The Effects of Antihypertensive Step-Therapy Protocols on Pharmaceutical and Medical Utilization and Expenditures

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Objective: To examine the effects of antihypertensive step therapy on prescription drug utilization and spending, and other medical care utilization and spending.

Study Design: Pre/post design.

Methods: Employers who had implemented step therapy were compared with employers who had not implemented step therapy. Data were drawn from the 2003 through 2006 MarketScan Research Databases. The study sample included employees and dependents who used antihypertensives (11,851 patients whose employer implemented a step-therapy protocol and 30,882 patients in the comparison group without step therapy). Multivariate generalized estimating equation models were used to estimate the immediate and time-varying effects of step therapy on medical and prescription drug spending and utilization, while controlling for important covariates and adjusting for clustering by patient.

Results: Results showed an initial 7.9% reduction in antihypertensive medication days supplied and an initial 3.1% reduction in medication costs among antihypertensive users in the step-therapy plans. However, these percentages grew in each subsequent quarter. Antihypertensive users in step-therapy programs also experienced an increase in inpatient admissions and emergency room visits. After an initial decline in spending, the step-therapy group incurred $99 more per user in quarterly expenditures than the comparison group.

Conclusions: The intended effect of step therapy is to substitute cheaper and equivalently effective medications for more expensive medications. As this study demonstrates, step therapy may create barriers to receiving any medication, resulting in higher medical utilization and costs. Further research is needed to understand why these unintended consequences occur and how they might be avoided.

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Managed care organizations and insurance plans are increasingly adopting step therapy in an effort to contain costs by steering patients away from more costly pharmacotherapies. Step therapy requires a member to try the first-line medication(s) within a drug class, often a generic alternative, prior to receiving coverage for a second-line agent, usually a branded product.[1] Currently, most pharmacy benefit managers implement step therapy using "smart edit" logic and grandfathering those members who had obtained a prescription for the target (second-line) drug in the recent past. At the point of service, the smart edit reviews the member's claims history (both electronically and in real time) for evidence of prior use of the first-line agent(s). If a claim is found, the system covers the second-line agent; otherwise, the claim is rejected. After claim rejection, members have the opportunity to have their prescriber change the prescription to the first-line agent or to submit a request for coverage of the second-line agent through a prior authorization.[1]

There is a small but growing literature on step-therapy programs. In 2007 Yokoyama and colleagues evaluated hypertension-related pharmacy use and costs for 3 managed care plans that implemented an angiotensin receptor blocker (ARB) step-therapy intervention compared with 1 health plan with no ARB step-therapy intervention.[2] The step-therapy intervention used a smart edit of patient pharmacy claim history in the preceding 3-month period. The ARB claim was rejected if there was no prior use of these drugs, in which case the pharmacist or patient had to contact the prescriber to obtain an alternative to the ARB or a prior authorization. The researchers found that within 12 months of follow-up, a step-therapy intervention for ARBs was associated with an 18% ratio of ARB users to the total number of patients using angiotensin-converting enzyme (ACE) inhibitors or ARBs compared with a 31% ratio in a health plan without the ARB step-therapy intervention. Of the patients who attempted to obtain an ARB and were rejected in the step-therapy group, 44.6% of patients went through the prior authorization process and received an ARB as initial therapy, 48.8% received other antihypertensive therapy, and 6.6% did not receive any antihypertensive therapy. Antihypertensive drug costs were about 13% lower for the ACE/ARB patients in the intervention group.

Motheral and colleagues examined the effect of prescription

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step-therapy programs in terms of plan-sponsor savings and member experience at the point of service.[3,4] Specifically, they studied a 20,000-member plan that implemented 3 step-therapy programs in September 2002. The step-therapy programs covered proton pump inhibitors, selective serotonin reuptake inhibitors, and nonsteroidal anti-inflammatory drugs. Pharmacy claims from September 1, 2001, through June 30, 2003, were examined to compare changes in pharmacy per-member-per-month (PMPM) net cost for the intervention group with changes in pharmacy PMPM net cost for a random sample of members from commercial plans without the step-therapy programs. A mailed, self-administered survey was sent to members with a step edit from September 1, 2002, through December 31, 2002. They found that the employer experienced a decrease of $0.83 PMPM in net cost after implementing step therapy, while the comparison group had an increase of $0.10 PMPM for these therapy classes.

