RESEARCH

Retrospective Database Analysis of the Impact of Prior Authorization for Type 2 Diabetes Medications on Health Care Costs in a Medicare Advantage Prescription Drug Plan Population

Joette Gdovin Bergeson, PhD; Karen Worley, PhD; Anthony Louder, RPh, PhD; Melea Ward, PharmD; and John Graham, PharmD

ABSTRACT

BACKGROUND: Health plans and pharmacy benefit managers have implemented utilization management strategies for newer type 2 diabetes mellitus (T2DM) medications to control pharmacy expenditures. Little is known about the impact of utilization management strategies on overall health care costs and subsequent use of T2DM medications among members who request, but do not receive, a T2DM medication requiring prior authorization (PA).

OBJECTIVE: To examine the relationship between the receipt of a T2DM medication requiring PA, health care costs, and subsequent treatment for T2DM.

METHODS: A retrospective cohort study using pharmacy, medical, and laboratory claims data was conducted among Medicare Advantage Prescription Drug plan members with a denied claim for a T2DM medication requiring PA (sitagliptin, a dipeptidyl peptidase-4 inhibitor [DPP-4i], and exenatide, an incretin mimetic) between January 1, 2008, and June 30, 2009. Subjects were required to have 12 months of continuous enrollment both before and after the index date. The entire study period was 24 months in duration, including a 12-month pre-index and 12-month post-index period. Three cohorts were identified: 1 that received a medication requiring PA (denied claim, subsequent fill) and 2 nonfilling control groups. Both control groups requested a medication requiring PA, as evidenced by the denied claim, but neither received the medication, either because the medication was not authorized or the member chose not to fill. Claims-based estimates were used to infer whether the individual likely met the criteria for PA, with 1 control group designated as having met the claims-based criteria (qualifying nonfilling cohort) and the other not having done so (nonqualifying nonfilling cohort.) The primary endpoint evaluated was the relationship between PA medication fill status and plan-paid costs (medical [including laboratory] and pharmacy) over the 12-month post-denial period, with generalized linear models adjusting for key covariates including demographics, concomitant medications, pre-index costs, pre-index adherence, and comorbidities. The secondary endpoint of T2DM medication use (post-denial) among the 2 nonfilling control groups was also evaluated.

RESULTS: There were 1,728 members identified who received medication for T2DM requiring PA (the received authorization cohort) and 2,373 who did not (606 qualifying nonfilling cohort; 1,767 nonqualifying nonfilling cohort.) Cohorts were similar with regard to age and gender, but the nonfilling cohort had more comorbidities. Total unadjusted plan-paid 12-month costs were lowest among the received authorization cohort ($11,739), slightly higher ($11,980) for the qualifying nonfilling cohort, and notably higher for the nonqualifying nonfilling cohort ($12,962), although no differences were statistically significant. After adjusting for key covariates, the difference between the nonqualifying nonfilling cohort ($11,980) and the received authorization cohort ($11,729) was statistically significant ($P=0.034$). Large differences in plan-paid medical costs ($10,127 for the nonqualifying nonfilling cohort vs. $8,192 for the received authorization cohort) appeared to drive the overall cost totals and were significant in both the unadjusted ($P=0.005$) and adjusted models ($P<0.001$). Pharmacy costs were significantly lower for the nonqualifying nonfilling cohort in the adjusted model and for the qualifying nonfilling cohort in both models (all $P<0.001$), but the lower pharmacy costs were not offset by the higher medical costs. In examining the use of medication for treatment of T2DM following the denied claim, 10.6% of the qualifying nonfilling cohort and 13.4% of the nonqualifying nonfilling cohort added another oral therapy, 10.2% and 5.8% added insulin, and 11.9% and 7.1% had treatment intensification, respectively. More than half (56.1%) of the qualifying nonfilling cohort, but only 32.1% of the nonqualifying nonfilling cohort, maintained current therapy.

CONCLUSIONS: This study found higher plan-paid health care costs (overall and medical alone) among members who requested a type 2 diabetes medication requiring PA, but never received it, compared with those who qualified for and received the requested medication. A notable number of individuals who were assumed to have met the criteria based on a claims-based equivalent, but who never received the medication, made no change to their current therapy. Failure of a member to take medication deemed necessary by his or her physician could translate to inadequate control of the diabetic condition and result in an excess of resource utilization and costs for treating the disease and associated comorbidities. In light of the present findings, health plans should consider not only the impact of utilization management strategies on reducing pharmacy costs, but the broader implication for overall health care costs and subsequent treatment patterns among members.

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What is already known about this subject

- Utilization management strategies such as prior authorizations (PAs) are frequently used by health plans and pharmacy benefit managers in an effort to reduce costs, improve safe prescribing, or limit use to product indications or populations where drugs have been proven effective and/or recommended by published treatment guidelines.
- PAs instituted primarily for cost management among type 2 diabetic mellitus (T2DM) medications have not been evaluated in the literature, although research has been published on the impact of PAs that aim to improve safe prescribing of a product with label restrictions.
- In April 2012, the American Diabetes Association and the European Association for the Study of Diabetes (ADA/EASD) published a new position statement for the treatment of T2DM, which included the need for a patient-centered approach.

What this study adds

- This retrospective cohort study of a large Medicare Advantage Prescription Drug plan population evaluated the impact of PA for branded T2DM medications on health care costs and subsequent treatment patterns.
- The results demonstrated significantly higher post-index costs (total and medical alone), after controlling for key covariates among members who failed to meet the criteria (via a claims-based proxy) and did not receive medication requiring PA, compared with members who met the criteria and received the medication.
- More than half of the individuals who met the criteria based on a claims-based equivalent, but who never received the medication, made no change to their current therapy despite the fact that their physicians prescribed that medication.
- The current study provides important new data to further assist health plans in evidence-based decision making regarding the use of utilization management strategies. The ADA/EASD recent position statement update recommends a patient-centric approach to the treatment of T2DM. Consistent with this recommendation, health plans should consider the impact of strategies geared only toward reducing pharmacy costs on total overall health care costs and subsequent member treatment patterns.

Formulary and utilization management strategies such as prior authorizations (PAs), step edits, tiered formularies, and therapeutic interchange are frequently used by health plans and pharmacy benefit managers (PBMs) in an effort to reduce costs. Notably, these strategies are also used for other reasons, such as to improve safe prescribing or to limit use to product indications or populations.[1] PA requires the prescriber to receive pre-approval for prescribing a particular drug in order for that medication to qualify for coverage under the terms of the pharmacy benefit plan.[2] The impact of PA on drug utilization and health care costs is highly dependent on the drug class and population to which it is applied. A 2010 literature review prepared for the Academy of Managed Care Pharmacy and published in the *Journal of Managed Care Pharmacy* found only 9 published studies evaluating PA programs, 4 of which were classified as "good" and 5 classified as "fair"; none evaluated the use of PA in the management of diabetes medications.[1] Most research on the topic of PA processes and other utilization management strategies has largely focused on the effects of copayment and tiering, and not many have assessed patient outcomes after the implementation of a PA policy.

