

Physician-Specific Variation in Medication Adherence Among Diabetes Patients

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Suboptimal adherence to prescribed medications is an important contributor to the high cost of healthcare in the United States, associated with additional direct and indirect costs of as much as \$290 billion yearly.¹ As many as half of patients with chronic conditions do not properly follow prescription orders,² increasing the risk of needless disease progression and complications, functional impairment, hospitalization, and even death. As a result, medication adherence has become a major focus of efforts to improve healthcare outcomes, particularly for those with chronic conditions.

Many factors have been shown to contribute to poor medication adherence and have been highlighted in recent disease-specific³⁻⁶ and general⁷⁻¹⁰ reviews. The literature on medication adherence has led to the development of several classifications of factors that influence nonadherence. More than 250 factors have been identified, including patient abilities, beliefs, involvement, practical difficulties, support systems, and provider relationships.¹¹ Notably, patient-related factors include disease characteristics, medication side effects, health literacy, and out-of-pocket costs. Because medication adherence is ultimately a patient decision, it is understandable that the focus of adherence research has been directed to understanding and addressing patient behaviors to improve adherence rates.⁸ However, because medication adherence by patients can be impacted by healthcare delivery-related factors—specifically, the patient-clinician interaction—it is important to better understand the potential impact of physician-related behaviors if patient adherence to treatment is to be improved.

The Employers Health Purchasing Corporation of Ohio (EHP-CO) is a 501(c)(3) nonprofit employer business coalition, composed largely of self-insured employers from northeast Ohio. Central to the coalition's mission is support for employer members to provide high-quality, cost-effective healthcare for their employees and family members, as well as the community at large. Employers participating in EHP-CO-sponsored group purchase programs have supported analysis of aggregated claims data from these programs as a means to better identify quality-of-care issues in the community. As such, the larger claims volume included in the aggregate data permits more meaningful statistical analysis of community healthcare service delivery.

Consistent with the coalition's charge, this aggregate information can then be used to identify specific opportunities for community-based healthcare

Objectives: To examine the relationship that the patient has with his/her healthcare practitioner as a factor affecting medication adherence.

Study Design: Aggregate, physician-level adherence rates for patients were compared in a retrospective, non-case-controlled study of 3777 diabetes patients enrolled in a commercial pharmacy benefits program in a 6-county area in northeast Ohio.

Methods: Data for the top prescribing 200 physicians and their 3777 patients were analyzed based on the adherence of their patients to medications for diabetes, statins, and angiotensin-converting enzyme inhibitors/angiotensin receptor blockers (ACEIs/ARBs). Physicians were then separated into adherence quartiles based on the results. Statistical tests for assessing between-group differences were performed. Results were reported for diabetes medication-specific adherence as well as adherence to statins and ACEIs/ARBs.

Results: No appreciable demographic differences were noted between patient or physician groups, including age, sex, race, cost share, and chronic medication use. Statistically significant differences in aggregate physician-specific medication adherence between the best performing and worst performing physician quartiles were identified, with medication adherence rates of 89.5% for the highest performing quartile compared with 68.1% for the lowest performing quartile. Medication adherence for statins and ACEIs/ARBs paralleled the results for diabetes medications: 88.4% versus 73.4% and 89.8% versus 76.9%, respectively. Importantly, significantly fewer patients in the lowest performing physician group had filled prescriptions for statins or ACEIs/ARBs.

Conclusions: Physician-specific factors have an underappreciated impact on medication adherence. A better understanding of these factors may have substantial benefit in improving compliance with treatment and clinical outcomes.

(*Am J Manag Care.* 2011;17(11):729-736)

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Take-Away Points

While considerable research has highlighted the impact of patient behaviors on medication adherence, this study illustrates the variability of physician-specific, aggregate patient adherence to chronic medications among diabetes patients.

- These findings provide a potential focus for evaluation of physician practices through pharmacy claims data analysis.
- Physicians with low adherence scores may benefit from directed education to improve communication skills.
- Ongoing monitoring of physician-specific, aggregate patient medication adherence can be considered for use as a quality metric for physician performance.

entire evaluation period and had pharmacy claims for diabetes medications during this period.

