibitors, PPIs, SSRIs, and statins ($p \leq .05$). The nonpersistent use rates were significantly lower for Plan C intervention SSRI users compared with Plan C comparison users ($p \leq .01$) and for Plan D intervention CCB users, statin users, and NSAID users ($p \leq .05$), relative to comparison users.

Discontinuation. Although the adjusted probability of discontinuation is low overall, intervention users were significantly more likely to discontinue use entirely relative to comparison users for six of the seven classes for Plan A (all but SSRIs), three classes for Plan B (PPIs, SSRIs, and statins), and one class for Plan D (statins) (Table 3). For example, the adjusted probability of discontinuation among Plan A intervention ACE inhibitor users was 4.7 percent relative to 3.8 percent in the comparison group ($p = .04$).

Medication Changes. For the majority of class/plan combinations, intervention patients were more likely to change from a tier 3 drug to a lower-tier drug relative to comparison patients, although fewer than half of tier 3 users did change to a lower-tier drug (results not shown). For example, 47 percent of

Table 3: Adjusted Probability of Nonpersistent Medication Use and Discontinuation in the Postperiod among Preperiod Users

Class/Plan	Nonpersistent Use		Discontinuation	
	Intervention (%)	Comparison (%)	Intervention (%)	Comparison (%)
ACEs				
A	18.4	15.3*	4.7	3.8 ⁺
B	15.4	14.2 ⁺	4.3	4.0
C	14.0	15.2	2.8	3.7
D	16.4	17.6	3.5	3.7
Statins				
A	15.1	10.4*	3.6	1.8*
B	14.8	12.0*	3.5	2.4*
C	11.6	12.0	1.8	2.3
D	14.6	16.2 ⁺	3.4	2.3*
PPIs				
A	24.9	17.9*	6.6	5.1*
B	23.8	18.7*	7.6	6.4 ⁺
C	18.6	18.6	5.6	6.2
D	22.4	22.1	4.3	5.3
SSRIs				
A	25.3	21.1*	7.8	6.2
B	24.1	21.5 ⁺	8.5	6.8 ⁺
C	19.5	27.1*	5.0	6.6
D	25.4	24.0	5.9	7.5
ARBs				
A	15.0	11.8*	5.4	3.7 ⁺
B	13.0	12.3	4.1	4.4
C	11.3	12.3	2.9	3.7
D	14.9	14.6	3.4	2.5
CCBs				
A	14.1	12.6 ⁺	5.0	4.0 ⁺
B	14.3	13.2	4.4	4.6
C	12.1	13.6	3.3	3.8
D	14.7	16.3 ⁺	4.5	4.0
NSAIDs				
A	43.3	42.9	21.6	16.5*
B	42.6	44.3	21.0	18.8
C	38.1	43.5	15.1	18.0
D	42.2	49.7*	19.2	17.3

* $p < .01$ (based on Wald's tests).⁺ $p < .05$ (based on Wald's tests).*Note:* Individuals who discontinue use entirely are also counted as having nonpersistent use.

Nonpersistent use probabilities are adjusted for age, gender, employee/spouse status, risk index, preperiod medication possession ratio (MPR), and the proportion of prescriptions filled through the mail-order program in the preperiod. Discontinuation probabilities are adjusted for age, gender, employee/spouse status, risk index, and preperiod MPR.

ACE, angiotensin-converting-enzyme; PPI, proton pump inhibitor; SSRI, selective serotonin reuptake inhibitor; ARB, angiotensin-receptor blocker; CCB, calcium channel blocker; NSAID, nonsteroidal anti-inflammatory drug.

intervention tier 3 statin users in Plan A changed to a lower-tier drug compared with 27 percent of comparison users ($p \leq .01$). Change rates were lowest for SSRIs (ranging from 8 percent for Plan D to 19 percent for Plan A intervention users), the only class for which tier 3 users were not significantly more likely to change medications in any plan.

Drug Spending. Three-tier implementation resulted in a shift in the distribution of spending between the plan and the enrollee for almost all classes and plans studied. For example, monthly ACE inhibitor spending by enrollees increased from \$1.01 (Plan D) to \$6.28 (Plan A) ($p < .01$), while monthly ACE inhibitor spending by plans decreased from \$1.67 (Plan D) to \$7.72 (Plan A) ($p < .01$), relative to comparison group users (Table 4). Three-tier adoption generally had a relatively small, negative effect (i.e., generally smaller than the effect on plan spending), or in some cases no effect, on total monthly spending. As for the MPR analyses, results from the GEE models for the 20 percent random sample were similar to those from the matched samples.