Research on the impact of PA policies for the use of type 2 diabetes medications is relatively limited. PA policies for this class of medications instituted primarily for cost management have not been evaluated in the literature, although research has been published on the impact of programs that aim to improve the safe prescribing of a product with label restrictions. One example is a study by Starner et al. (2012), which evaluated antidiabetic drug utilization after the implementation of a PA program for rosiglitazone in a large private health plan.[3] The policy required patients to have no history of either insulin or nitrate supply in the 60 days prior to rosiglitazone use in order to receive medication coverage. The authors found a 15-fold reduction in prevalence of concurrent rosiglitazone and nitrate or insulin use 6 months post-index, illustrating a notable change toward safer prescribing of rosiglitazone. While patients with a rejected claim for the medication were more likely to have no supply of any antidiabetic therapy at 30 days follow-up (10% vs. 0% in the comparison group), that difference became less pronounced and was not statistically significant at 60-180 days follow-up. Overall, the authors concluded that PA was associated with safer prescribing of the antidiabetic medication, due to a significant reduction in concurrent use of rosiglitazone with nitrates or insulin.

In April 2012, the American Diabetes Association and the European Association for the Study of Diabetes (ADA/EASD) published a new position statement for the treatment of type 2 diabetes.[3] The new recommendations are less prescriptive than previous versions and highlight the need for a patient-centered approach, which challenges physicians to individualize treatment based on patient preferences, needs, and values. With the approval of several new medications into the pharmacopeia, the ADA/EASD guidelines recognize that diabetes is a complex disease that manifests differently in different patients and state that the best way to manage the disease in one individual may not work well for another. The ADA/EASD guidelines include a variable for "cost" within the decision tree and acknowledge that costs are a critical element in the selection of medications. They state that "for resource-limited settings, less expensive agents should be chosen. However, due consideration should be also given to side effects and any necessary monitoring, with their own cost implications."

There is currently a lack of evidence to help formulary decision makers select the appropriate utilization management strategy to control pharmacy costs for members with diabetes. Health plans and PBMs should evaluate their utilization management strategies in light of the updated guidance from ADA and EASD to ensure patients with type 2 diabetes and providers have access to medication classes allowing for individualization of medication management. While metformin (if tolerated and not contraindicated) remains the recommended first-line therapy among newly diagnosed patients with type 2 diabetes, addition of a second agent is suggested for nonresponsive patients after just 3 months of therapy, and there are multiple viable therapies for consideration, including both oral agents and insulin.[4] Currently, the impact of PA as a utilization

management tool on patient outcomes and health plan costs has not been well researched in antidiabetic class management. The present study helps to fill this gap by evaluating the impact of PA for branded type 2 diabetes agents on health care costs and subsequent treatment patterns.

Methods

Data Source

A retrospective cohort study was conducted using member enrollment, medical and pharmacy claims, and laboratory data from a large national Medicare Advantage Prescription Drug (MAPD) plan population. Member enrollment data include information on member demographics and coverage start and end dates. Medical claims data include detailed information on physician visits, outpatient visits, and hospital inpatient stays. Pharmacy claims data include detailed information on each member's prescription fill. Such information includes, but is not limited to, the specific medication filled (National Drug Codes [NDCs] and Generic Product Identifier [GPI] codes); prescription fill date; quantity dispensed; days supply; member out-of-pocket costs for the prescription; the amount the plan paid for the prescription; and medications that were denied at the place of service (POS). Laboratory claims (including the cost of the test) are available for all plan members with medical benefits; for the percentage of patients receiving those services at laboratories that provide results directly to the health plan, the measurement values (results) can also be linked to the claim. An Institutional Review Board exemption letter was granted by the Western Institutional Review Board.

Prior Authorization

Members within the health plan who request prescriptions for medications requiring PA must go through a specific process to receive approval. Typically, the member's health care provider must submit a form, which is faxed to the health plan and evaluated by a staff pharmacist. The pharmacist then reviews this information in combination with the member's pharmacy claims data to determine whether the member meets the criteria for the medication. On occasion, a member might not meet 1 or more criteria, but may obtain approval through a grievance and appeal process, wherein a medical director reviews and approves the medication requiring. Once the authorization is granted, the health plan will cover the cost of the medication.

Study Design and Sample

Members with type 2 diabetes mellitus (T2DM), aged 18 to 89 years, with a denied pharmacy claim for a branded medication for this disease requiring PA between January 1, 2008, and June 30, 2009 (intake period), were included in the study. Sitagliptin (DPP-4 inhibitor) and exenatide (incretin mimetic) were the 2 branded medications requiring PA at the time of the study. (GPI codes are listed in Appendix A, available online.) The date of the first denied claim for a type 2 diabetes medication during the intake period was considered the index date, and subjects were required to have 12 months of continuous enrollment both before and after the index date. The entire study period was 24 months in duration, including a 12-month pre-index period and a 12-month post-index period.

Those with gestational diabetes—identified by an *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) code of 648.8 (abnormal glucose tolerance of mother complicating pregnancy, childbirth, or the puerperium) during the 12-month pre- or post-index period—were also excluded, as were individuals with a Type 1 diabetes mellitus (T1DM) diagnosis (ICD-9-CM code 250.x1 or 250.x3) in the absence of at least 1 T2DM diagnosis (ICD-9-CM code 250.x0 or 250.x2) any time during the study period. The latter exclusion criterion was applied to maximize the likelihood of identifying T1DM patients without excluding true T2DM patients who had received an erroneous diagnosis of T1DM at some point during their medical history, as the alternating fourth-digit coding for diabetes may produce misclassification of T1DM and T2DM. Finally, members with a claim in the previous 12 months for any branded type 2 diabetes medication requiring PA were excluded from the present study in order to capture only newly initiating users.

Members were assigned to 1 of 3 cohorts, based first on whether they had a subsequent paid pharmacy claim for the same branded medication requiring PA, and second on whether their claims showed that they met the health plan's criteria for reimbursement of the medication. If the member did have at least 1 paid pharmacy claim during the first 45 days of the post-index period, it was determined that the member met the criteria and was authorized to receive reimbursement for the medication; such members were placed in the received authorization cohort. Members who had a paid pharmacy claim beyond the first 45 days were excluded from analysis because there may have been changes in their qualifying characteristics during the extended delay that would be difficult to measure and because it was necessary to put some time constraint around the length of follow-up for practical purposes.

Next, the medication profiles of the members who did not have subsequent paid claims for the branded type 2 diabetes medication requiring PA were checked to see if these members would meet the health plan's 2011 criteria for these medications. It was necessary to run the claims through a new set of criteria since the pharmacy processing data that recorded the actual approval of authorization and the supporting information used to assess eligibility (e.g., physician fax forms, review of fill patterns, and other documentation from health care practitioners) from 2008-2009 were not available.

The 2011 criteria were identical to the 2008 and 2009 criteria except for the removal of insulin use as an exclusionary measure.