Physician Population

Physicians were included in the preliminary data analysis if they wrote 1 or more prescriptions for diabetes medication during the study period. The physicians with the greatest number of patients receiving diabetes medications were selected for further analysis.

quality improvement efforts for the potential benefit of all residents.

This retrospective study was performed to evaluate medication adherence of diabetes patients receiving care from different physicians in a 6-county area in northeast Ohio. The goal of the study was to aggregate diabetes patient adherence data by prescribing physician to better understand physician-specific medication adherence rates. Significant variation in adherence patterns could then provide a focus for quality improvement interventions.

Adherence Methodology

Adherence was measured by medication possession ratio (MPR), the numerator being the sum of the days of supply during the study period and the denominator being the number of days from the first fill date to either the end of the last day of supplied medication during the study period or the end of the study period, whichever came first. For analytic purposes, MPR is a continuous measure that ranges from 0 to 1. In this study, MPR calculations that exceeded 1.0 were truncated at 1.0. When class-level MPR calculations were averaged to the disease level, this truncation took place before averaging. The study methodology allowed for inclusion of patients with new medication starts, as well as those with prescriptions existing prior to the start of the evaluation period.

METHODS

Study Population

Study participants were employees of coalition member employers participating in the coalition's group purchase pharmacy benefits program who (1) were enrolled in the pharmacy benefits program and (2) lived in a 6-county area in northeast Ohio (Holmes, Medina, Stark, Summit, Tuscarawas, and Wayne counties). This geographic area represents approximately 12% of the entire state's population based on 2008 census data. Zip code analysis of enrollee home address was used to identify individuals living in the region under study. Employees, spouses, and dependents (85.6%) and non-Medicare retirees over age 65 years (14.4%) who were enrolled in the pharmacy benefits program comprised the eligible population. Only those employers continuously enrolled in the group purchase program for the entire period of study were included in the analysis.

Class-Level and Disease State Adherence. Standard definitions for a therapeutic class were adopted to calculate class-level adherence (Table 1). For the purpose of calculating MPR, all drugs within a given therapeutic class were deemed interchangeable and treated as a single drug. The clinical assumption is that drugs within a class are never intended as concomitant therapy.

To arrive at a disease state adherence estimate, therapeutic class-level MPRs were calculated as described, and the weighted average of these class-level MPRs was calculated. The therapeutic-class MPR calculations were weighted by days of therapy by drug class for the study period.

Data Source

Data for analysis was generated by CVS Caremark from pharmacy claims records, using the organization's proprietary pharmacy claims database.

Statistical Analysis

We performed descriptive analyses of patient and physician characteristics as well as medication adherence rates of physician groups. Following stratification by aggregate patient diabetes medication adherence, differences in characteristics and medication adherence rates were evaluated between the physician groups. Differences were assessed for significance using nonparametric tests (Kruskal-Wallis), with significance levels set at $P < .05$. Linear multivariate regression was performed to identify the magnitude of impact of the patient and

Study Time Frame and Eligibility Criteria

The study period consisted of a 1-year interval, from January 1, 2009, through December 31, 2009. Patients were included in the study only if they were eligible for benefits during the

Table 1. Categorization of Generic Product Identifiers Into Therapeutic Classes Used to Define Adherence by Diabetes Disease State in This Study

Therapeutic Class of Diabetes Medication	GPI	Notes
Sulfonylureas	27-20-x	
Glitazones	27-60-x, 27-99-80-x	Also includes glitazone plus metformin combinations
Insulins	27-10-x	
Metformin	27-25-x, 27-99-70-x	Also includes metformin plus sulfonylurea combinations

GPI indicates generic product identifier.

physician factors on patient adherence to diabetes medication. All the models weighted the observations based on the number of patients that each physician treated. The statistical testing was performed using SAS version 9.1 (SAS Institute Inc, Cary, North Carolina).

RESULTS

Study Population

A total of 80 plan sponsors were included in the data analysis, representing a broad range of employer industries including manufacturing, banking, healthcare, and unions, as well as public sector employers including school systems and regional government. There were 68,611 individuals enrolled in the group purchase benefits program, of which 5890 (8.5%) had filed a claim for prescription medication for treatment of diabetes.