DISCUSSION

Incentive formularies are intended to give financial incentives to enrollees to select medications that cost less for the payer, when clinically appropriate. To date, there has been little empirical evidence to inform employers and public policy makers about the likely impacts of three-tier formulary use in employer-sponsored retiree plans or in Medicare Part D drug plans. In the retiree plans we studied, a sizeable number of elderly patients using a tier 3 drug did change to a lower-tier medication after three-tier adoption, particularly for the classes used to treat cardiovascular conditions. However, the majority of tier 3 users did not change, and three-tier adoption and the accompanying copayment increases resulted in a shifting of costs from the plan to the patient. In this elderly population with fairly high continuation rates before the changes, three-tier adoption had relatively small effects on average medication continuation as measured by the MPR among those with at least some medication use in the postperiod. However, a small number of patients either had gaps in their medication use or discontinued use entirely. We have no explanation for the positive effect of three-tier adoption on MPR or for higher rates of nonpersistent use in the comparison group than the intervention group for a

Table 4: Adjusted Change in Monthly Enrollee, Plan, and Total Spending in Matched Samples, by Class

<i>Class</i>	<i>Enrollee</i>	<i>Plan</i>	<i>Total</i>
ACE			
A	\$6.28*	– \$7.72*	\$1.44*
B	\$4.88*	– \$6.28*	\$1.40*
C	\$2.44*	– \$2.46*	– \$0.01
D	\$1.01*	– \$1.67*	– \$0.66
Statins			
A	\$5.13*	– \$9.49*	– \$4.36*
B	\$5.04*	– \$7.78*	– \$2.73*
C	\$3.17*	– \$2.81*	\$0.37
D	\$1.18*	– \$4.46*	– \$3.28*
PPIs			
A	\$4.94*	– \$12.87*	– \$7.92*
B	\$4.83*	– \$13.39*	– \$8.56*
C	\$3.09*	– \$2.61*	\$0.49
D	\$2.26*	– \$4.99*	– \$2.72*
SSRIs			
A	\$3.66*	– \$7.14*	– \$3.49*
B	\$4.48*	– \$8.81*	– \$4.33*
C	\$3.85*	\$0.63	\$4.48 ⁺
D	\$1.64*	– \$4.72*	– \$3.08*
ARBs			
A	\$7.65*	– \$9.21*	– \$1.55*
B	\$4.67*	– \$5.74*	– \$1.07*
C	\$3.11*	– \$2.69*	\$0.42
D	\$1.13*	– \$3.02*	– \$1.88*
CCBs			
A	\$4.84*	– \$6.65*	– \$1.80*
B	\$1.74*	– \$5.30*	– \$1.88*
C	\$1.88*	– \$1.87*	\$0.01
D	\$1.00*	– \$1.76*	– \$0.76 ⁺
NSAIDs			
A	\$1.88*	– \$5.04*	– \$3.17*
B	\$2.04*	– \$2.96*	– \$0.93
C	\$1.28*	\$1.06	\$2.34 ⁺
D	\$0.32*	\$0.21	\$0.53

* $p < .01$,⁺ $p < .05$; adjusted for age, gender, employee/spouse status, risk index, and the proportion of prescriptions filled through the mail-order program in the preperiod.

ACE, angiotensin-converting-enzyme; PPI, proton pump inhibitor; SSRI, selective serotonin reuptake inhibitor; ARB, angiotensin-receptor blocker; CCB, calcium channel blocker; NSAID, nonsteroidal anti-inflammatory drug.

subset of cases. However, these statistically significant differences were relatively small in magnitude and our large sample sizes allowed us to detect very small differences. We observed small negative effects on MPR and discontinuation even for the statin class, despite the fact that the two most commonly prescribed statins (Lipitor and Zocor) were on tier 2 after three-tier adoption. The small negative effects may be due in part to the fact that two of the four plans increased copayments for tier 2 drugs and to a general effect of three-tier adoption. For example, some statin users who also used several other medications and faced large increases in out-of-pocket spending after three-tier adoption might have decided to cut back use of their statin medications (e.g., by skipping doses or cutting pills in half) as cholesterolemia is typically an asymptomatic condition.