In 2011, exenatide, sitagliptin, and sitagliptin/metformin were considered medically necessary and met the PA criteria when the following criteria were met: (a) pharmacy claims for 1 of the following commercially available combination products: metformin and a sulfonylurea; metformin and a thiazolidinedione; or sulfonylurea and a thiazolidinedione; or 1 medication from at least 2 of the following classes: biguanide, sulfonylurea, or thiazolidinedione, covering at least 180 of the 360 days prior to the index date; and (b) at least 1 glycated hemoglobin A1c (HbA1c) value ≥ 7.0% in the past 12 months. The claims-based equivalent of the PA criteria was assessed using member-level pharmacy claims (including the GPI code and days supply fields to estimate days covered) and laboratory results (Logical Observation Identifiers Names and Codes [LOINC] 4548-4, 4549-2, or 17856-6) to indicate an HbA1c measure. Members were consequently excluded from the study if they did not have at least 1 available HbA1c result reported during the pre-index period; although laboratory tests for these members were reflected by paid claims, the results of those tests were not available to the health plan or study authors.

Two control groups were then constructed: the qualifying nonfilling cohort and the nonqualifying nonfilling cohort. Members meeting the claims-based equivalent of the PA criteria were classified as the qualifying nonfilling cohort, as they never received a prescription for a PA medication after their initial attempts at obtaining the medication (index denied claim). The reason a member did not receive a prescription for the requested medication is unknown. These individuals might have been using insulin and therefore did not meet the 2008-2009 criteria; they might have chosen not to fill the medication for personal reasons; or the pharmacy and/or prescriber might not have moved the authorization process forward by completing the phone or fax process. Alternatively, those members who did not meet the claims-based equivalent of the criteria were classified as the nonqualifying nonfilling cohort. Although these individuals also attempted to obtain a medication requiring PA, they failed to meet 1 or more of the claims-based criteria and never received a prescription for this medication. A flowchart of the sample selection process and construction of study cohorts is illustrated in Figure 1.

Statistical Analysis

Baseline Characteristics. Demographic characteristics were measured as of the member's index date or within the 12-month pre-index period. The demographic variables included age; gender; geographic region (Northeast, Midwest, South, and West); low-income subsidy (LIS) status; and dual eligibility (for both Medicaid and Medicare services). Other variables, related to cost sharing and clinical characteristics, included the member cost share for the index medication (adjusted to 30-day claim); member cost share for all medications in the post-index period; number of concurrent medications (defined as count of unique medications based on first 8 bytes of the GPI code identified during the 12-month post-index period); and the RxRisk-V Score, the Deyo adaptation of the Charlson Comorbidity Index (CCI), and selected individual comorbidities of interest (see Appendix B, available online). The latter 3 variables all were measured over the 12-month pre-index period.[5,6,7]

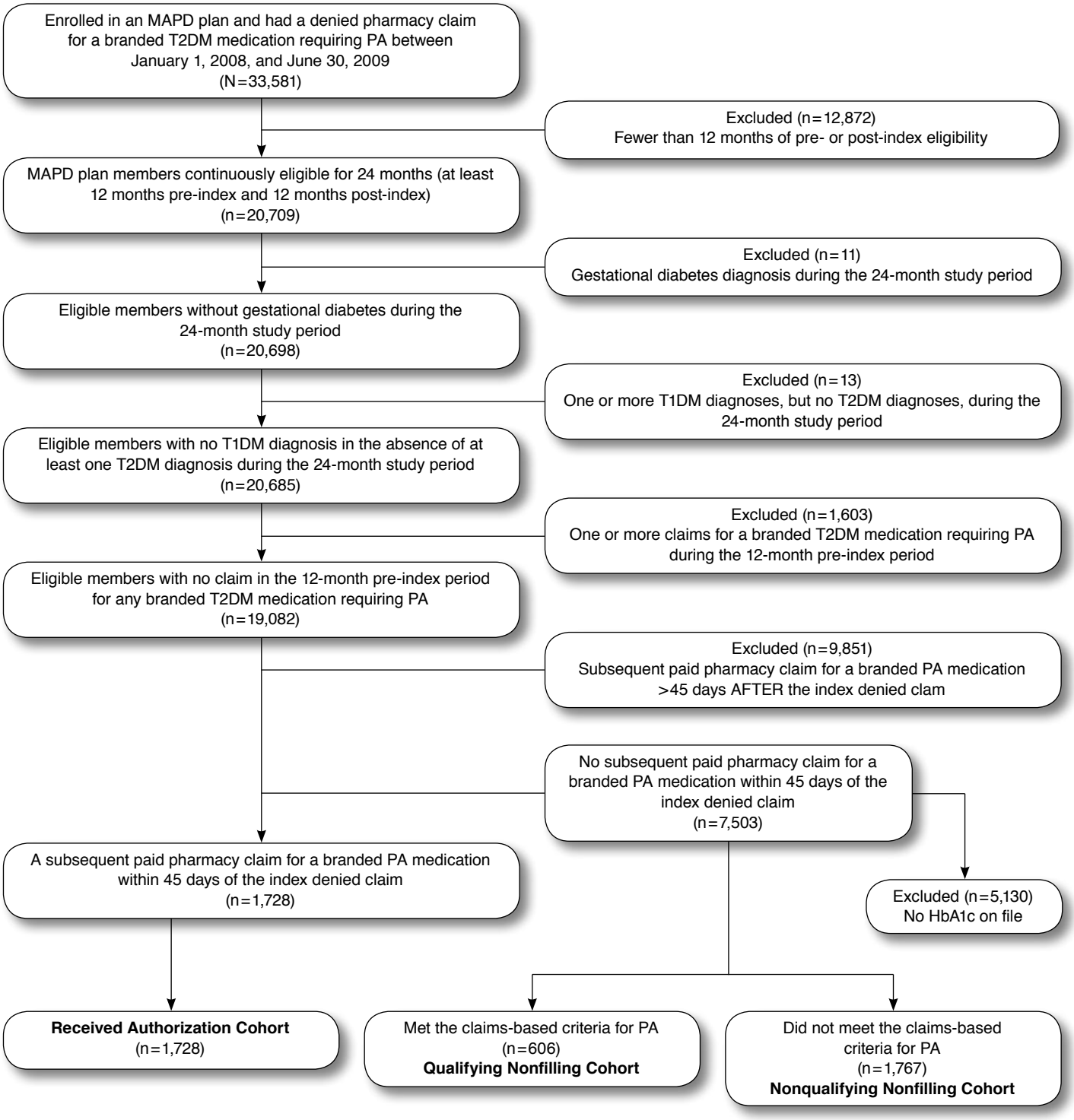
The CCI is a disease-based indicator using data from medical records and was designed to assess the risk of 1-year mortality among inpatients on a medical service.[5] The Deyo adaptation of the CCI adapts the index to administrative claims research via mapping to ICD-9-CM diagnoses and procedure codes.[8] The RxRisk-V is a prescription claims-based comorbidity index originally developed as an enhancement of the RxRisk risk assessment instrument for use in the Veterans Health Administration (VHA) population.[7] The RxRisk-V score is determined based on the identification of 45 distinct comorbid conditions via their associated medication treatments. Although the RxRisk-V was originally developed for use in the VHA population, the measure has been found to perform well in other populations and to outperform both the Deyo-Charlson and other comorbidity indices in predicting health care expenditures among managed care plan members.[9]

The list of individual comorbidities was chosen to further evaluate the impact of specific diseases that are especially prevalent among diabetics. A measure of pre-index adherence to any type of diabetes medication was generated using a proportion of days covered (PDC) approach, wherein the number of days with drug on hand over the total number of days in the pre-index period was calculated.[10] Summary statistics were summarized as frequency and percentage for each categorical variable and mean, median, and range for continuous variables.