Physicians

Approximately 800 physicians were identified as prescribing diabetes medications to individuals in the study population during the study period. The top 200 physicians prescribed medications to 3777 patients, or 64.1% of the overall population of patients with diabetes. This physician group (71.0% primary care clinicians and 6.5% endocrinologists) was the focus of more detailed analysis. The other physicians were represented by other specialties, including gynecologists and internal medicine subspecialists.

Physician Grouping Based on Patient Adherence. Based on the average patient MPR for diabetes medication, the 200 physicians were divided into 4 groups of 50 physicians each ranked on the average patient adherence to diabetes medication, as measured by MPR. Group 1 comprised physicians with an average patient MPR between 85.7% and 96.1% (highest patient adherence). Group 2 comprised physicians with an average patient MPR between 81.0% and 85.6%. Group 3 comprised physicians with an average patient MPR between 74.3% and 80.9%. Group 4 (lowest patient adherence) comprised physicians with an average patient MPR between 38.8% and 74.3%. The average MPR for diabetes medications prescribed

to patients in the top physician quartile (group 1) was 89.5%, and the average MPR in the bottom physician quartile (group 4) was 68.1%.

Patient and Physician Subgroup Comparisons

Patients. Analysis of patients in physician groups 1 and 4 revealed no difference in sex, race, or estimated education level or income. The average age of the patients in the group with the highest adherence (group 1) was 60.7 years, significantly greater than that of the patients with the lowest adherence (group 4), where the average age was 57.1 years ($P = .001$). However, the 2 groups did not differ in terms of patient cost share for prescription medications or in the average number of chronic medication prescriptions being filled. However, there was a significant difference between each of the groups with respect to 90-day prescription fills (mail channel). Details on the demographic data for the patients in all physician quartiles are shown in **Table 2**.

Physicians. Comparison of physician data between the top and bottom physician adherence quartiles revealed no appreciable differences in the mean or median numbers of study patients in each physician practice. The number of diabetes patients receiving prescribed medications from an individual physician in the overall group ranged from a low of 3 to a high of 106. Interestingly, both of these physicians were in the bottom quartile of medication adherence. The distribution of primary care physicians and endocrinologists in the respective quartiles was not significantly different. Details of physician factors associated with medication adherence quartiles are also included in **Table 2**.

Physician-Related Medication Adherence

As noted, the patient adherence to diabetes medications was significantly higher for physicians in group 1 compared with those in group 4. The adherence to statin and angiotensin-converting enzyme inhibitor/angiotensin receptor blocker (ACEI/ARB) therapy was similarly significantly higher for patients of group 1 physicians than for patients of group 4 physicians: 88.4% in group 1 versus 73.4% in group 4 for statins and 89.8% in group 1 versus 76.9% in group 4 for ACEIs/ARBs (**Table 3**).

■ **Table 2.** Distribution and Characteristics of Diabetes Patients by Physician Adherence Quartile

Characteristic	Physician Adherence Quartile				Mean	P ^a
	Group 1	Group 2	Group 3	Group 4		
MPR range for patients receiving diabetes medications	85.7-96.1	81.0-85.6	74.3-80.9	38.8-74.3	—	—
Number of patients	824	909	1165	879	3777 ^b	NA
Average number of patients analyzed	16.5	18.2	23.3	17.6	18.9	.0673
Average age	60.7 y	59.6 y	58.1 y	57.1 y	58.0 y	.001
Male	54.1%	52.9%	51.0%	53.1%	47.1%	.7672
Caucasian	90.5%	90.8%	88.8%	89.7%	90.4%	.8396
Diabetes, insulin dependent	19.8%	16.6%	21.9%	21.5%	20.0%	.4502
Diabetes, non-insulin dependent	80.3%	83.5%	78.2%	78.6%	80.1%	.4405
College educated	11.7%	12.2%	12.1%	11.7%	11.9%	.8391
Average income	\$47,693	\$48,580	\$47,811	\$47,711	\$47,949	.8227
Patient cost share	15.1%	15.5%	16.2%	15.4%	15.6%	.3825
Generic days	56.3%	58.2%	56.2%	56.8%	56.9%	.7963
Mail order days	71.7%	64.7%	63.0%	59.8%	64.8%	.0138 ^c
Number of chronic medications	3.18	3.33	2.92	3.04	3.11	.1551
Prevalence of ACEI/ARB use	79.3%	77.2%	73.2%	70.0%	74.9%	.0146 ^c
Prevalence of statin use	71.9%	69.5%	63.3%	58.0%	65.7%	<.0001 ^c
Endocrinologists	10.0%	4.0%	6.0%	6.0%	6.5%	.6696
Internists, general practitioners, family practice, and pediatrics ^d	64.0%	78.0%	74.0%	68.0%	71.0%	.4230