Of the approximately 657 members who experienced a step-therapy edit and were mailed a survey, 33% returned the survey. Member-reported outcomes indicated that approximately 30% of patients received a generic after the step-therapy edit, 23% were granted a medical exception for the brand, and another 16% paid out-of-pocket for the brand medication. Nearly 17% received no medication, and another 10% received a sample or a nonprescription alternative. Compared with those who received first-line therapy, those who paid out-of-pocket for the brand medication and those who did not receive any medication were less likely to be satisfied with their pharmacy benefit.[4]

Dunn and colleagues evaluated the impact on utilization and costs of a generic step-therapy program for antidepressant drugs in a health maintenance organization.[5] In the program, brand-name antidepressants were covered only after a trial with a generic antidepressant, excluding tricyclic antidepressants. The authors found that the generic antidepressant dispensing rate increased by 20 percentage points (32.5%-52.5%) in the intervention group but only 7.4 points in the comparison group (24.9%-32.3%). Antidepressant costs per day of therapy in the intervention group decreased 11.7% versus a 2.7% decrease in the comparison group. The combination of change

Table 1. Characteristics of Step-Therapy and Comparison Groups

	Antihypertensive Users				
	Step Therapy (N = 11,851)		Comparison (N = 30,882)		
Characteristic	**Mean/N**	**SD/%**	**Mean/N**	**SD/%**	***P***
Age (mean, SD)	51.81	9.0	53.46	8.5	<.001
Age group, y (No., %)					
0-17	44	0.4%	104	0.3%	.587
18-34	567	4.8%	1138	3.7%	<.001
35-44	1664	14.0%	2745	8.9%	<.001
45-54	4142	35.0%	9714	31.5%	<.001
55-64	5434	45.9%	17,181	55.6%	<.001
Sex (No.,%)					
Female	6642	56.0%	14,205	46.0%	<.001
Male	5209	44.0%	16,677	54.0%	<.001
Relationship to employee (No., %)					
Self	1664	82.2%	17,924	58.0%	<.001
Spouse	2015	17.0%	12,470	40.4%	<.001
Child/Other	99	0.8%	488	1.6%	<.001
Median household income (mean, SD)	$41,593	$11,750	$47,312	$16,065	<.001
Percent college graduates (mean, SD)	19	11	25	14	<.001
Deyo-Charlson Comorbidity Index (mean, SD)	0.65	1.15	0.68	1.20	.053
Chronic Disease Score (mean, SD)	5.67	3.09	5.78	3.00	<.001
Number of diagnoses by 3-digit *ICD-9-CM* code (mean, SD)	8.31	6.19	9.15	6.77	<.001

ICD-9-CM indicates *International Classification of Diseases, Ninth Revision, Clinical Modification.*

in drug costs and utilization resulted in a 13% decrease in antidepressant drug costs, from $4.16 PMPM in 2004 to $3.62 PMPM in 2005, versus a 7.6% decrease (from $3.57 to $3.30 PMPM) in the comparison group.

While prior research examined the effects of step therapy on prescription drug utilization and spending, this study focused on the effects of step therapy on all types of medical care utilization and spending. Specifically, the goal of this study was to examine the impact of a step-therapy program for ACE/ARBs on prescription drug and medical utilization and spending. Our estimates of the effects of step therapy are based on 2 ACE/ARB step-therapy programs implemented at different points in time, not a single program implementation. This strengthens the study design, providing an estimate of the common effects of step-therapy programs on utilization and spending.

METHODS

The data source is the MarketScan Research Database from Thomson Reuters, representing the healthcare experience of enrollees in employer-sponsored health plans in the United States. Although the MarketScan Database in its entirety represents the healthcare experiences of more than 60 employers, we selected employers who had either (1) recently implemented step therapy (as a treatment group) or (2) could be verified as not having a step-therapy program in place (as a comparison group). Two firms had recently implemented step-therapy programs and were selected as the treatment group. As an additional requirement, the step-therapy program had to be implemented equally across all benefit plans available to an enrollee. To reduce the likelihood of selection bias, step therapy could not be selected or deselected by the individual enrollee. Two employers that did not have a step-therapy program in effect during the same time served as a control group.