In order to assess glycemic control at baseline, laboratory claims were used to identify the most recent HbA1c result during the pre-index period. The received authorization cohort was assumed to have met the criteria for PA and therefore was not required to have any reported laboratory claims. Although HbA1c results were not required for members in the received authorization cohort, results were evaluated for members of this cohort with claims available. The mean, median, and range of values were summarized for each cohort.

Health Care Costs. The relationship between study cohort and health care costs was evaluated using generalized linear models (GLM) with a log-link and a gamma distribution, wherein the dependent variable was post-index, all-cause, plan-paid costs. The primary independent variable in the model was the study cohort, with the received authorization cohort serving as the reference group. Both an unadjusted and an adjusted statistical model were produced, with the latter including the covariates of age, gender, geographic region, LIS status, dual eligibility, RxRisk-V score, comorbidities, total number of concurrent medications, pre-index adherence to all antidiabetic medications, total pre-index member

FIGURE 1 Study Sample Selection Flowchart



HbA1c = glycated hemoglobin A1c; MAPD = Medicare Advantage Prescription Drug plan; PA = prior authorization; T1DM = type 1 diabetes mellitus; T2DM = type 2 diabetes mellitus.

TABLE 1 Baseline Demographics

	Received Authorization		Qualifying Nonfilling		Nonqualifying Nonfilling	
N	1,728		606		1,767	
Age, years[a]	69.23	(69)	69.1	(69)	69.1	(70)
(mean, median, range)	[21-89]		[34-89]		[29-89]	
Age category	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
18-29	1	(0.1)	0	(0.0)	1	(0.1)
30-39	6	(0.4)	3	(0.5)	14	(0.8)
40-49	37	(2.1)	18	(3.0)	56	(3.2)
50-59	162	(9.4)	51	(8.4)	173	(9.8)
60-69	682	(39.5)	234	(38.6)	639	(36.2)
70-79	665	(38.5)	237	(39.1)	660	(37.4)
80-89	175	(10.1)	63	(10.4)	224	(12.7)
Gender						
Female	883	(51.1)	315	(52.0)	949	(53.7)
Geographic region						
Northeast	66	(3.8)	7	(1.2)	24	(1.4)
Midwest	495	(28.6)	68	(11.2)	245	(13.9)
South	997	(57.7)	485	(80.0)	1,323	(74.9)
West	170	(9.8)	46	(7.6)	175	(9.9)
LIS status	484	(28.0)	161	(26.6)	420	(23.8)
Dual eligibility	325	(18.8)	95	(15.7)	256	(14.5)

[a]Age was calculated as of index date.
LIS = low-income subsidy.

pharmacy cost share, total pre-index pharmacy plan-paid cost share, and pre-index all-cause total health care costs. In addition to total plan-paid costs, unadjusted and adjusted plan-paid costs for medical (including laboratory) and pharmacy components were evaluated separately to determine the contribution of each type of cost. Differences in costs for antidiabetic medications alone were also calculated to assess expenditures for treatment of the disease across the 3 study groups.

Treatment Patterns. To determine the treatment patterns of members in the control groups who did not receive the medication prescribed, the use of type 2 diabetes medications after the denied claim was assessed for both control cohorts (qualifying and nonqualifying nonfillers.) The number and percentage who added another diabetes medication, intensified the dose of their current medication, switched to another therapeutic class, continued use of their current medication, or discontinued use of their current medication were calculated. Members could be classified into more than 1 category (e.g., those who added an oral medication and increased the dose of their current medication, or added an oral medication as well as insulin). Adding another diabetes medication was defined as adding a medication from a different therapeutic category (sulfonylureas, metformin, or TZDs) when comparing the 120 days prior to the index date and the 120 days after the index date. Continuation of a member's current medication was defined as having at least 1 prescription from the same class (i.e., sulfonylurea, thiazolidinedione, or biguanide) in the last 120 days pre-index and the first 120 days post-index, while discontinuation was defined as no use of the medication in the last 180 days of the post-index period. A period of 180 days was chosen arbitrarily, as it represented a full 6 months without therapy. Members were considered to have increased their doses (intensified treatment) when an increase in daily dose was observed in the 120 days after the index date compared with 120 days prior to the index date. Daily dose was calculated by multiplying strength of the active ingredient(s) by the quantity dispensed and dividing by the days supply (using the highest daily dose for each period, and requiring the member to have used the same medication in both periods).

Results

Study Population

There were 33,581 MAPD plan members with a denied pharmacy claim for a branded type 2 diabetes medication requiring PA between January 1, 2008, and June 30, 2009 (see Figure 1). After applying the inclusion and exclusion criteria, 4,101 members remained for analysis. This included 1,728 individuals in the received authorization cohort (those who requested and received a T2DM medication requiring PA); 606 qualifying nonfilling members who requested a medication requiring PA and qualified for the medication per the claims-based criteria, but never received the medication; and 1,767 nonqualifying nonfilling members who requested a type 2 diabetes medication requiring PA but did not qualify per the claims-based criteria and never received the medication.

Baseline Characteristics

Age and gender distributions were similar among the three cohorts. (Table 1) The average age was 69 years for all 3 groups, and the majority was female. In terms of geographic distribution, the received authorization cohort had twice as many members from the Midwest compared with the 2 control cohorts, whose members were drawn primarily from the South. The received authorization cohort also had a slightly higher proportion of Medicare-Medicaid dual-eligibles (18.8%) compared with both the qualifying nonfillers (15.7%) and nonqualifying nonfillers (14.5%.) The percentage of LIS status members followed a similar pattern across the 3 groups.

With respect to clinical characteristics, the RxRisk-V and CCI scores were lower for the received authorization cohort, but cost share amounts were notably higher, both for a 30-day claim of the index medication and for all medications in total (Table 2). For most of the individual comorbidities evaluated (e.g., hypertension, dyslipidemia, nephropathy) the received authorization cohort had a lower percentage of members with these comorbidities, while the 2 control cohorts showed comparable frequencies. Concurrent medication use was fairly similar across the 3 groups.

