Effect of Patient Medication Cost Share On Adherence and Glycemic Control

Higher cost sharing decreases adherence to oral diabetes drugs and worsens glucose levels

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ABSTRACT

Purpose: To evaluate the effect of patient cost-sharing on oral diabetes medication adherence and glycemic control.

Design: Retrospective observational study.

Methodology: Medical and pharmacy claims from a managed care plan and electronic medical records (EMR) from a large physician organization in Oregon were used to identify a cohort with diabetes. Medication adherence and mean patient cost share was obtained from claims. Glycosylated hemoglobin (A_{1c}) values were obtained from an EMR database.

Principal findings: Lower mean cost share for patients was associated with higher medication adherence. Each $5 increase in patient cost share resulted in a 15 percent decrease in the adjusted odds of being adherent and a 0.1 percentage point increase in A_{1c}.

Conclusion: Increased medication cost share resulted in a decrease in adherence and poorer glycemic control. Employers and insurers should consider the potential consequences of increased medication cost share on diabetes-related outcomes and health care costs.

INTRODUCTION

Type 2 diabetes is a growing epidemic, with approximately 20.8 million persons with diagnosed and undiagnosed type 2 diabetes in the United States (National Institutes of Health 2007). Diabetes-related costs in the United States are staggering and result from mortality, permanent disability, and lost productivity (Hogan 2003). Improved glycemic management, as measured by reduced glycosylated hemoglobin (A_{1c}), can minimize the risk of diabetes complications (UKPDS 1998), lower health care costs, and increase workplace productivity (Shetty 2005, Stephens 2006, Testa 1998, Tunceli 2007, Von 2005, Wagner 2001).

Adherence to medications plays a critical role in the achievement and maintenance of glycemic control. Adherence to diabetes medication regimens has been associated with improved glycemic control and reduced health care costs (Krapek 2004, Lawrence 2006, Lee 2006, Schectman 2002, Sokol 2005, Wagner 2001). Patients' out-of-pocket expense (cost share) has been identified as one of several factors that can influence adherence to prescribed medications (Briesacher 2007, Chernew 2008, Cole 2006, Ellis 2004, Gibson 2005, Gibson 2006a, Gibson 2006b, Zeber 2007). Research suggests that 32 percent of older adults take less medication than prescribed in order to avoid costs (Soumerai 2006).

The extent to which patient cost share affects adherence and, therefore, health outcomes is important to understand, given recent insurance trends. In response to escalating pharmaceutical costs, pharmacy benefit design has evolved to increase the portion of medication expense borne by beneficiaries. For patients enrolled in employer-sponsored health plans, copayments for prescription drugs increased significantly between 2000 and 2006, rising from $13–$24 to $17–$38 (Kaiser Family Foundation & Health Research and Educational Trust 2007). Such changes in pharmacy benefit design may have unintended effects on patients' adherence to medications for chronic conditions. The strategy of shifting costs to patients in an attempt to combat escalating health care expenditures and patient cost-sharing as an impediment to care are topics of widespread debate (Braithwaite 2007).

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For patients with diabetes, data that link patient cost share with adherence to diabetes medications and clinical outcomes are sparse. This study was undertaken to evaluate the associations between patient medication cost share and (1) adherence to oral diabetes medications and (2) glycemic control.

METHODS

Setting

This retrospective, observational cohort study was conducted at Providence Health & Services in Oregon, a not-for-profit integrated delivery network, after approval by the local institutional review and privacy boards.

To assess the association between cost share and medication adherence, all eligible health plan members were included. The plan covers more than 200,000 adults and children, with approximately 55 percent covered by commercial exclusive provider organization plans (EPO), 20 percent by Medicare, and 5 percent by Medicaid. This study included patients enrolled in commercial EPO plans having two-tiered prescription drug benefits. Copayment schedules varied across the two-tiered plans with respect to cost-sharing amounts for each tier. Tier one included predominantly generic drugs where prescription copayments ranged from $2 to $25. Tier two included branded drugs with copayments ranging from $10 to $90, or with 50 percent coinsurance.

To assess the association between cost share and glycemic control, a subgroup of eligible health plan members who also received primary care services from Providence Medical Group were included. Providence Medical Group is a provider organization employing 148 internal and family medicine physicians, caring for 203,547 patients of mixed insurance status in 18 clinic locations. All physicians in the group share a common electronic medical record and diabetes disease management software program.