Previous studies of three-tier adoption among nonelderly employees found larger effects on use and discontinuation than we find here (e.g., Huskamp et al. 2003; Goldman et al. 2004). Our results may differ due to a variety of factors, including the differences in the benefit options available to our retiree sample versus the active employees studied previously, the magnitude of the copayment changes involved (typically larger copayment changes for previous studies than for our four retiree plans), differences in adherence behavior across age cohorts, or differences in the presence of medical comorbidities, which could influence adherence behavior. Hsu et al. (2006) found that elderly Medicare+Choice beneficiaries with capped pharmacy benefits were significantly more likely to be nonadherent to long-term drug therapy for hypertension, hyperlipidemia, and diabetes than similar beneficiaries without capped pharmacy benefits. The copayment increases in the plans we studied were much smaller in magnitude than the copayment increase experienced when someone exceeds a pharmacy spending cap.

Our study approach has several strengths, including a large sample size, a large number of drug classes, and a matched comparison of enrollees from four large retiree plans that implemented three-tier formularies and two that did not. This allows us to examine four elderly populations with similar demographic characteristics and different benefit design changes. Despite this, our results may not be generalizable to all instances of three-tier adoption among elderly populations because our population had reasonably generous drug coverage relative to many Medicare beneficiaries and may have had higher than average incomes (Centers for Medicare & Medicaid Services [CMS] 2002a). We did not have data on each enrollee's actual income, but we included in our propensity score models data from the 2000 Census on median

household income for the zip code of residence. The median income levels for zip code of residence, which ranged from an average of \$39,563 for Plan A to \$48,946 for Plan B, are somewhat higher than those for the Medicare population as a whole, for which only approximately 31 percent had incomes over \$30,000 in 2002 (CMS 2002b). However, median income for zip code of residence is a crude proxy for actual household income among seniors. Our results are likely most generalizable to Medicare beneficiaries who currently have employer-sponsored drug coverage, of which 46 percent had incomes >\$30,000 and 72 percent had incomes >\$20,000 in 2002 (CMS 2002b). The limited variability in median household income for zip code of residence in our sample, which makes stratifying the analysis by this variable uninformative with the current data, is also a limitation of the study and represents an opportunity for future research.

There were several additional limitations of our study. First, we were unable to obtain proprietary information on the magnitude of rebates negotiated with manufacturers as a result of three-tier adoption. Consequently, the estimates of effects on plan and total spending are likely understated. Second, filling a prescription does not guarantee that an enrollee continues to take the medication for the full time period. Third, with pharmacy claims data we are unable to determine the impact of reduced medication use on health outcomes or medical spending, or to observe use of over-the-counter (OTC) medications (e.g., use of an OTC H2-blocker as a substitute for a PPI prescription). Fourth, using only outpatient drug claims, we were unable to assess differences across plans in hospitalization rates. As medications received during a hospitalization are not captured in our drug claims, outpatient medication use could appear lower in plans with higher hospitalization rates. Finally, our propensity score models are only able to reduce differences between the intervention and comparison groups in observed confounders; we are unable to control for differences in unobserved confounders.

The costs of retiree health coverage have increased rapidly in recent years and many employers have cut retiree benefits, particularly drug benefits. Fifty-three percent of large private employers surveyed in 2004 reported that they increased prescription drug copayments or coinsurance within the past year and 24 percent adopted three-tier formularies (Kaiser/Hewitt 2004). Our findings suggest that moderate cost sharing increases from three-tier adoption resulted in some shifting of costs with at most a modest impact on continuation for most enrollees in a population of relatively well-insured seniors. We did find higher rates of nonpersistent use and discontinuation for intervention medication users relative to comparison users, but the magnitude

of the differences was small. Based on results from the nonelderly, effects on continuation could be more dramatic among beneficiaries experiencing larger increases in cost sharing or more restrictive formulary content than implemented by the plans we studied. This hypothesis will need to be tested in the setting of more dramatic cost sharing changes in an elderly population. In our study, it appears that increased enrollee cost sharing did not have a deleterious impact on medication compliance for a broad range of commonly prescribed drugs.

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SUPPLEMENTARY MATERIAL

The following supplementary material for this article is available:
Appendix A. Three-Tier Formulary Content

This material is available as part of the online article from <http://www.blackwell-synergy.com/doi/abs/10.1111/j.1475-6773.2007.00722.x> (this link will take you to the article abstract).

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