As a measure of disease severity, the last HbA1c result for

TABLE 2 Clinical and Cost-Sharing Characteristics

	Received Authorization	Qualifying Nonfilling	Nonqualifying Nonfilling
N	1,728	606	1,767
RxRisk-V Score (pre-index)[a]	5.3 (5) [1-13]	5.4 (5) [1-14]	5.5 (5) [1-14]
Charlson Comorbidity Index (pre-index)[a]	3.1 (3) [1-16]	3.7 (3) [1-15]	3.8 (3) [1-17]
Member cost share per 30-day claim[a] ($)	26 (20) [0-275]	10 (4) [0-134]	13 (4) [0-325]
Member cost share for all medications (post-index)[a] ($)	1,181 (851) [0-9,311]	648 (315) [0-5,187]	688 (387) [0-10,718]
Number of concurrent medications (post-index)[a]	14.3 (13) [2-52]	14.8 (14) [3-54]	14.4 (14) [1-49]
Comorbidity (post-index)			
Hypertension (%)	1,471 (85.1)	569 (93.9)	1,622 (91.8)
Dyslipidemia (%)	1,430 (82.8)	551 (90.9)	1,600 (90.5)
Nephropathy (%)	321 (18.6)	171 (28.2)	526 (29.8)
Neuropathy (%)	369 (21.4)	192 (31.7)	517 (29.3)
Retinopathy (%)	280 (16.2)	129 (21.3)	242 (13.7)
Ischemic heart disease (%)	494 (28.6)	230 (38.0)	668 (37.8)
Prior angina (%)	84 (4.9)	51 (8.4)	160 (9.1)
Congestive heart failure (%)	232 (13.4)	105 (17.3)	347 (19.6)
Chronic obstructive pulmonary disease (%)	160 (9.3)	74 (12.2)	207 (11.7)
Peripheral vascular disease (%)	318 (18.4)	174 (28.7)	478 (27.1)
Cerebrovascular disease (%)	218 (12.6)	84 (13.9)	296 (16.8)
Obesity (%)	235 (13.6)	109 (18.0)	301 (17.)
Amputations (%)	5 (0.3)	3 (0.5)	7 (0.4)
Depression (%)	187 (10.8)	69 (11.4)	277 (15.7)
Dementia (%)	34 (2.0)	3 (0.5)	31 (1.8)
Psychoses (%)	24 (1.4)	5 (0.8)	18 (1.0)
Last HbA1c measure (pre-index)[a,b]	7.9 (7.6) [5.3-13.6]	8.2 (7.9) [6.0-14.0]	7.7 (7.2) [5.1-16.9]
Adherence (pre-index PDC)[a,c]	0.80 (0.88) [0.01-1.0]	0.85 (0.89) [0.33-1.0]	0.61 (0.68) [0.01-1.0]

[a]*Mean, median, range.*
[b]*561 members of the received authorization cohort had an HbA1c measure available for analysis.*
[c]*Adherence for all antidiabetic medications used over the 12-month pre-index period.*
PDC = proportion of days covered.

TABLE 3 Mean All-Cause Plan-Paid Health Care Costs for the 12 Months After Denied Claim

Measure	Mean Unadjusted Costs, $[a] (95% CI)	Unadjusted *P* Value[b]	Adjusted *P* Value[b]
Total Costs (Medical + Pharmacy)			
Received authorization cohort	11,739 (10,862, 12,616)	—	—
Qualifying nonfilling cohort	11,980 (10,300, 13,660)	0.809	0.320
Nonqualifying nonfilling cohort	12,962 (11,871, 14,054)	0.087	0.034
Medical costs			
Received authorization cohort	8,192 (7,348, 9,036)	—	—
Qualifying nonfilling cohort	9,014 (7,384, 10,643)	0.391	0.550
Nonqualifying nonfilling cohort	10,127 (9,086, 11,168)	0.005	<0.001
Pharmacy costs			
Received authorization cohort	3,547 (3,377, 3,716)	—	—
Qualifying nonfilling cohort	2,966 (2,740, 3,192)	<0.001	<0.001
Nonqualifying nonfilling cohort	2,835 (2,647, 3,023)	0.168	<0.001

[a]*Per member per year.*
[b]*Generalized linear model with log-link and gamma distribution; covariates included age, gender, geographic region, total member pharmacy cost share, total number of concurrent medications, LIS status, dual eligibility, RxRisk-V score, pre-index all-cause total health care costs, pre-index adherence, and comorbidities.*
CI = confidence interval.

each cohort is shown in Table 2. Only 561 members of the received authorization cohort had an HbA1c measurement on file; they were not required to meet the claims-based criteria because their medication was approved by virtue of the fill. Average HbA1c results ranged from 7.7% in the nonqualifying nonfilling cohort to 7.9% in the received authorization cohort and 8.2% in the qualifying nonfilling cohort.

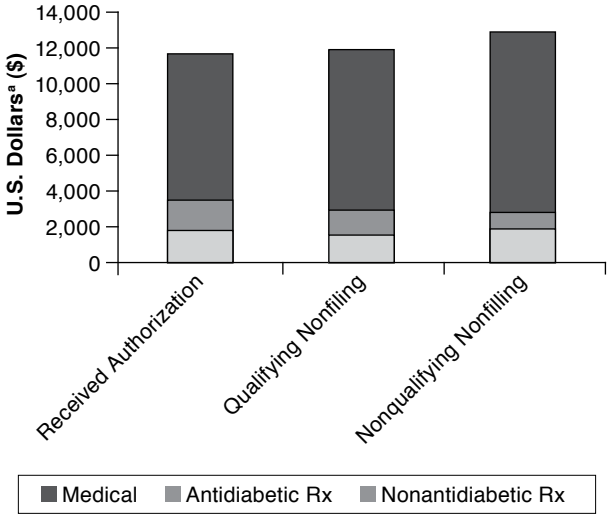
Health Care Costs

All-cause total plan-paid health care costs (medical and pharmacy) were lowest for the received authorization cohort, with mean unadjusted 12-month costs of $11,739. (Table 3) Costs were just slightly higher, but not significantly different, for the qualifying nonfillers at $11,980. The nonqualifying nonfilling cohort, however, had notably higher total costs of $12,962, which were not statistically significantly different from the received authorization cohort in the unadjusted model ($P = 0.087$), but were significantly different ($P = 0.034$) in the adjusted model that controlled for covariates.

Plan-paid medical costs were $8,192 for the received authorization cohort and $10,127 for the nonqualifying nonfilling cohort; this difference in plan-paid medical costs was significant in both the unadjusted and adjusted models ($P = 0.005$ and $P < 0.001$, respectively; see Table 3). Medical costs for the qualifying nonfilling cohort ($9,014) were also higher than the received authorization cohort but not significantly different in either model. Compared with the received authorization cohort ($3,547), pharmacy costs were significantly lower for both the qualifying nonfilling cohort ($2,966, $P < 0.001$) and the nonqualifying nonfilling cohort ($2,835, $P < 0.001$; Table 3), although the difference for the nonqualifying nonfilling cohort was only statistically significant after adjusting for the selected covariates (unadjusted $P = 0.168$; adjusted $P < 0.001$).

FIGURE 2 Mean All-Cause Plan-Paid Health Care Costs for the 12 Months After Denied Claim

(Pharmacy costs separated by antidiabetic and all other medications)



[a]*Costs are per member per year.*
Rx = prescription.

Costs for antidiabetic medications followed a similar trend, with higher costs ($1,681) among those in the received authorization cohort, somewhat lower costs ($1,175) in the qualifying nonfilling cohort, and the lowest costs ($789) in the nonqualifying nonfilling cohort (both $P < 0.001$ vs. the received authorization cohort). However, when antidiabetic medications were excluded from the pharmacy cost calculation, the nonqualifying nonfilling cohort had the highest pharmacy costs for medications indicated for other conditions or comorbidities ($2,046 compared with $1,866 and $1,791 for the received authorization and qualifying nonfilling control cohort, respectively). Figure 2 illustrates the distribution of medical and pharmacy costs for each of the 3 cohorts, and the portion of pharmacy costs related to antidiabetic versus other medications.