The step-therapy programs identified were implemented at different times, from 2003 through 2005, depending on the particular employer and prescription drug class. Exact dates of implementation are not disclosed to protect the identities of the employers.

This analysis focuses on step-therapy programs for antihypertensive medications because these are among the most commonly used medications. Two employers in the study implemented step therapy for antihypertensives, in particular ACE inhibitors and ARBs. The step-therapy program required certain (first-level or preferred) ACE inhibitors or ARBs to be used for a period of time (eg, 130 days) before using another (second-level) ACE inhibitor or ARB. Both step-therapy programs included the same antihypertensive medications for steps 1 and 2:

Step 1: benazepril, captopril, enalapril, fosinopril, lisinopril, moexipril, Quinaretic.

Step 2: Atacand, Avalide, Avapro, Benicar, Cozaar, Diovan, Hyzaar, Micardis, Teveten.

The sample was limited to employees and dependents of the selected employers (step-therapy and comparison group) who were continuously enrolled from 2003 through the third quarter of 2006, under 65 years of age, and not eligible for Medicare. An analytic file was created using a panel data (repeated measures) framework with 1 observation each quarter for each individual. Each enrollee in the analytic file had 15 observations (ie, quarters of data). The total sample comprised 269,561 enrollees. Of this group, 66,308 were enrolled in step-therapy plans and 203,253 were enrolled in comparison plans.

All Enrollees				
Step Therapy (N = 66,308)		Comparison (N = 203,253)		
Mean/N	SD/%	Mean/N	SD/%	*P*
32.43	17.9	33.59	18.16	<.001
19,105	28.8%	55,666	27.4%	<.001
13,663	20.6%	38,340	18.9%	<.001
11,803	17.8%	31,159	15.3%	<.001
14,678	22.1%	54,340	26.7%	<.001
7059	10.7%	23,748	11.7%	<.001
37,186	56.1%	105,682	52.0%	<.001
29,122	43.9%	97,571	48.0%	<.001
38,840	58.6%	82,031	40.4%	<.001
7453	11.2%	54,564	26.8%	<.001
20,015	30.2%	66,658	32.8%	<.001
$40,557	$14,223	$48,148	$14,007	<.001
22	14	23	13	<.001
0.18	0.59	0.16	0.57	.001
1.75	2.50	1.57	2.34	<.001
4.67	4.29	4.70	4.54	.113

We also focused on the subset of enrollees in each plan who were antihypertensive users (N = 42,733). Of these, 11,851 were in step-therapy plans and 30,882 were in comparison plans.

The dependent variables were prescription drug and medical costs and utilization. Six quarterly utilization measures were examined for antihypertensive users: the number of antihypertensive (ACE/ARB) days supplied (within the time period covered by the quarter), the antihypertensive (ACE/ARB) discontinuation rate (as defined by a gap of at least 60 days with no evidence of use of any drug in the class), the number of prescriptions filled, the number of emergency room visits, and the number of inpatient admissions. Five spending measures for antihypertensive users were examined: outpatient prescription drug, emergency room, inpatient medical (admissions), outpatient medical (nondrug), and total (medical and drug). Expenditures were defined as the total amount reimbursed to providers from all sources of payment including the health plan, the patient, and any third party (coordination of benefits amount). One utilization measure was examined for all enrollees: the antihypertensive (ACE/ARB) days supplied.

Statistical evaluations were performed using UNIX SAS version 9.01 (SAS Institute Inc, Cary, NC) and Stata 9.0 for Windows (StataCorp LP, College Station, TX). Chi-square and Student *t* tests were used to compare demographic and clinical characteristics as well as outcome variables between the step-therapy and comparison groups after step therapy had been implemented.

The general model specification was:

$$Y = g(a_0 + \beta_1 * Step_{it} + \beta_2 * TimeStep_{it} + \beta_3 * Quarter_t + \beta_4 * Quarter^2_t + \beta_5 * Dem_{it} + \beta_6 * Clinical_{it}),$$ where i is person and t is time in quarters.

The explanatory variables were defined as follows: *Y*: medical care utilization or expenditure measure. *Step:* a 0/1 dummy variable that equals 1 after the employer instituted step therapy and 0 otherwise. *TimeStep:* a numeric counter measuring the number of quarters since step therapy began (ie, 1, 2, 3...). *Quarter:* a time trend variable to capture the linear utilization and spending trends common to both the step-therapy and comparison groups, with the first quarter of 2003 coded as 1 and the third quarter of 2006 coded as 15. Quadratic trends were captured with the $Quarter^2$ variable. *Dem:* demographic characteristics including age, sex, median income in the patient's ZIP code of residence, and percentage of college graduates in the patient's ZIP code of residence (from the US Census). *Clinical:* clinical characteristics including number of *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes in the prior year and Deyo-Charlson Comorbidity Index over the prior year.

Multivariate generalized estimating equation models were used to estimate the effects of step therapy on spending and utilization while controlling for important covariates and adjusting for clustering by patient.[6] Utilization variables, representing counts of each type of service, were estimated with a negative binomial distribution and a log link. Discontinuation was estimated by using a binomial distribution and a logit link. Expenditures were estimated by using a gamma distribution with a log link.

The effects of step therapy are captured in the coefficients of the *Step* and *TimeStep* variables. The *Step* variable captures the immediate, and static, effects of step therapy, and the *TimeStep* variable captures the time-varying effects in each quarter after step therapy was implemented. To estimate the full magnitude of the effects of step therapy on the outcome measures (as expressed in these 2 coefficients), we calculated a nonlinear prediction (predictnl in Stata) at the mean of each control variable.[7]

RESULTS

Sample Description

Table 1 compares the characteristics of 2 study samples: (1) all enrollees in step therapy plans and comparison plans and (2) enrollees who used antihypertensives at any time in the study period in step-therapy plans and comparison plans. Relative comparisons between the step-therapy plans and the comparison plans were similar for the all-enrollee group and the antihypertensive users. The step-therapy participants were slightly younger (age 32.4 vs 33.6 years for all enrollees and 51.8 vs 53.5 years for antihypertensive users; all $P < .001$). The age group distribution also was skewed slightly younger in the step-therapy group. There were a greater percentage of females in the step-therapy group than in the comparison group and a greater percentage of the step-therapy beneficiaries were employees (59% vs 40% female and 82% vs 58% employees, respectively; all $P < .001$). The step-therapy participants had a lower median income in their ZIP code of residence and a lower percentage of college graduates.

The samples were relatively comparable in terms of the comorbidity measures. For all enrollees there was no statistically significant difference in the count of 3-digit *ICD-9-CM* diagnostic categories ($P = .113$). The Deyo-Charlson Comorbidity Index and the Chronic Disease Score were slightly higher in the step-therapy group (0.18 vs 0.16, $P = .001$, and 1.75 vs 1.57, $P < .001$, respectively). For antihypertensive users, there was no statistically significant difference between the step-therapy and comparison groups

Table 2. Unadjusted Utilization and Expenditure Measures for the Step-Therapy and Comparison Groups in 2006

Measure	Step Therapy		Comparison		*P*
	Mean	SD	Mean	SD	
Antihypertensive users[a]					
Antihypertensive medication					
Days supplied (average per antihypertensive user)	224.49	143.54	252.41	137.66	<.0001
Antihypertensive discontinuation rate per user	0.13	0.60	0.10	0.53	<.0001
All conditions					
Number of prescriptions filled (average per user)	32.53	26.08	35.55	28.81	<.0001
Number of emergency room visits (average per user)	0.41	1.13	0.28	0.85	<.0001
Number of outpatient office visits (average per user)	5.93	5.30	4.72	5.68	<.0001
Number of inpatient admissions (average per user)	0.16	0.56	0.13	0.53	.0002
Expenditures, $					
Outpatient prescription drug	2265.36	3004.50	2908.56	3873.40	<.0001
Emergency room	537.70	5604.00	260.99	1185.80	<.0001
Inpatient medical	2170.26	12,652.00	2160.83	13,773.00	.9484
Outpatient office medical	434.78	424.61	376.33	488.33	<.0001
Outpatient medical	4246.88	12,341.00	4530.22	13,350.20	.1488
Total expenditures	9220.20	20,310.00	9860.60	20,680.00	.0037
All enrollees[b]					
Days supplied (average per enrollee)	40.12	105.26	38.35	105.30	.0002

[a]Among antihypertensive medication users, 11,851 were in the step-therapy group and 30,882 were in the comparison group.
[b]Among all enrollees, 66,308 were in the step-therapy group and 203,253 were in the comparison group.

in the Deyo-Charlson Comorbidity Index (P = .053). The Chronic Disease Score was slightly lower in the step-therapy group (5.67 vs 5.78, P <.001), and the *ICD-9-CM* counts were slightly lower in the step-therapy group (8.31 vs 9.15, P <.001).

Table 2 describes prescription drug utilization and spending in 2006—the year that all plans implementing step therapy had step therapy in place. It should be noted that the effect of step therapy cannot be easily discerned from this table because the effects were measured about a year after implementation for 1 health plan, while effects were measured about 3 years after implementation for the other plan. For antihypertensive users, the mean number of days supplied per year of antihypertensives (ACE/ARB) was lower in the step-therapy group than in the comparison group (224.5 vs 252.4 days, respectively), while the antihypertensive discontinuation rate per user for the step-therapy group was higher than that for the comparison group (.13 vs .10, respectively) (all comparisons P <.001). The relationships between the step-therapy group and the comparison group were consistent across all service utilization and spending measures. Specifically, prescription drug utilization and spending measures were lower in the step-therapy group. However, the step-therapy group had more emergency room utilization, outpatient visits, and inpatient admissions. For all enrollees, the step-therapy group had more antihypertensive (ACE/ARB) days supplied per year than the comparison group.

Multivariate Model Results (Utilization)

In the multivariate models of antihypertensive users (Table 3), step therapy was associated with a higher rate of discontinuation of antihypertensive (ACE/ARB) medications, as the immediate effect on discontinuation was significant (P <.001), and the time-varying effect on discontinuation was positive and grew with time (an expanded version of Table 3 is available at **www.ajmc.com** as **eAppendix Table 3**). The effects of step therapy on the number of antihypertensive (ACE/ARB) days supplied per antihypertensive user was more complex, with an immediate 7.9% drop in the number of antihypertensive days supplied after implementation (coefficient –0.079, P <.001). However, the number of antihypertensive days supplied increased with time (coefficient 0.016 per quarter, P = .002), and 5 quarters after implementation of step therapy, the number of antihyperten-

Table 3. Multivariate Effects of Step Therapy on Prescription Drug Utilization[a]

	Antihypertensive Users[c]									All Enrollees[d]		
	Antihypertensive (ACE/ARB) Days Supplied			Antihypertensive (ACE/ARB) Discontinuation Rate			Number of Prescriptions (All Medication Classes)			Antihypertensive (ACE/ARB) Days Supplied		
Variable[b]	Co-efficient	SD	*P*>|z|	Co-efficient	SD	*P*>|z|	Co-efficient	SD	*P*>|z|	Co-efficient	SE	*P*>|z|
Step-therapy effect (static)	−0.079	0.008	<.001	0.121	0.036	.001	−0.024	0.006	<.001	−0.071	.015	<.001
Step-therapy effect (time-varying)	0.016	0.002	<.002	0.016	0.008	.038	0.011	0.001	<.001	0.018	0.003	<.001
Quarter	0.084	0.001	<.001	−0.095	0.01	<.001	0.020	0.001	<.001	0.064	0.002	<.001
Quarter²	−0.003	0.000	<.001	0.004	0.001	<.001	−0.001	0.000	<.001	−0.003	0.000	<.001

ACE indicates angiotensin-converting enzyme; ARB, angiotension receptor blocker.
[a]Days supplied and the number of prescriptions were estimated using a negative binomial generalized estimating equation (GEE) model with a log link. Coefficients represent partial elasticities. Discontinuation and initiation were estimated using a logit GEE model with a log link.
[b]Quarter is a time trend variable used to capture the linear utilization and spending trends common to both the step-therapy and comparison groups; *Quarter*² is a time trend variable used to capture quadratic trends.
[c]Among antihypertensive medication users, 11,851 were in the step-therapy group and 30,882 were in the comparison group.
[d]Among all enrollees, 66,308 were in the step-therapy group and 203,253 were in the comparison group.

Table 4. Multivariate Effects of Step Therapy on Medical Care Utilization Among Antihypertensive Users[a]

	Outpatient Office Visits			Inpatient Admissions			Emergency Department Visits		
Variable[b]	Coefficient	SD	*P*>|z|	Coefficient	SD	*P*>|z|	Coefficient	SD	*P*>|z|
Step-therapy effect (static)	0.054	0.009	<.001	0.141	0.044	<.001	-0.039	0.024	.100
Step-therapy effect (time-varying)	0.008	0.002	<.001	0.014	0.010	.138	0.084	0.005	<.001
Quarter	0.020	0.002	<.001	0.044	0.009	<.001	0.161	0.007	<.001
Quarter²	−0.001	0.000	<.001	−0.002	0.001	<.001	−0.013	0.000	<.001

[a]Models were estimated using a negative binomial generalized estimating equation model with a log link. Coefficients represent partial elasticities. Among antihypertensive medication users, 11,851 were in the step-therapy group and 30,882 were in the comparison group.
[b]*Quarter* is a time trend variable used to capture the linear utilization and spending trends common to both the step-therapy and comparison groups; *Quarter*² is a time trend variable used to capture quadratic trends.

Table 5. Multivariate Effects of Step Therapy on Expenditures Among Antihypertensive Users[a]

	Inpatient			Outpatient		
Variable[b]	Coefficient	SE	*P*>|z|	Coefficient	SE	*P*>|z|
Step therapy effect (static)	−0.002	0.064	.977	−0.013	0.016	.425
Step therapy effect (time-varying)	0.027	0.013	.031	0.001	0.003	.653
Quarter	0.09	0.016	<.001	0.031	0.003	<.001
Quarter²	−0.004	0.001	<.001	−0.001	0.000	<.001

[a]Models were estimated using a generalized estimating equation model with a gamma distribution and a log link. Coefficients represent partial elasticities. Among antihypertensive medication users, 11,851 were in the step-therapy group and 30,882 were in the comparison group.
[b]*Quarter* is a time trend variable used to capture the linear utilization and spending trends common to both the step-therapy and comparison groups; *Quarter*² is a time trend variable used to capture quadratic trends.

sive days supplied in step-therapy plans began to exceed the days supplied in comparison plans (ie, in the fifth quarter after implementation the combined effect was −0.079 + 5*0.016 = .001). Similarly, the number of antihypertensive days supplied for all enrollees dropped after step therapy was initiated (coefficient –0.071, P <.001), but then grew to equal that of non–step-therapy plans. Mirroring these effects, the total number of prescriptions per antihypertensive user that were filled in all medication classes dropped after implementation of step therapy and, after an initial decline, began to increase.

For antihypertensive users, step therapy was associated with an increase in outpatient office visits and inpatient admissions (Table 4). Step therapy also was positively associated with the number of emergency room visits, and the increase in emergency room visits grew with the amount of time elapsed since step therapy was implemented (an expanded version of Table 4 is available at **www.ajmc.com** as eAppendix Table 4).

Table 5 displays the coefficients of the spending models for antihypertensive users. For inpatient spending, the immediate effects of step therapy were not significantly different than zero (P = . 977), but the effects increased with time and step therapy was not associated with a significant effect on outpatient spending. In contrast, emergency room spending increased immediately after implementation of step therapy and the effects increased with time. Finally, while prescription drug spending declined 3.1% (P <.001) after implementation of step therapy, spending on prescription drugs in step-therapy plans grew over time to be closer to that in non–step-therapy plans (an expanded version of Table 5 is available at **www.ajmc.com** as eAppendix Table 5).

Table 6 shows the predicted results of the inpatient, emergency room, and prescription drug spending models—the 4 expenditure categories significantly affected by implementation of a step-therapy program. In the first quarter after step therapy was implemented, inpatient costs were lower in the step-therapy plan ($18.84). However, by quarter 4 the reverse was true; step-therapy inpatient costs grew relatively more expensive, reaching a $52.57 difference by quarter 8. Similarly, step-therapy prescription drug expenditures were lower through quarter 4 but exceeded the comparison group expenditures by $15.84 by quarter 8. Also, emergency room spending for step-therapy plans consistently exceeded the spending levels of the comparison group.

DISCUSSION AND CONCLUSION

Step therapy has become a common aspect of private health insurance plans; nevertheless, the research examining its effects has been limited. In particular, little attention has been paid to outcomes beyond reduced medication use and spending. In theory, if step 1 (preferred) medications are perfect substitutes for step 2 medications, and selecting the preferred drug was administratively seamless, then one would anticipate that step therapy would lower medication costs with no negative effects on drug use patterns, outcomes, or expenditures. One might hypothesize that step-therapy plans also could improve effectiveness by substituting more efficacious medications.

Yet step therapy may have unintended consequences. Step-therapy plans may act as a deterrent to filling prescriptions. For example, if patients are unwilling to switch to step 1 medications and authorization for step 2 medications is difficult, they may not fill medications or discontinue medications altogether. Patients who were given a prescription for an antihypertensive on step 2 may have filled a prescription by obtaining a physician authorization or paying full price. However, they may have been reluctant or unable to fill more than 1 prescription given administrative and financial hurdles. Prior studies have found that many people who are subject to step-edits ultimately do not obtain a prescription.[2,4] Further, a number of studies have shown that discontinuation of antihypertensive medications has negative health and economic consequences.[8,9]

This study provides some support for the idea that step therapy may create unintended barriers to filling prescrip-

Emergency Room			Prescription Drug			Total Expenditures		
Coefficient	SE	P>|z|	Coefficient	SE	P>|z|	Coefficient	SE	P>|z|
0.113	0.044	.01	−0.031	0.009	.001	−0.058	0.023	.011
0.040	0.010	<.001	0.004	0.002	.051	0.016	0.006	.003
0.076	0.008	<.001	0.044	0.001	<.001	0.044	0.005	<.001
−0.003	0.001	<.001	−0.002	0.000	<.001	−0.002	0.000	<.001

Table 6. Predicted Effects of Step Therapy on Expenditures[a]

No. of Quarters Since Step-Therapy Implementation	Inpatient, $	Emergency Department, $	Prescription Drugs, $	Total Expenditures, $
1	(18.84)	2.68	(13.35)	(77.07)
2	(12.92)	6.69	(10.06)	(58.07)
3	(5.57)	11.68	(6.44)	(36.91)
4	3.26	17.75	(2.52)	(13.64)
5	13.86	24.98	1.70	11.66
6	25.28	33.45	6.18	38.88
7	38.33	43.21	10.90	67.90
8	52.57	54.25	15.84	98.55

[a]Effects are expressed as the difference in spending between step-therapy plans and comparison plans in each quarter after implementation of step therapy.

Take-Away Points

This study examined the effects of step therapy on prescription drug, inpatient, and emergency room utilization and spending among users of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers. Although step therapy led to medication cost savings, it also had unintended consequences:

- The number of days supplied for antihypertensives declined.
- The number of people discontinuing therapy increased immediately after step therapy was implemented.
- Inpatient and emergency room admissions and costs were higher in step-therapy programs.

tions, particularly in the first several months after it is initiated. We found that although step therapy led to medication cost savings, the number of days supplied on antihypertensives declined and the number of people discontinuing their medication increased immediately after step therapy was implemented. However, it should be noted that the discontinuation rates, as a whole, were lower in this study than discontinuation rates in other studies of naïve users[10,11] because discontinuation in this study was measured for both new and continuing users. In addition, inpatient and emergency room admissions and costs among antihypertensive users were relatively higher in the step-therapy plans after implementation compared with the comparison plans.

The study should be understood in light of its limitations. Step therapy is implemented in various ways by different pharmacy benefit managers and health plans. By its nature, it must be examined through a convenience sample, as was done in this study. Although the study used a strong pre/post design with a contemporaneous control group, it is possible that studies of other step-therapy systems would yield different results. Another limitation of the study is that the utilization and cost measures were comprehensive, and additional analyses might examine cardiac-specific utilization measures.

The intended effect of step therapy is to substitute less expensive and equally or more effective medications for more expensive medications. As this study demonstrates, step therapy may create barriers to receiving medication, resulting in higher medical healthcare utilization and spending. Clearly, there is a need for additional research to understand both the strengths and limitations of step therapy.

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