ACEI/ARB indicates angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; MPR, medication possession ratio.
^aSignificance testing between the 4 groups using the nonparametric Kruskal-Wallis test.
^bTotal value.
^cDifferences between the groups are statistically significant.
^dOther clinicians included obstetrics/gynecology, nurse practitioners, surgeons, and other subspecialists in internal medicine.

Frequency of patient use of statins and ACEIs/ARBs was directly correlated with adherence to diabetes medications and was lowest among the patients in group 4. For statins, 71.2% of group 1 patients had filled a prescription during the study period, compared with 57.3% of patients in group 4 ($P < .0001$). For ACEIs/ARBs, the range of values was smaller, with 65.9% of patients in group 1 and 57.3% in group 4 filling a prescription during the study period ($P = .007$).

Multivariate regression analysis of patient-specific and physician factors contributing to patient diabetes medication adherence revealed that none of the demographic factors except for age had any significant impact on patient adherence to diabetes medication. Use of mail delivery channel (90-day supply of maintenance medication) and use of cholesterol-lowering medications were the only other factors that were associated with adherence to diabetes therapy. For every percent increase in mail channel use for prescription fulfillment, there was a 0.1% increase in diabetes MPR. The identified physician factors, including specialty, did not contribute significantly to patient adherence. The results of the regression

analysis are shown in **Table 4**. The factors that we investigated accounted for 36.8% ($r^2 = 0.368$) of the variation in the physician-level diabetes adherence.

DISCUSSION

The World Health Organization's comprehensive evaluation of global medication nonadherence² identified the potential impact that the healthcare delivery system can have on patient adherence behavior, and characterized the lack of understanding of healthcare delivery strategies to improve medication adherence as a serious gap in the applied knowledge base. In its assessment, it declares the need for healthcare practitioners to have access to specific training in adherence management, with an adherence counseling tool kit to address knowledge, clinical decision making, and behavioral tools to help them address medication nonadherence issues.

This study was designed to improve the understanding of physician-related factors contributing to patient medication adherence concerns. Our analysis capitalized on data derived

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Table 3. Medication Adherence Characteristics by Physician Adherence Quartile^a

Characteristic	Physician Adherence Quartile				Mean	P ^b
	Group 1	Group 2	Group 3	Group 4		
MPR range for patients receiving diabetes medications	85.7-96.1	81.0-85.6	74.3-80.9	38.8-74.3	—	—
Number of patients	824	909	1165	879	3777 ^c	—
Adherence to diabetes medication (average)	89.5%	83.3%	78.3%	68.1%	79.8%	<.0001 ^d
Adherence to ACEIs/ARBs (average)	89.8%	85.4%	81.9%	76.9%	83.5%	<.0001 ^d
Adherence to statins (average)	88.4%	82.5%	80.1%	73.4%	81.1%	<.0001 ^d
ACEI/ARB use	65.9%	66.2%	59.6%	57.3%	62.3%	.0069 ^d
Statin use	71.2%	69.1%	63.5%	57.3%	65.3%	.0002 ^d

ACEI/ARB indicates angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; MPR, medication possession ratio.
^aMedication use refers to percentage of patients filling at least 1 prescription for the identified medication class during the study period.
^bSignificance testing between the 4 groups using the nonparametric Kruskal-Wallis test.
^cTotal value.
^dDifferences between the groups are statistically significant.

Table 4. Linear Regression Analysis of Patient Adherence (Medication Possession Ratio) to Diabetes Medications^a

Variable	Parameter Estimate	SE	Pr > t
Intercept	0.49946	0.12977	0.0002
Male, %	-0.01618	0.04158	0.6977
Average age, y	0.00345	0.0014	0.0149 ^b
Patients on lipid therapy, %	0.14888	0.03793	0.0001 ^b
Patients on ACEIs/ARBs, %	0.04028	0.04196	0.3384
College educated, %	0.17687	0.1852	0.3408
Caucasian, %	0.1194	0.08574	0.1654
Patient cost share, %	0.28258	0.19052	0.1397
Generic use, %	-0.11253	0.06528	0.0864
Mail use, %	0.0984	0.0357	0.0064 ^b
Nonspecialist physician	0.0026	0.01385	0.8513
Insulin-only therapy, % patients	-0.0123	0.03579	0.7315

ACEI/ARB indicates angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; SE, standard error.
^aThe demographic factors (college education, income, and race) were derived from data at the zip code level, summarized to a patient level, and then aggregated at the physician level.
^bSignificant at $P < .05$. The r^2 value of above model was 0.368.

from a group purchase pharmacy benefit arrangement to better understand community healthcare delivery patterns, with the goal of quantifying provider-specific variability in the medication adherence rates of providers' patients. While this study does not provide a sufficient level of detail regarding the physician-related or delivery system-related factors responsible for the observed variability in medication adherence, it does provide another example of practice variation in the healthcare system, which, if effectively addressed, can improve health outcomes.

While prior studies have provided significant insight into patient-related factors contributing to suboptimal medication adherence, few have directly addressed the impact of

individual physician practices on medication adherence by their patients. Based on the results of this study, it appears that physicians can have a significant impact on medication adherence. Despite a general lack of systematic analysis, there is evidence that medication adherence varies by provider.¹² In addition, there is support for valuing the role of the clinician-patient relationship in promoting patient adherence to recommended treatment.^{13,14}

Atlas et al¹⁵ demonstrated that patient-provider connect- edness, as evidenced by a longitudinal relationship between patient and clinician, favorably influenced delivery of general and disease-specific preventive care services. In this study, no specific interventions to promote treatment adherence were

provided. The observed results were deemed to result from the nature of the relationship between patient and clinician, which was noted to be a stronger determinant of delivery of preventive services than proven predictors such as patients' age, sex, and race or ethnicity. The findings were consistent across a range of prevention activities and subgroups of patients defined by their disease or type of medical insurance.

Higher-quality patient-physician relationships have been associated with higher reported adherence to treatment for human immunodeficiency virus (HIV).¹⁶ In this study, specific physician attributes reported by patients that were associated with greater adherence included general communication skills, overall patient satisfaction, trust in the physician, provision of HIV-specific information, and satisfaction with physician approach to discussion about medication adherence. The authors noted that 4 of the 5 physician characteristics were not HIV related, suggesting that the results could be generalized to a broader patient population.

In a qualitative study of female diabetes patients, patient-provider communication was identified as the most significant factor impacting patient adherence.¹⁷ Evaluation of physician communication styles and their impact on patient self-reported medication adherence to antihypertensive medications revealed that more collaborative provider communications were associated with improved patient adherence.¹⁸ The authors emphasized that patient-reported perceptions of clinician communication drive patient behaviors and that interventions need to be developed to target not only the disease outcomes, but also effective patient-physician communication. In contrast, in a study of diabetes patients, those with a regular physician were found to be no more successful in reaching treatment goals than those receiving care from different providers, based on clinical outcome measures.¹⁹ However, the study did not evaluate medication adherence or therapeutic intensification, and perhaps more importantly, did not account for the potential impact of differences in communication approaches by physicians.

An interesting finding in our study was the correlation of lower medication adherence with a reduced prevalence of both ACEI/ARB and statin use. Based on the similar demographic attributes of groups 1 and 4, we conclude that the lower prevalence is unlikely the result of significant differences in comorbid conditions. While no medical claims data or e-prescribing information was available, the reduced prevalence of medication use was most likely due either to failure of patients to fill prescriptions for these medications or possibly to a lower frequency of diagnosis of these comorbid conditions by the physicians in group 4.

Ninety-day prescription fills are associated with greater medication adherence rates compared with use of 30-day prescriptions.^{20,21} In this study, use of 90-day prescription fills was

greater for patients in group 1 than patients in group 4 and likely contributed to the lower adherence rates noted in group 4. However, the regression analysis of factors contributing to medication adherence suggests that this was a minor contributor to the adherence differences observed in this study.

This study supports a growing and compelling body of evidence demonstrating the impact of clinicians on patient adherence to medications. The patient-physician relationship is a fundamental component of healthcare delivery. The nature and quality of communication between physicians and their patients merit review and consideration for modification to improve compliance with recommended care and to drive improved outcomes. This research adds to the evidence that attributes of the patient-physician relationship can meaningfully impact patient adherence to treatment.

Effective integration of research data regarding physician communication techniques and patient preferences for provider behaviors will help to orient physician practices to more effectively meet the health literacy needs and communication preferences of their patients.¹⁴ Done systematically, this process has the potential to enhance patient adherence with treatment. With documented improvements in medication adherence,¹⁰ the medical home approach to care delivery represents a productive setting in which to accelerate learning about the nature of patient-provider interactions and their role in improving patient adherence to treatment.

Limitations

There are several limitations to the current study. As noted, this study was performed using pharmacy claims data. No medical claims information was available for the study population. Consequently, it was difficult to assess the severity of the disease burden for the patient populations, since the information was based only on prescription data. As a proxy, the number of concurrent chronic medication prescriptions filled by each patient was viewed as a combined measure of condition severity and the presence of comorbid conditions. With no significant differences in this measure across the different groups, we conclude that there was no meaningful difference in aggregate severity across the patient populations in physician practices. While skewed distribution of patients of individual physicians was possible, we believe that the consistency of the aggregate number of chronic medication prescriptions mitigates against this possibility.

Additionally, administrative pharmacy data are surrogate measures for medication adherence and do not guarantee that patients consumed the medication. The population demographics and comorbid conditions may not parallel those in other communities, and the patient and physician characteristics in this study might be unique to northeast Ohio and might not be generalizable outside the 6-county region

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under study. Benefits design, including use of 90-day supply, may vary regionally within the study population, with higher cost-share plans potentially being geographically consolidated, therefore adversely impacting medication adherence of patients of physicians in those communities due to cost considerations rather than physician practice. We evaluated member cost share as a proxy for benefit design and found no significant difference between all 4 physician groups. In the absence of any difference in cost share or imputed out-of-pocket cost between the groups, we conclude that any existing medication coverage policy differences between the highest and lowest groups did not meaningfully impact the findings in this study.

In addition, several potential predictors of nonadherence could not be accounted for using pharmacy claims data, including patient knowledge, attitudes, and beliefs. Further, patient lifestyle behavior changes and physician medication prescribing changes during the study period might have also adversely impacted this analysis. However, variations in these events would likely have been evident across the entire study population and were unlikely to have selectively impacted any single clinician or patient group. Additionally, discount medications purchased with cash payments may not have been incorporated with the pharmacy claims data, resulting in falsely low adherence data for selected patients. It is difficult to determine the significance, if any, of this possible confounding variable. Lastly, patients who are referred to diabetes educators have better performance on selected quality measures for diabetes care.²² For these individuals, medication adherence may be similarly impacted, as noted by the higher per member per month diabetes medication costs. Because this study only utilized pharmacy claims, the use of patient referrals for diabetes educators was not specifically evaluated.

CONCLUSIONS

Optimal patient adherence to medications is impacted by a number of well-described factors. Identifying and addressing the potential barriers to adherence posed by each of these factors is necessary if patients' adherence is to be improved. In this study, we characterized the variability of physician-specific aggregate patient medication adherence to diabetes treatment. The available data clearly highlight the importance and potential impact of clinicians on their patients' adherence to chronic medications.

Physician-specific medication adherence data may be used as a tool for physicians to better understand the medication adherence profile of their diabetic patients. This approach may also help to focus efforts to improve medication adher-

ence among physicians with low aggregate medication adherence rates. Subsequent studies are planned to evaluate specific physician attributes contributing to low patient adherence and to develop a medication adherence education program for low-performing physicians to benefit their diabetic patients. Further research is also needed to better understand how other clinical office staff, including diabetes educators, can enhance patient medication adherence.

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Funding Source: CVS Caremark and Employers Health Purchasing Corporation of Ohio.

Author Disclosures: The authors (BWS, AS, STP, CAR) report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

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

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