Treatment Patterns

In an effort to understand the treatment patterns of members who did not receive the medication prescribed by their physicians, post-denial treatment patterns (for the control cohorts only) were assessed. Results showed that more than half of those in the qualifying nonfilling cohort (56.1%) and a third of those in the nonqualifying nonfilling cohort (32.1%) made no change in therapy (Table 4). A smaller percentage of qualifying and nonqualifying nonfillers, respectively, added another oral therapy (10.6% and 13.4%), added insulin (10.2% and 5.8%), and/or increased the dose of their current therapy (11.9% and 7.1%.) A small percentage (4% or less) of members switched to another therapeutic class or discontinued therapy altogether.

TABLE 4 Post-denial Treatment Summary

Measure	Qualifying Nonfilling Cohort		Nonqualifying Nonfilling Cohort	
N	606		1,767	
Added another diabetes medication				
Added another oral therapy (%)	64	(10.6)	237	(13.4)
Added insulin (%)	62	(10.2)	103	(5.8)
Increased dose (%)	72	(11.9)	125	(7.1)
Switched to another therapeutic class				
Monotherapy (%)	5	(0.8)	70	(4.0)
Combination therapy (%)	0	(0.0)	8	(0.5)
No change—continuing use (last 120 days of pre-index period/first 120 days of post-index period) (%)	340	(56.1)	567	(32.1)
Discontinued use (no use in last 180 days of post-index period) (%)	13	(2.1)	91	(5.2)

Discussion

This retrospective cohort study of a large MAPD plan population evaluated the impact of PA for branded medications for treatment of T2DM on health care costs and subsequent treatment patterns. The results demonstrated significantly higher post-index costs (total and medical alone), after controlling for the specified covariates among members who failed to meet the PA criteria (via a claims-based proxy) and did not receive the medication, compared with members who met the criteria and received the medication.

The observed differences in medical costs alone suggest that the type 2 diabetes medications requiring PA may have been prescribed to gain better glycemic control or reduce side effects of current treatment, which could potentially also lower costs for the health plan. While it is necessary to consider the underlying differences in health status of the study cohorts on these cost disparities, the statistical model adjusted for a number of important variables, thus controlling for the impact of many known confounders. Furthermore, although the overall pharmacy costs were significantly lower for the nonfilling cohorts, a notable portion of the expenditures for the filling cohort was related to the cost of the antidiabetic medications, including branded medications that are generally more expensive. When all diabetes treatments were excluded from the pharmacy cost calculation, the disparity in pharmacy costs among the 3 cohorts was much less apparent.

Currently, there is no published literature available with which the findings of this study can be directly compared. Much of the research to date has focused on the effect of PA processes on access to medications and subsequent pharmacy

utilization, but none have specifically examined the impact on health care costs when members do not receive prescribed antidiabetic therapies requiring PA. Studies in other disease areas have shown that PAs are effective in reducing utilization of nonpreferred agents, and sometimes the reduced utilization is offset by increased use of preferred agents.[11,12,13] However, decreases in utilization of nonpreferred agents have also been associated with higher rates of hospitalization or disease-related costs, which may offset the cost savings related to the decline in use of the nonpreferred agent.[13,14]

While studies that specifically address the use of PA to control use of nonpreferred agents for diabetes are not presently available, findings from research directed at safe use of rosiglitazone do provide some insight on trends in prescribing after claims are denied for medications requiring PA. Starner et al. found that members with a rejected claim for rosiglitazone (due to concomitant nitrate or insulin use) were more likely not to have prescriptions for any antidiabetic therapy 30 days following the rejected claim, compared with members not subject to a PA policy.[3] While this difference was less pronounced, and no longer statistically significant at 60-180 days of follow-up, it does bring to light the possibility that PA programs could decrease overall utilization of a drug class and not just the use of the targeted agent.

The current study also evaluated treatment patterns post-denial of the prescribed medication. It is important to consider that members in all 3 study cohorts had a physician prescribe a type 2 diabetes medication requiring PA, indicating that their physicians believed some type of treatment change or intensification was necessary given their current disease status. However, only a portion of the study population went on to fill a prescription for the medication. Among the remaining members (a large proportion) who either did not meet the criteria or chose not to fill their prescription, one-third to more than half made no change to their current treatment. In other words, they maintained their current therapy without changing dose, switching, or adding any other medications. Therefore, it is unknown if these members remained uncontrolled in their diabetes or took other nonpharmaceutical steps to gain better control of their illness.

These members who did not fill their prescriptions might exhibit lower pharmacy costs for the diabetes medication itself, but without adequate control of their disease, their medical and pharmacy expenditures, perhaps related to disease progression and comorbidities, might be similar or higher. Additionally, there could be members who were not identifiable in the claims database analysis whose physicians did not even try to prescribe the medication requiring PA due to the presence of the process itself. Kahan et al. (2011) evaluated whether rescinding the PA policy for losartan in a health maintenance organization (HMO) could reduce prescribing of more expensive angiotensin receptor blockers.[15] The authors found that doing so was an "effective limited-duration strategy for the reduction of prescription of relatively expensive drugs." Therefore, PA policies do have an impact on prescribing behavior, particularly in an HMO environment. The current study demonstrated that some physicians were still attempting to prescribe the needed medication for their patients, despite the authorization process. It is not possible from the claims database to assess how many physicians did not try to access the medication for appropriate patients.

Limitations

Limitations inherent to administrative claims data apply to this study. These include the absence of certain information in the database (e.g., health behavior information), error in claims coding, and the potential influence of unidentified confounding variables. Administrative claims data include paid claims only and cannot identify a member's use of sample medications or therapies for which the member paid solely out of pocket. Alternatively, a claim for a medication does not necessarily mean the member actually took the medication. The present study may also be limited in its generalizability to the general population. Although the database used is from a national plan with members from various geographic regions, the generalizability of this population to the U.S. population has not been evaluated.

The present study was also limited by the method used to determine whether the member met the PA criteria. A claims-based proxy was implemented because the health plan pharmacy records that document whether the member met criteria at the time of their index date—including physician fax forms and other documentation that the physician may have provided as qualifying information for the request—were not available to be linked with the administrative claims data. In addition, it was of interest to know how members fared under the current PA system; thus, the criteria at the time of study completion (2011), rather than the index date, were applied for the proxy. The current criteria do not list insulin use as an exclusion, so insulin use was not evaluated as a criterion. The implications of this were 2-fold: the claims-based criteria were only an estimate and were limited to what was available in the claims, and the criteria reflected current policy rather than that at the time the prescription was processed. For some members, it may have appeared that the individual met the PA criteria per the claims-based estimate, but he or she was actually denied the medication requiring PA due to insulin use. We found that 17.0% of members in the qualifying nonfilling cohort used insulin, compared with only 6.7% of those who received the PA medication, indicating that about 10% of the individuals in the qualifying nonfilling cohort probably did not fill because they failed to meet the insulin criterion. As a result, the

classification as "qualifying" nonfilling includes some individuals who, although they qualified according to the 2011 criteria, were technically "nonqualifying," and therefore misclassified according to the 2008-2009 criteria.