Patient identification

Eligible patients enrolled in a commercial exclusive provider organization plan were identified by medical and pharmacy claims. Each patient's first prescription for an oral diabetes medication (ODM) in the identification period (Jan. 1, 2001 to Dec. 31, 2004) was considered that patient's "index drug," and the date of the first ODM prescription fill was termed the "index date." Patients were required to be ≥18 years on the index date, have a diagnosis of diabetes (ICD-9 code 250.xx), and an ODM claim during the identification period. Patients were required to be continuously enrolled for six months before the index date (baseline period), and a minimum of 12 months after the index date. Information on baseline characteristics had been collected during the baseline period. Each patient was followed for 12 months after the index date. Medication utilization metrics were calculated using data from the follow-up period.

Measurement of study variables

Primary variable of interest. Patients' cost share (copayment or coinsurance) was assessed as mean out-of-pocket expense for a 30-day supply of ODM. For example, a 90-day supply of ODM with a total patient cost share of $45 would result in a cost share of $15 per 30-day supply. ODM days' supply and associated out-of-pocket costs for all fills were utilized to calculate ODM cost share per member per 30-day supply.

Measurement of A_{1c} level. Patients from the primary study cohort who were also patients of a Providence Medical Group primary care provider were identified (n=1,077) to evaluate the relationship between cost share and A_{1c} level. Of these, 604 had at least one A_{1c} test in the baseline and follow-up periods. If patients' A_{1c} level was evaluated more than once in the baseline or follow-up period, their most recent A_{1c} test was used in the analysis.

Measurement of adherence. Adherence was calculated using a fixed medication possession ratio (MPR). It was analyzed overall for ODM, regardless of therapy changes; therefore, patients' therapy could have been augmented, switched or restarted (Table 1). Overlapping ODM days' supply were not double-counted, and any data indicating adherence beyond 100 percent (e.g.,

TABLE 1
Definitions

Medication possession ratio (MPR) Sum of days' supply of ODM that a patient received during the 12-month follow-up period divided by 365 days

Combination therapy Addition of another ODM from a different therapeutic class filled within 30 days of the index ODM prescription, where the index ODM was subsequently filled again within 1.5 times days' supply of index therapy

Adherent day Medication refill data indicated that the patient had at least one ODM on hand on that day

Chronic disease score (CDS) Estimate of number of primary care visits based on age, gender, and disease conditions. Disease conditions are identified by presence of prescription claims for that particular disease

Medication burden Total number of medications, including ODM, which were consumed in the follow-up period based on unique National Drug Codes

early ODM refill) was limited to 100 percent.

Measurement of other variables. The relationship between cost share and adherence can be affected by many factors. Information for these characteristics was collected from the database and incorporated in multiple regression analysis. Age was calculated as of the time of index prescription. Gender was obtained from claims. Each patient's ODM regimen at baseline ("index ODM regimen") was categorized as (1) sulfonylurea (SU), (2) metformin, (3) metformin+SU, (4) thiazolidinedione (TZD), and (5) other (alpha glucosidase inhibitor and/or meglitinide).

As seen in Table 1, patients' comorbidity was estimated by a modified chronic disease score (CDS), a marker for chronic illness that uses prescription claims during the six-month baseline period (Clark 1995). Medication burden was utilized as an additional measure of comorbidity (Table 1). Unlike ODM, it is not possible to determine adherence to insulin based on claims. However, insulin does affect glycemic control and patient cost share. A dichotomous variable (yes/no) was created to record insulin use in the baseline period. Out-of-pocket non-ODM medication expenditures, including insulin, in the follow-up period were summed and included as a covariate.

Statistical analysis

Descriptive statistics were calculated for all study variables. Continuous data were described using means and standard deviations, and nominal and categorical data were described using frequencies and percentages. Bivariate analysis between each independent and outcome variable was completed using correlation analysis, t-tests, or nonparametric equivalents where appropriate. Difference in mean cost share was evaluated for adherent and nonadherent patients using a t-test. Bivariate association between cost share and A_{1c} was assessed using the Pearson correlation analysis. Trend analysis using the Cochran-Amritage test examined adherence at different cost-sharing levels. cost share categories were created with $5 increments.

Variables significant in the bivariate analysis ($p<0.05$), including patient age, CDS, gender, index regimen, insulin, and out-of-pocket non-ODM medication expenditures, were entered in the logistic regression followed by a backward elimination process (Hosmer 2003). This model was utilized to evaluate the association between medication cost share and ODM adherence. Patients with an MPR ≥80 percent were classified as adherent. Age was excluded because of collinearity with CDS. Variables that were subsequently dropped from the multivariate model as insignificant included out-of-pocket non-ODM medication expenditures and insulin use.

Linear regression was employed to evaluate the association between medication cost share and glycemic control with A_{1c} as the dependent variable. Variables in the final model considered gender, baseline A_{1c}, index ODM regimen, insulin use, and CDS.

TABLE 2
Descriptive characteristics of study cohort

Variable	Total eligible study population	Sub-population with A_{1c} data
n	4,585	604
Demographics – mean (SD)*		
Gender, male	51%	47%
Age	54 yrs. (11)	55 yrs. (11)
Insulin	23%	25%
CDS – number of primary care visits	3 (1)	3 (1)
Index ODM regimen status		
Metformin	40%	43%
Metformin+SU	9%	10%
Other	6%	2%
SU	33%	38%
TZD	11%	6%
Medication cost share and medication burden		
ODM cost share per patient per month		
Mean (SD)	$15 (8)	$13 (7)
Median	$13	$11
Non-ODM cost share per patient per month		
Mean (SD)	$35 (30)	$36 (30)
Median	$28	$28
Total medications		
Mean (SD)	6.8 (4.7)	7 (5)
Median	7	7
Medication adherence		
Overall ODM adherence (MPR)	0.82 (0.3)	0.83 (0.2)
Percent adherent (MPR≥ 0.8)	69	68
Glycemic control		
Baseline A_{1c} level	NA	8.1 (1.89)
Follow-up A_{1c} level	NA	7.6 (1.67)

* Mean (standard deviation) presented unless noted otherwise.

TABLE 3

Association between patient oral diabetes medication (ODM) cost share and overall ODM adherence

Effect		Odds ratios	95% Wald confidence limits		p-value
Cost share		0.988	0.980	0.996	0.0025
CDS – primary care		0.888	0.813	0.969	<.0001
Patient gender	M vs F	1.300	1.132	1.492	0.0002
Index Rx	METFM-SU vs METFM	4.303	3.139	5.899	<.0001
Index Rx	Other vs METFM	2.248	1.623	3.114	0.0118
Index Rx	SU vs METFM	1.001	0.861	1.164	<.0001
Index Rx	TZD vs METFM	1.125	0.895	1.414	0.0002

Abbreviations: METFM=metformin; SU=sulfonylurea; TZD=thiazolidinedione

The index ODM regimen was transformed from a categorical variable into four indicator variables for inclusion into the linear regression model. These independent predictors were found to be insignificant and, therefore, were removed from the model.

All data manipulation and statistical analysis was completed using SAS version 9.1.3.

RESULTS

The study population with diabetes that initiated ODM therapy during the identification period included 4,585 patients (Table 2). The mean age was 54 years (SD=11 years), and 51 percent were male. The mean ODM cost share per patient per month was $15 (SD=$8). Mean CDS was 3.0 (SD=1.0) and 23 percent used insulin.

Overall ODM adherence was 0.82 (SD=0.3) with 69 percent of patients classified as "adherent" (MPR≥0.8). During the 12-month follow-up period, 23 percent of the population discontinued their index ODM, whereas 38 percent experienced augmentation of the index therapy, 19 percent switched to a different ODM regimen, and 23 percent restarted the index ODM. Only 14 percent had no modifications to their index therapy during the follow-up period. In the subset with linked EMR data, mean A_{1c} in the baseline and follow-up periods was 8.1 percent (SD=1.9 percent) and 7.6 percent (SD=1.7 percent), respectively.

Adherent patients had a lower mean cost share than those who were nonadherent ($14 vs. $16, p=0.002). A statistically significant trend in adherence was found when stratified by cost share amount categories (p=0.03). Logistic regression using adherence as the dependent variable revealed that as patient cost share increased by $1, the odds of ODM adherence decreased by 1.2 percent, adjusting for gender, CDS, and index ODM regimen. When scaled to different units, for each $5 increase in cost share there was a 6 percent decrease in the odds of ODM adherence (p<0.0001) (Table 3).

In the subpopulation of patients with documented A_{1c} values (n=604), bivariate analysis revealed a moderate but positive correlation between cost share and A_{1c} (r=0.15, p=0.0002). When adjusted for statistically and clinically significant predictors including baseline A_{1c}, CDS, patient gender, and insulin, and in the multivariate regression, the relationship between A_{1c} and cost share remained significant. As seen in Figure 1, for each $5 increase in ODM cost share a 0.1-point increase in A_{1c} was observed, controlling for other covariates in the model (p=0.02).

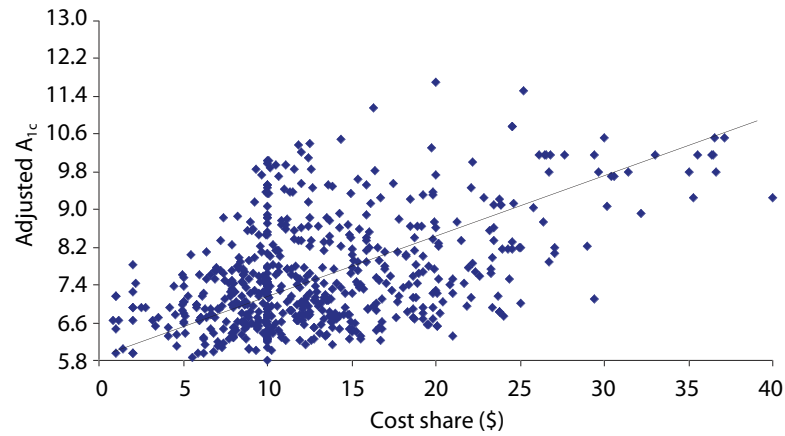
DISCUSSION

This study sought to further clarify the ramifications of medication

FIGURE 1

Association between ODM patient cost share and A_{1c} levels

Adjusted A_{1c} = 3.19 + 0.02 × cost share – 0.12 x CDS + 0.55 × baseline A_{1c} – 0.2 × gender + 0.6 × insulin



cost share on patient refill behavior and short-term health outcomes in a diabetes population. In a managed care setting, we observed that patients with lower medication cost share were more adherent to ODM therapy and had better glycemic control, adjusted for available patient characteristics. Approximately two thirds of patients exhibited good adherence to prescribed ODM therapy, with 0.82 mean adherence. This finding is comparable to ODM adherence that has been observed in other managed care populations.(Boccuzzi 2001, Venturini 1999).

However, for every $5 increase in patient cost share we observed, there was a 6 percent decrease in the adjusted odds of being adherent. One of the few published studies on the effect of increasing cost share for patients with diabetes found that doubling in cost share was followed by a 25 percent reduction in the annual days of ODM (Goldman 2004). Interestingly, the same study found that in patients with diagnosed hypertension, a doubling of medication cost share resulted in only a 10 percent decrease in annual days of antihypertensive medication. Studies evaluating cost share and adherence in other chronic conditions (e.g., heart failure, hypercholesterolemia, schizophrenia) have also found an inverse relationship between cost share and adherence. Although the inverse relationship appears consistent, the magnitude may differ across medical conditions.(Cole 2006, Ellis 2004, Gibson 2006a, Gibson 2006b, Zeber 2007).

Though published studies assessing the effect of cost share on medication adherence are somewhat contradictory for various conditions, the majority in diabetes suggest that patients with high medication cost share may experience therapy disruptions, such as medication discontinuation, therapy gaps, or lower medication adherence (Gibson 2005, Gibson 2006). Although cause-and-effect cannot be established based on observational study, a reduction in medication adherence is a logical intermediary step explaining the negative correlation between cost share and glycemic control that is illustrated in Figure 1. In a subpopulation of our study with linked medical records, the relationship between patient out-of-pocket costs and glycemic control indicated that each $5 increase in ODM cost share was associated with a 0.1-point increase in A_{1c}. Although statistically significant, the clinical relevance of this magnitude of change is uncertain. The UK Prospective Diabetes Study findings suggest that for every 1 percentage point reduction in A_{1c} there is a 21 percent reduction in diabetes-related death over 10 years (UKPDS 1998).

Although few published studies have evaluated the relationship between cost share and adherence in diabetes, our findings are rendered significant by research demonstrating that improved adherence to diabetes medications has demonstrated improved clinical outcomes and reduced health care costs.

In a cohort of elderly patients with type 2 diabetes, higher ODM adherence was the strongest predictor of reduced annual health care costs (Balkrishnan 2003). In another study, higher medication costs from improved adherence to prescribed ODM were offset by decreased risk of hospitalization and lower medical costs, resulting in an overall net reduction in total health care costs (Sokol 2005). Observational studies conducted by Schectman (2002) and Krapek (2004) demonstrated a significant effect of improved adherence in reducing A_{1c}. The present study, by linking increased patient cost share to both adherence and glycemic control, provides additional information in the context of other studies, which have demonstrated the importance of both adherence and glycemic control to health outcomes and health care cost in patients with type 2 diabetes.

How might insurers and employers respond to these findings? Certainly, strategies to improve utilization of currently available low-cost generic medications meet the dual objectives of effectively improving glycemic control for many patients while lowering employer and patient drug costs (Motheral 2004). Additional strategies like step edits and pill splitting attempt to control drug costs with minimal potential effect on disease control (Choe 2007, Mager & Cox 2007, Motheral 2004, Shrank 2006). When cost-sharing is employed to combat excess consumption of high-cost medications, patient access to information on medication costs and quality is essential. However, the resources necessary to guide patients in making appropriate therapeutic choices are too often absent (Fendrick & Chernew 2007).

Some employers and insurers are experimenting with the benefit-based copayment (BBC) strategy originally proposed by Fendrick and colleagues (Fendrick 2001). While the traditional tiered cost-sharing approach results in all members sharing the same out-of-pocket costs and establishes the member contribution based on formulary status and/or drug acquisition cost, the BBC strategy determines member cost-sharing using the expected clinical benefit of the medication on the patient's disease. For example, according to the BBC paradigm, a patient diagnosed with cardiovascular disease and prescribed a cholesterol-lowering medication to prevent a recurrent coronary event would have a lower cost share compared to a patient for whom the same medication is prescribed to prevent the development of new coronary disease.

A similar approach is being tested by Pitney Bowes with diabetes by shifting diabetes medications and devices from higher tiers to the lowest tier. Preliminary results from a noncontrolled study demonstrate improvements in ODM medication ad-

herence as well as reductions in emergency department visits and total health care costs up to three years post implementation (Mahoney 2005). Similar benefit design changes in other settings have not found the same initial success (Kaiser Family Foundation & Health Research and Educational Trust 2007).

While our study provides valuable insights into the potential relationship between increased patient cost share and short-term health outcomes in diabetes, there are several limitations. As mentioned previously, a causal link cannot be established between patient cost share and outcomes based on observational study. While we observed significant associations between cost share and adherence, the strength of the association was not large (OR=0.97). There are probably other characteristics that influence medication adherence that are not captured in insurance claims and medical record information and therefore are not accounted for in this analysis (Rubin 2005). There could also be a health plan selection bias that is inherent in a retrospective analysis.

The study assessed cost share that is dependent on a pharmacy benefit offered to the patients. There is a possibility that patients may choose benefits based on cost-sharing amounts. We feel this type of bias could be minimal in this study as most of the patients did not have more than two options that were chosen by their employers. This study assessed medication adherence based on refill patterns and not actual drug consumed. This method of measuring adherence based on pharmacy records is reliable, but it cannot guard against instances of undetected adherence such as the case when patients receive medications during hospitalization in which no record exists in their pharmacy benefit data. Also, in using prescription refill claims to assess adherence, we assumed that refill behavior correlates with actual medication consumption. Previous research, however, has validated the use of data from pharmacy claims for the evaluation of medication utilization (Choo 1999).

Our study population consisted of members in a managed care organization in the northwestern United States; therefore, our findings may not apply to patients without health insurance and may not be representative of patients across the United States. In populations where the prevalence of lack of insurance and of low income is higher than in our population, the effect of increased cost-sharing on adherence and glycemic control is probably enhanced relative to our findings (Briesacher 2007). In addition, the subpopulation of patients with linked EMR data was cared for by providers with access to an automated diabetes disease management program. To the extent this health information technology encourages providers to engage patients in better self-care and medication adherence, our results may differ from patients with diabetes cared for by providers without access to such decision-support tools.

CONCLUSION

This study found that increased patient medication cost share in a managed care population was associated with a decrease in adherence to oral diabetes medications and worse glycemic control. Further research is warranted to better understand the role of patient cost share in the context of other important factors.

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