While the purpose of this study was to understand the cost and treatment patterns among these patients given the current PA environment, it is important to note that this portion of the qualifying nonfilling cohort could have characteristics that make them more similar to the nonqualifying nonfilling cohort than to the qualifying cohort, which could be attenuating some of the differences in costs between those 2 groups. As for the other reasons why individuals in that control group did not fill, it is possible that they either were approved for the medication but elected not to fill the prescription, or the pharmacy review team denied the authorization because of evidence (beyond what was available in the claims) that indicated failure to meet the criteria. However, the nonqualifying nonfilling cohort possibly did not fill because they did not meet the authorization criteria and were not approved, or because they were approved but elected not to fill for other reasons. Thus, the study groups may include members with disparate reasons for not filling the medication, which indicates that there may be some misclassification of members in the control groups by qualification status as well as variability within each cohort with respect to the reasons for nonfillers opting not to fill. While members may have elected not to fill their prescriptions for a variety of reasons (e.g., out-of-pocket cost of the medication, inability to return to the pharmacy to pick up the medication, misunderstanding of the PA process, forgot to pick up the medication), neither member nor physician behavior was evaluated in the present analysis, and future studies are warranted to further elucidate these factors.

Generally speaking, the present study did not have the information available to assess the reasons for members not filling, but it is possible that those members are different than the members who were denied medication requiring PA and never had the opportunity to fill. Although this unknown factor could not be controlled for in the analysis, it is important to note the potential for this variability within the cohorts when interpreting the study results.

It is also worthwhile to mention that this study did not include members who had a denied claim for a type 2 diabetes medication requiring PA and received the therapy more than 45 days after the initial denial. There was a substantial number of screened members who fell into this category. The present study chose to exclude these individuals from analysis because a variety of factors could have resulted in extremely late filling of the prescription, and a thorough assessment of those factors was outside the scope of the present analysis. It was also necessary to truncate follow-up to a reasonable amount of time post-denial to create cohorts based on similar filling behaviors. However, the characteristics of these members are not inconsequential and future analyses are needed to explore costs and treatment patterns among this group.

Conclusions

Utilization management techniques are important tools for use by health plans and PBMs in managing costs and appropriate use of medications. There is, however, a lack of clear evidence to assist health plans in making evidence-based decisions in implementing these processes. In the evaluation of a PA program seeking to control costs associated with the use of branded type 2 diabetes medications, this study found that members who were prescribed a medication requiring PA, but who never filled the prescription, had higher plan-paid health care costs (overall and medical alone), compared with those who qualified for the medication and subsequently filled the prescription within 45 days. A notable number of individuals who were assumed to have met the criteria based on a claims-based equivalent, but who never received the medication, made no change to their current therapy despite receiving a prescription for this medication. Failure of a member to take medication deemed necessary by his or her physician could translate to inadequate control of the diabetic condition and result in an excess of resource utilization and costs for treating the disease and associated comorbidities.

The current study provides important new data to further assist health plans in evidence-based decision making regarding the use of utilization management strategies. While the 2012 ADA/ESD guidelines were not in place at the time the present study population was observed, the recent position statement update recommends a patient-centric approach to the treatment of T2DM. Consistent with this recommendation, health plans and PBMs should consider the impact of strategies geared only toward reducing pharmacy costs on total overall health care costs and subsequent member treatment patterns.

Authors

JOETTE GDOVIN BERGESON, PhD, is Director, and JOHN GRAHAM, PharmD, is Executive Director, Health Services Outcomes Research, Bristol-Myers Squibb, Plainsboro, NJ; KAREN WORLEY, PhD, and ANTHONY LOUDER, RPh, PhD, are Research Directors, Comprehensive Health Insights, Louisville, KY; and MELEA WARD, PharmD, is Clinical Pharmacist, Humana Inc., Louisville, KY.

AUTHOR CORRESPONDENCE: Karen Worley, PhD, 325 W. Main St. WFP6W, Louisville, KY 40202; Tel.: 513.476.6874; Fax: 513.898.7604; E-mail: kworley@humana.com.

DISCLOSURES

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REFERENCES

1. Shoemaker SJ, Pozniak A, Subramanian R, Mauch D. Effect of 6 managed care pharmacy tools: a review of the literature. *J Manag Care Pharm*. 2010;16(6 Suppl):S3-S20. Available at: http://www.amcp.org/WorkArea/DownloadAsset.aspx?id=8359.

2. Academy of Managed Care Pharmacy. Concepts in Managed Care Pharmacy: Prior Authorization. Concept Document. April, 2012. Available at: http://www.amcp.org/prior_authorization/. Accessed March 31, 2013.

3. Starner CI, Fenrick B, Coleman J, Wickersham P, Gleason PP. Rosiglitazone prior authorization safety policy: a cohort study. *J Manag Care Pharm*. 2012;18(3):225-33. Available at: http://www.amcp.org/JMCP/2012/April/14984/1033.html.

4. Inzucchi SE, Bergenstal RM, Buse JB, et al. Management of hyperglycemia in type 2 diabetes: a patient-centered approach: position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care*. 2012;35(6):1364-79.

5. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373-83.

6. Fishman PA, Goodman MJ, Hornbrook MC, Meenan RT, Bachman DJ, O'Keeffe Rosetti MC. Risk adjustment using automated ambulatory pharmacy data: the RxRisk model. *Med Care*. 2003;41(1):84-99.

7. Sloan KL, Sales AE, Liu CF, Fishman P, Nichol P, Suzuki NT, Sharp ND. Construction and characteristics of the RxRisk-V: a VA-adapted pharmacy-based case-mix instrument. *Med Care*. 2003;41(6):761-74.

8. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45(6):613-19.

9. Farley JF, Harley CR, Devine JW. A comparison of comorbidity measurements to predict health care expenditures. *Am J Manag Care*. 2006;12(2):110-19.

10. Hess LM, Raebel MA, Conner DA, Malone DC. Measurement of adherence in pharmacy administrative databases: a proposal for standard definitions and preferred measures. *Ann Pharmacother*. 2006;40(7-8):1280-88.

11. Vogt WB, Joyce G, Xia J, Dirani R, Wan G, Goldman DP. Medicaid cost control measures aimed at second-generation antipsychotics led to less use of all antipsychotics. *Health Aff (Millwood)*. 2011;30(12):2346-54.

12. Lu CY, Law MR, Soumerai SB, et al. Impact of prior authorization on the use and costs of lipid-lowering medications among Michigan and Indiana dual enrollees in Medicaid and Medicare: results of a longitudinal, population-based study. *Clin Ther*. 2011;33(1):135-44.

13. Margolis JM, Johnston SS, Chu BC, et al. Effects of a Medicaid prior authorization policy for pregabalin. *Am J Manag Care*. 2009;15(10):e95-102.

14. Abouzaid S, Jutkowitz E, Foley KA, Pizzi LT, Kim E, Bates J. Economic impact of prior authorization policies for atypical antipsychotics in the treatment of schizophrenia. *Popul Health Manag*. 2010;13(5):247-54.

15. Kahan NR, Chinitz DP, Blackman S, Waitman DA, Vardy DA. Modifying prescribing behaviour of angiotensin receptor blockers by selectively rescinding managerial prior authorization requirements for losartan. *Br J Clin Pharmacol*. 2011;72(6):997-1001.

APPENDIX A GPI[a] Codes Used to Define T2DM Medications

GPI 4	Description
Insulin	
2710[b]	Insulin
Oral monotherapy	
2715	Antidiabetic–Amylin Analogs
2717	Incretin Mimetic Agents (GLP-1 Receptor Agonists)
2720	Sulfonylureas
2723	Antidiabetic–D-Phenylalanine Derivatives
2725	Biguanides
2728	Meglitinide Analogues
2750	Alpha-Glucosidase Inhibitors
2755	Dipeptidyl Peptidase-4 (DPP-4) Inhibitors
2760	Thiazolidinediones
Oral combination therapy	
2799	Dipeptidyl Peptidase-4 Inhibitor-Biguanide Combinations
	Meglitinide-Biguanide Combinations
	Sulfonylurea-Biguanide Combinations
	Sulfonylurea-Thiazolidinedione Combinations
	Thiazolidinedione-Biguanide Combinations

[a]*Generic Product Identifier: Medi-Span's therapeutic classification system, useful for aggregating similar drug products at a drug class level. It is a 14-digit code that contains 7 pairs of digits. The first pair of digits represents the drug group and subsequent paired digits represent the drug class, drug subclass, drug name, drug name extension, dosage form, and strength.*

[b]*GPI codes used to identify the received authorization cohort include: exenatide (27170020002050 and 27170020002060); sitagliptin (27550070100320, 27550070100330, and 27550070100340); sitagliptin-metformin combinations (27992502700320, 27992502700340, 27992502700520, 27992502700530, 27992502700540).*

T2DM = type 2 diabetes mellitus.

APPENDIX B Listing of Comorbid Conditions and Associated Diagnosis or Procedure Codes

Comorbid Condition	ICD-9-CM or Procedural Code	CPT Code
Hypertension		
Essential hypertension	401.xx	
Hypertensive heart disease	402.xx	
Hypertensive renal disease	403.xx	
Hypertensive heart and renal disease	404.xx	
Dyslipidemia		
Disorders of lipid metabolism	272.xx	
Nephropathy		
Diabetes with renal manifestations	250.4x	
Nephritis and nephropathy, not specified as acute or chronic	583.xx	
Acute renal failure	584.xx	
Chronic renal failure	585.xx	
Unspecified renal failure	586.xx	
Nephrogenic diabetes insipidus	588.1x	
Hypokalemic nephropathy	588.89	
Vesicoureteral reflux, with reflux nephropathy, unilateral	593.71	
Vesicoureteral reflux, with reflux nephropathy, bilateral	593.72	
Vesicoureteral reflux, with reflux nephropathy, NOS	593.73	
Proteinuria	791.0x	
Neuropathy		
Diabetes with neurological manifestations	250.6x	
Peripheral autonomic neuropathy in disorders classified elsewhere	337.1	
Mononeuritis of lower limb	355.x	
Polyneuropathy in diabetes	357.2x	
Myasthenic syndromes in diseases classified elsewhere	358.1x	
Gastroparesis	536.3	
Arthropathy associated with neurological disorders	713.5	
Retinopathy		
Diabetes with retinal manifestations	250.5x	
Diabetic retinopathy	362.0x	
Glaucoma associated with systemic syndromes	365.44	
Diabetic cataract	366.41	
Ischemic heart disease		
Acute myocardial infarction	410.xx	
Other acute and subacute forms of ischemic heart disease	411.xx	
Other forms of chronic ischemic heart disease	414.xx	
Prior angina		
Angina	413.xx	
Congestive heart failure		
Hypertensive heart disease; malignant; with heart failure	402.01	
Hypertensive heart disease; benign; with heart failure	402.11	
Hypertensive heart disease; unspecified; with heart failure	402.91	
Hypertensive heart and renal disease; malignant; with heart failure	404.01	
Hypertensive heart and renal disease; malignant; with heart failure and renal failure	404.03	
Hypertensive heart and renal disease; benign; with heart failure	404.11	
Hypertensive heart and renal disease; benign; with heart failure and renal failure	404.13	
Hypertensive heart and renal disease; unspecified; with chronic heart failure	404.91	
Hypertensive heart and renal disease; unspecified; with heart failure and renal failure	404.93	
Heart failure	428.x	
Peripheral vascular disease		
Diabetes with peripheral circulatory disorders	250.7x	
Atherosclerosis	440.xx	
Peripheral angiopathy	443.81	

APPENDIX B Listing of Comorbid Conditions and Associated Diagnosis or Procedure Codes *(continued)*

Comorbid Condition	ICD-9-CM or Procedural Code	CPT Code
Peripheral vascular disease, unspecified	443.9x	
Gangrene	785.4x	
Endarterectomy, upper limb vessels	38.13	
Endarterectomy, lower limb vessels	38.18	
Aorta-iliac-femoral bypass	39.25	
Other intra-abdominal vascular shunt or bypass	39.26	
Other (peripheral) vascular shunt or bypass	39.29	
Angioplasty or atherectomy of other non-coronary vessel(s)	39.5	
Insertion of nondrug-eluting peripheral vessel stent(s)	39.9	
Embolectomy or thromboectomy, arterial, with or without catheter; by arm incision		34101-34111
Embolectomy or thromboectomy, arterial, with or without catheter; by leg incision		34201-34203
Thromboendarterectomy		35311-35381
Transluminal balloon angioplasty, open; iliac, femoral-popliteal		35454-35456
Transluminal balloon angioplasty, open tibioperoneal trunk and branches, each vessel		35459
Transluminal balloon angioplasty, percutaneous; iliac, femoral-popliteal		35473-35474
Transluminal peripheral atherectomy, open; iliac, femoral-popliteal, brachiocephalic trunk or branches, tibioperoneal trunk and branches		35482-35485
Transluminal peripheral atherectomy, percutaneous; iliac, femoral-popliteal, brachiocephalic trunk or branches, tibioperoneal trunk and branches		35492-35495
Bypass graft, with vein; axillary-femoral-femoral		35533
Bypass graft, with vein		35541-35571
Bypass graft, with other than vein; aortoiliac or bi-iliac		35641
Bypass graft, with other than vein; aortobifemoral		35646
Bypass graft, with other than vein; axillary-femoral-femoral		35654
Transluminal balloon angioplasty, peripheral artery, radiological supervision and interpretation		75962-75964
Transluminal artherectomy, peripheral artery, radiological supervision and interpretation		75992-75993
Peripheral arterial disease rehabilitation, per session		93668
Cerebrovascular disease		
Occlusion and stenosis of precerebral arteries	433.xx	
Occlusion of cerebral arteries	434.xx	
Transient cerebral ischemia	435.xx	
Acute but ill-defined cerebrovascular disease	436.xx	
Other and ill-defined cerebrovascular disease	437.xx	
Late effects of cerebrovascular disease	438.xx	
Obesity		
Overweight and obesity	278.0x	
Amputations		
Amputation of lower limb	84.1x	
Amputation, thigh, through femur, any level		27590-27596
Disarticulation at knee		27598
Amputation, leg, through tibia and fibula		27880-27886
Amputation, ankle, through malleoli of tibia and fibula		27888
Ankle disarticulation		27889
Amputation, foot		28800-28805
Amputation, toe		28810-28825

CPT = Current Procedural Terminology; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification.