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Reduced Cost Sharing for Preventive Drugs Preferentially Benefits Low Income Patients with Diabetes in High Deductible Health Plans with Health Savings Accounts: A Natural Experiments for Translation in Diabetes (NEXT-D2) Study

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Abstract

Background—High deductible health plans linked to Health Savings Accounts (HSA-HDHPs) must include all care under the deductible except for select preventive services. Some employers and insurers have adopted Preventive Drug Lists (PDLs) that exempt specific classes of medications from deductibles.

Objectives—We examine the association between shifts to PDL coverage and medication utilization **among patients with diabetes in HSA**-HDHPs.

Research Design—Natural experiment comparing pre-post changes in monthly and annual outcomes in matched study groups.

Subjects—Intervention group included 1744 commercially-insured HSA-HDHP patients with diabetes age 12–64 switched by employers to PDL coverage; control group included 3349 propensity-matched HSA-HDHP patients whose employers offered no PDL.

Measures—Outcomes were out-of-pocket (OOP) cost for medications and number of pharmacy fills converted to 30-day equivalents.

Results—Transition to the PDL was associated with a relative pre-post decrease of $612 (−35%, p<0.001) in per-member OOP medication expenditures; OOP reductions were higher for key classes of antidiabetic and cardiovascular medicines listed on the PDL; the policy did not affect unlisted classes. The PDL group experienced relative increases in medication use of 6.0 30-day fills per person during the year (+11.2%, p<0.001); the increase was more than twice as large for lower income (+6.6 fills,+12.6%, p<0.001) than higher income (+3.0 fills, +5.1%, p=0.024) patients.

Conclusions—Transition to a PDL which covers important classes of medication to manage diabetes and cardiovascular conditions is associated with substantial annual OOP cost savings for

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patients with diabetes and increased utilization of important classes of medications, especially for lower income patients.

Keywords

high deductible health plans; health savings accounts; preventive drug lists; cost sharing; disparities

Introduction

Diabetes mellitus is associated with substantial cardiovascular and kidney disease burden in the United States and is the seventh leading cause of death,[1–3] accounting for 25% of health care spending.[4] Patients with diabetes are frequently prescribed multiple medications to manage the disease and reduce its short-term and long-term complications.[3,5] but half fail to adhere after only six months of treatment.[6,7]

In recent years, commercial health plans have steadily increased annual health insurance deductibles, hoping to reduce unnecessary care and promote higher value care.[8–10] High deductible health plans (HDHPs) – defined as those with annual deductibles of at least $1000 – are growing rapidly and in 2018 nearly 60% of U.S. workers had HDHPs.[11] The 2003 Medicare Modernization Act created an option for linking HDHPs to Health Savings Accounts (HSA-HDHPs) into which employers and employees can contribute tax-free funds to pay for IRS-approved medical services.[12] HSA-HDHPs must include all care (including visits, tests, procedures, and medications) under the deductible.[12] HSA-HDHPs are the fastest growing type of HDHP, covering 19% of commercially-insured persons in 2018.[11]

Studies have shown for decades that increasing patient out-of-pocket (OOP) costs can decrease both necessary and unnecessary medical care;[13,14] our group and others have shown that high cost sharing in HDHPs can adversely affect timely care seeking, treatment, and outcomes for chronic illness.[15–18] Because they need to pay the full cost of medications until their annual deductible is met, patients in HSA-HDHPs are particularly susceptible to negative effects of increased cost-sharing, such as medication discontinuation or underuse.[19,20]

Section 223 of the Internal Revenue Code allows preventive services to be exempt from annual deductibles in HSA-HDHP plans, but is not specific about which services qualify.[21,22] Many employers and insurers have developed Preventive Drug Lists (PDLs) that specify medications exempt from the deductible which can be dispensed with no or low copayments. As of 2013, >40% of large employers offered a preventive drug benefit in HSA-HDHPs, many covering the full cost of certain medications.[23,24] PDLs are a form of value-based insurance design (VBID) that encourages patients to use high-value services by offering them at lower cost. Such designs can improve adherence to chronic medications, although prior studies have mostly examined a narrow range of therapies in single large employers or small health plans.[25–27]

In this study, we examine the impact of PDLs implemented by mid-sized and large employers among patients with diabetes in a large national health plan. We hypothesize that

patients in HSA-HDHPs pay lower OOP medication costs after their employers adopt a PDL, resulting in increased utilization of medicines covered by the PDL, as well as increases in non-covered medicines due to OOP savings. We also hypothesize that these effects will be larger among lower income patients.

Methods

Study design

Our study, which is part of the Natural Experiments in Diabetes Translation (NEXT-D2) network, compares longitudinal changes in outcomes between propensity matched cohorts of commercially-insured patients with diabetes. Some employers switched all members to an HSA-HDHP plan with a PDL that covered diabetes and other cardiovascular medications, while other employers continued to offer only HSA-HDHPs without a PDL. We examined utilization for one year before and after the plan anniversary date (index date) when employers made this coverage decision.

Our design and analysis approaches follow recommendations for rigorous analysis of natural experiments.[28,29] We used an interrupted time series with comparison group study design. After examining baseline equivalence of propensity-matched study groups, we compared monthly outcome trends for one year before and after the index date. We then used difference-in-differences analysis to assess the magnitude and significance of changes in utilization between the baseline and follow-up years, and survival analysis to compare rates of new treatment in the follow-up year among patients without baseline use of specific medication classes.

Study Population

Our study population included commercially-insured members with diabetes enrolled in a large national health plan between 1/2005–12/2014; members with any other type of insurance coverage (e.g., Medicare or Medicaid) have been excluded from the database. Data captured in the Commercial and Medicare Advantage claims database included details on enrollment (including information on the employer of the policy subscriber) and all medical and pharmacy claims of employees and family members. Our study cohort was defined by first identifying employers offering HSA-HDHPs, then identifying members with diabetes working for those employers.

Using the presence of an individual deductible amount of at least $1000 as the criterion for a high deductible plan, we first defined employers with high-deductible coverage as those offering exclusively plans with annual deductibles of ≥$1000,[11] which were identified according to previously described methods (see details in Supplemental Digital Content (SDC), Section 1). Briefly, we used a variable specifying deductible level available for smaller employers (≤100 employees); for larger employers, we imputed deductible levels using OOP spending amounts on claims. The data vendor provided a variable identifying members with HSAs.

The PDL lists offered by the national insurer in our data are of two basic types – core and expanded – but employers can modify their contents. Medicines and supplies to treat

diabetes are included only on the expanded list, while medicines to treat hypertension and hyperlipidemia are on both lists (SDC, Tables 1 and 2). We had no direct measure of whether employers offered a PDL in a given benefit year, so we used deductible and copayment amounts on medication claims for all members in each employer's account to impute the presence of a PDL covering diabetes medicines.

Our PDL imputation methods are detailed in SDC, Section 2. We first identified all eligible employers (n=51,365) that offered HSA-HDHPs for two consecutive 12-month benefit years. We identified all products on the PDLs using the First DataBank National Drug Data File Plus™ (First DataBank, Inc., San Bruno, CA), and then for the eligible employers, we extracted information from pharmacy claims on deductibles and copayments paid for medications listed on the core and expanded PDLs as well as for unlisted products.

Using rules based on the percentages of claims with deductibles and copayments for PDL-listed and unlisted medications, we identified benefit years in which eligible employers offered an expanded PDL. Our study population ("PDL switchers") included members in employer HSA-HDHP plans without a PDL for a full baseline year who were then switched to an HSA-HDHP with an expanded PDL for a full follow-up year. Our control population comprised members working for employers that continued to offer only an HSA-HDHP without a PDL for two consecutive years; for members with multiple pairs of years, we randomly selected a single pair for inclusion in the study.

We identified all patients with diabetes age 12–64 using a standard claims-based algorithm (see SDC-3 and SDC Table 3). To be eligible, patients needed to be employees or covered family members insured by an eligible employer at the index date, have previously diagnosed diabetes, and be continuously enrolled for 12 months before and after that date. Our eligible sample included 1760 PDL switchers and 32,835 control pool members (Table 1).

To further minimize selection effects, we matched PDL switchers 1:2 with controls using a 0.2 caliper.[30,31] Our matching approach used both employer-level and member-level variables to predict the likelihood that a member worked for an employer that switched to PDL coverage (see SDC-4). Our final sample included 1744 PDL switchers with diabetes and 3349 matched controls; propensity matching increased similarity with respect to gender, income, race/ethnicity, region of residence, rates of baseline medication use, calendar year of the index date, baseline deductible amount, and employer size (see Table 1; similar results by income subgroup are in SDC Table 5).

Study outcome measures

We assessed changes in several OOP medication classes used for chronic illnesses (SDC Table 4): oral antidiabetics, insulin, and diabetes test strips (most on the expanded PDL); antihypertensives and lipid lowering medications (most on both the core and expanded PDL); other cardiovascular medications and asthma medications (some on the expanded PDL); and antidepressants and antiulcer medications (none on either PDL).

Our primary outcome measures are OOP payments for medicines and number of 30-day dispensings (i.e., days' supply converted to 30-day equivalents). We examined monthly and yearly rates of these measures among patients who initiated the respective medication at baseline; for patients who received no medication in a particular therapeutic class at baseline, we examined the rate of treatment initiation in that class after the index date.

Covariates

We used employer-level and patient-level covariates (definitions in SDC-5) for propensity matching, adjusting statistical models, and creating analytic subgroups. At the employer level, we included contract anniversary date (index date), employer size (number of insured members), and type of change in HDHP deductible category ($1000-$2499; ≥$2500; ≥ $1000 but level undetermined) from baseline to follow-up. For members, we included age, sex, and U.S. region of residence. We included a measure of household socioeconomic status derived from geocodes supplied by our data vendor linked to 2008–2012 American Community Survey (ACS) data, grouped for analysis as lower vs. higher income based on ≥10% vs. <10% of households below the federal poverty standard,[16, 17] and a measure of race/ethnicity that blended data on neighborhood racial concentration (grouped as ≥75% white, ≥75% black, or ≥75% Hispanic)[34,35] combined with Asian and Hispanic ethnicity data from Ethnic Technologies.[36] We used members' baseline data to derive Johns Hopkins Adjusted Clinical Group® (ACG®) System comorbidity scores (version 10.0.1),[37] and defined high vs. low comorbidity as ≥3.0 and <3.0, respectively. Patients treated with insulin or 3 or more oral antidiabetic medications at baseline were defined as having severe diabetes, with others classified as non-severe.

Our primary subgroup of interest was patients living in lower income communities; based on our previous studies of HDHPs,[15,38,39] we hypothesized that lower income patients would experience greater relative changes in OOP costs and medication utilization with the adoption of a PDL than higher income patients. In secondary analyses, we also compared subgroups with higher vs. lower levels of comorbidity, severe vs. non-severe diabetes, and those living in predominantly white (≥75%) vs. non-white neighborhoods.

Analysis

We compared baseline characteristics of our study groups using standardized differences.[40] Among patients who used each medication class at baseline, we first displayed monthly data on OOP cost and utilization to examine equivalence of baseline trends and to visualize intervention effects; we then used generalized estimating equation (GEE) models[41,42] and difference-in-difference analysis to examine changes in outcomes from baseline to the follow-up year. Among individuals who did not use a medication class at baseline, we used Cox proportional hazard models[43] to examine group differences in time (in months after the index date) until initiating a new treatment in the class. We adjusted all statistical models for the variables used in propensity matching.

Results

Table 1 describes the characteristics of our study population. A majority of both study groups were male (57%), over age 45 (79%), had ACG scores <3.0 (79%), and lived in predominantly white (61%) neighborhoods. Nearly one-half (47%) lived in lower income neighborhoods and 42% were from the South. More than four-fifths of employer-mandated switches within HSA-HDHPs from no PDL to PDL coverage (81%) took place from 2012–2014. Most patients took oral antidiabetics (59%), antihypertensives (61%), and lipid lowering medications (54%) at baseline, while nearly one-fourth (24%) were on insulin.

Baseline CPI-adjusted OOP expenditures on medications in both groups (Figure 1, left top) followed a cyclical pattern typical of patients covered by HSA-HDHPs, with higher monthly expenditures in the first quarter (~$150-$175 per member) which decreased during the year as more patients met their annual deductibles; by the last quarter, average monthly OOP medication expenditures were much lower (~$50-$60 per member). Following the switch in coverage, the PDL group had substantially lower OOP expenditures at all points in the year, while HSA-HDHP members who remained without PDLs had essentially the same annual expenditures as during the baseline period; these patterns were similar in both income subgroups (Figure 1, left middle and bottom).

On an annual basis (Table 2, left), the PDL and control groups has comparable baseline OOP medication expenditures ($1249 vs. $1295, respectively) groups; expenditures were somewhat higher in the higher income ($1399 vs. $1486, respectively) than in the lower income ($1158 vs $1201, respectively) subgroups. Transition to the PDL was associated with a relative decrease of $612 (−35%, p<0.001) in overall OOP medication expenditures in the follow-up year; OOP reductions were generally higher for medicines covered by the expanded PDL (oral antidiabetics, insulin, diabetes test strips, lipid lowering medications, antihypertensives), and nonsignificant for non-covered classes (antidepressants, ulcer medications).

All patient subgroups experienced similar percentage reductions in OOP costs for PDL medications, although the amount of OOP savings differed substantially depending on baseline expenditure level (Table 2, SDC Table 6). For example, for oral antidiabetic medications, OOP savings were $338 vs. $233 for higher vs. lower income subgroups, respectively, and $419 vs. $252 for patients living in white vs. non-white neighborhoods.

When their OOP expenditures fell, the PDL group increased their 30-day fills (Figure 1, right top), amounting to a relative increase of 6.0 additional 30-day fills per member for all medicines during the year (+11.2%, p<0.001). The relative increase in utilization (Table 2, right) was more than twice as large in the lower income subgroup (+6.6 fills,+12.6%, p<0.001) than the higher income subgroup (+3.0 fills, +5.1%, p=0.024). The lower income subgroup increased utilization between 11% and 20% for oral antidiabetics, insulin, diabetes test strips, lipid lowering medications, and antihypertensives (Table 2, right; SDC Figure 1); higher income members experienced smaller relative increases in each class except diabetes test strips. Increases in the unlisted medications for depression and ulcers were consistently nonsignificant. Relative increases in utilization of key therapeutic classes were higher for

patients with severe diabetes but did not differ consistently by white vs. nonwhite race or lower vs, higher morbidity level (SDC Table 6).

PDL switchers were more likely to initiate new treatments sooner. For the six classes of medications covered by the PDL (Figure 2, top 6), HSA-HDHP PDL members initiated medications at higher rates than controls throughout the follow-up year, although only the increases for insulin (hazard ratio=1.40, 95%CI=[1.02, 1.92]) and diabetes test strips (1.54, [1.26, 1.89]) were statistically significant; for two classes not covered (Figure 2, bottom 2), control group members had slightly higher rates of new treatment in the follow-up year. Lower income patients had significantly higher rates of insulin initiation after switching to the PDL, while both lower and higher income subgroups both had significant increases in initiation of diabetes monitoring (Table 3).

Discussion

Transitions to a PDL that covers medications to manage diabetes and other important cardiovascular conditions were associated with substantial annual OOP cost savings for patients with diabetes, substantial increases in utilization of important therapeutic classes of medications, and lower barriers to initiating treatment. Utilization increases for key classes of medicines were larger and potentially more important for lower income patients, who are more likely to underuse medicines due to cost thus increasing their risk for adverse clinical outcomes. Overall savings in OOP spending were much larger for patients with severe diabetes, primarily due to savings on insulin.

Compared to controls, the $612 relative reduction in OOP costs for PDL patients represented a savings of 35% of predicted OOP expenditures on medications during the follow-up year based on observed utilization in the non-PDL group. The largest OOP savings in every subgroup were for medications to manage diabetes. For patients taking insulin, which has experienced rapidly escalating costs in recent years,[44] average OOP savings were $661 for that medication alone.

Although OOP savings were not large, reduced cost sharing under the PDL resulted in a 23% relative increase in use of diabetes test strips and supplies. When faced with decisions about allocating OOP resources, patients in HSA-HDHPs without PDLs may choose to forego spending on home glucose monitoring compared to when monitoring supplies are free. Increases in medication use were concentrated in the therapeutic classes subsidized under the PDL and did not appear to spill over into unlisted classes like antidepressants or antiulcer medications.

High cost sharing can deter patients from continuing medications (secondary nonadherence), but also can delay adoption of new ones (primary nonadherence).[45] Earlier post-PDL initiation of new treatment in a class by PDL members could indicate they started prescriptions previously unfilled due to cost, or had greater willingness to add a new subsidized therapy when it was prescribed in the normal course of clinical treatment. In the overall sample, hazard ratios are generally positive for most PDL-listed medication classes, indicating more rapid initiation of therapy among PDL switchers. Increased rates of

treatment initiation appear limited to covered classes and do not extend to classes not on the PDL. However, these analyses are limited by length of follow-up and the relatively small samples of untreated patients, especially for classes widely used at baseline such as antihypertensive or lipid lowering medications; only a relatively small subset of patients would be “exposed” to the PDL in this way, so effects may be more difficult to detect with only one year of follow-up.

Most studies of VBIDs have examined reduced copayments for a limited range of medications, usually in a single employer. This study is unique in examining a cost sharing reduction that is broad, covering >500 high value medications; deep, with OOP savings equal to the full price of the medicine while under the deductible; and widespread, currently adopted by thousands of employers. The observed success of this type of VBID in reducing OOP costs and increasing utilization of key therapies across a range of employers points to an approach that can reduce disparities and potentially achieve better health outcomes. Unfortunately, we have no information about how the insurer or individual employers communicated with members about the addition of the PDL. Future work should address whether communication about new benefits or access to user-friendly planning tools can improve member knowledge about benefits and enhance the positive impacts of PDLs.

One important question we sought to address was whether all patients with diabetes shared equally in the benefits of PDL coverage.[46] Reduced cost sharing can sometimes increase disparities,[47] although studies of some VBID programs have shown that reducing cost sharing for statins[48] or cardiovascular medications following myocardial infarction[49] reduced racial disparities. Our primary subgroup of interest was lower income patients, for whom high levels of medication cost sharing present the greatest deterrent to use. Lower income patients spent less OOP than their higher income counterparts at baseline in both the PDL (by 17%) and control (by 19%) groups. Following switch to PDL coverage, the lower income subgroup experienced a smaller reduction in OOP payments than the higher income subgroup ($519 vs. $692, respectively); however, their net increases in utilization were substantially higher (a gain of 6.6 vs. 3.0 fills per year, respectively), indicating that their baseline utilization may have been more constrained by the pre-existing HSA-HDHP coverage. Thus, although the monetary savings due to PDL coverage may favor higher income patients, the clinical impact of coverage may be greater for lower income groups who experienced prior disparities in use. Employers should consider tailored benefit designs that concentrate PDL coverage in lower income employees who may benefit most from such subsidized coverage.

Limitations

Our analyses are subject to several limitations inherent in natural experiment research. Assignment to PDL coverage was not random. We minimized potential imbalance by limiting the study to members whose employers offered no choice of health plan. The study examines the impact of transitioning to PDL coverage for patients already in an HSA-HDHP. We did not observe the earlier impact of entering HSA-HDHP coverage; HSA plans have lower premiums and may differentially attract certain types of members (e.g., lower income or those with lower comorbidity). Nevertheless, our propensity matching produced

samples that were comparable on measurable baseline characteristics, and results on the impacts of adding PDLs are likely generalizable to all HSA-HDHP members, whether self-selected or switched to that coverage without choice.

We had no direct measure of PDL exposure and used a claims-based algorithm to infer presence of a PDL. The patterns of medication expenditure we observed before and after the switch suggest that our algorithms reliably identified employers switching to PDLs, but we have no way to determine how many employers were missed, especially smaller employers with less claims experience. However, mis-assigning PDL employers to the control pool would have decreased the size of observed effects. We also have no data on employer or member HSA contributions or balances, which may affect how members make health care purchasing decisions. Members with larger HSA balances might be affected less by the cost sharing burden of HSA-HDHPs and thus less affected by the switch to a PDL. We had incomplete individual data on SES or race/ethnicity; however, our geographic SES measures are well-established proxies and have been validated in numerous other population-based studies.

Finally, this study only examines the effects of PDLs on medication OOP cost and utilization after a single year; studies of longer-term medication use and clinical outcomes will require larger samples and additional years of follow-up data. Future research is also needed to examine the impact of PDLs for those in non-HSA HDHPs or traditional low deductible insurance plans under which medicines require smaller member copayments. We hypothesize that PDLs would be associated with smaller out-of-pocket savings and utilization increases than those observed in this study; previous studies have examined the impact of reducing copayments for specific medications or a narrow range of medication classes, but not the broad, value-focused reductions across many therapy classes inherent in PDLs.

Conclusion

Preventive drug lists offer an effective strategy for employers and insurers to supplement coverage under HSA-HDHPs in order to lower member cost sharing and encourage use of key medications to manage chronic illnesses. For patients with diabetes, especially those with lower incomes, addition of a PDL to HSA-HDHP coverage resulted in substantial reductions in annual OOP costs, increased use of antidiabetic, antihypertensive, and antihyperlipidemic medications, and reduced barriers to initiating these therapies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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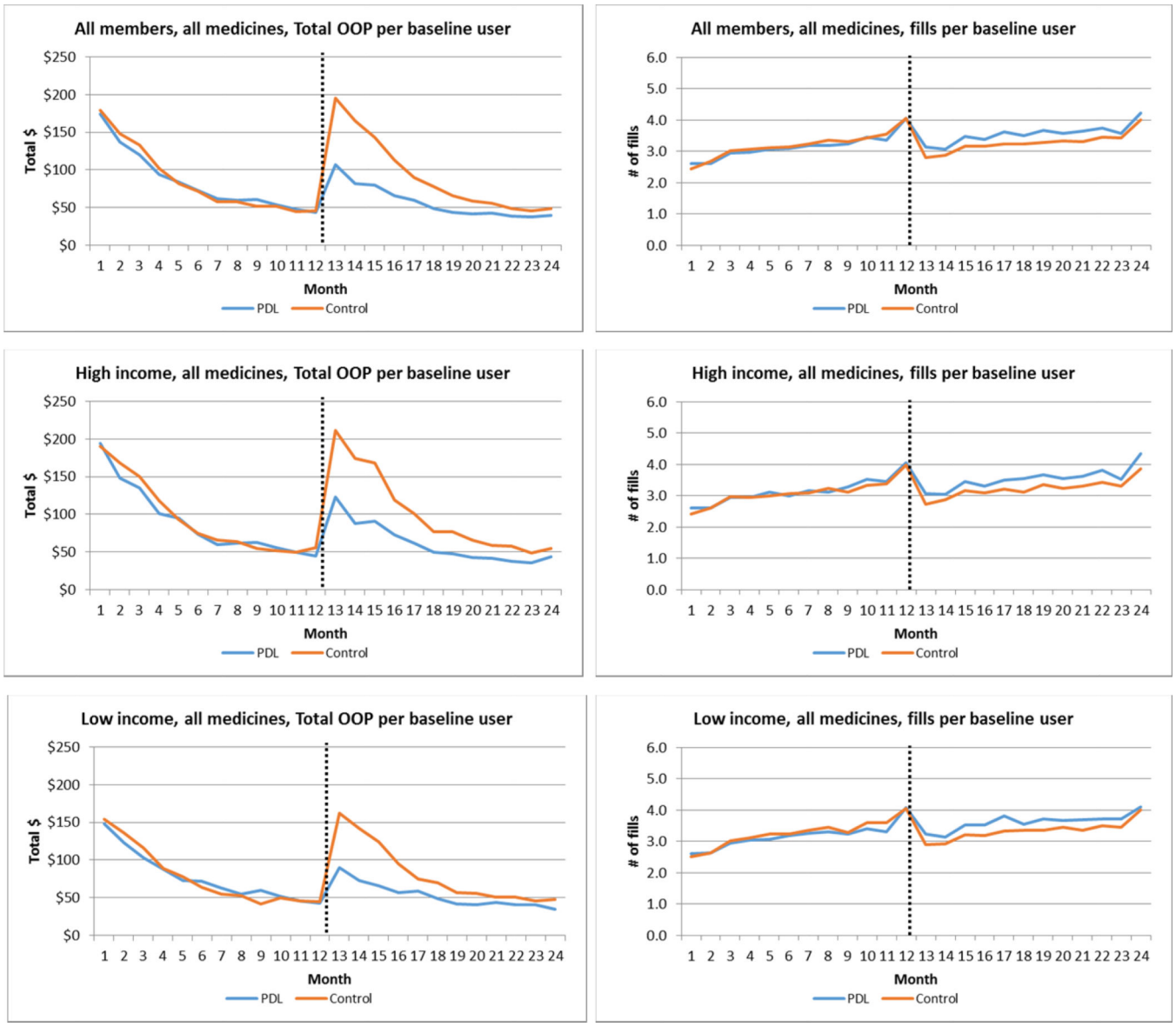

Figure 1.

Average monthly out-of-pocket costs for all medicines (left) and number of 30-day equivalent fills (right) for HSA-HDHP PDL switchers compared to non-PDL controls (top), and for higher income members (middle) and lower income members (bottom)

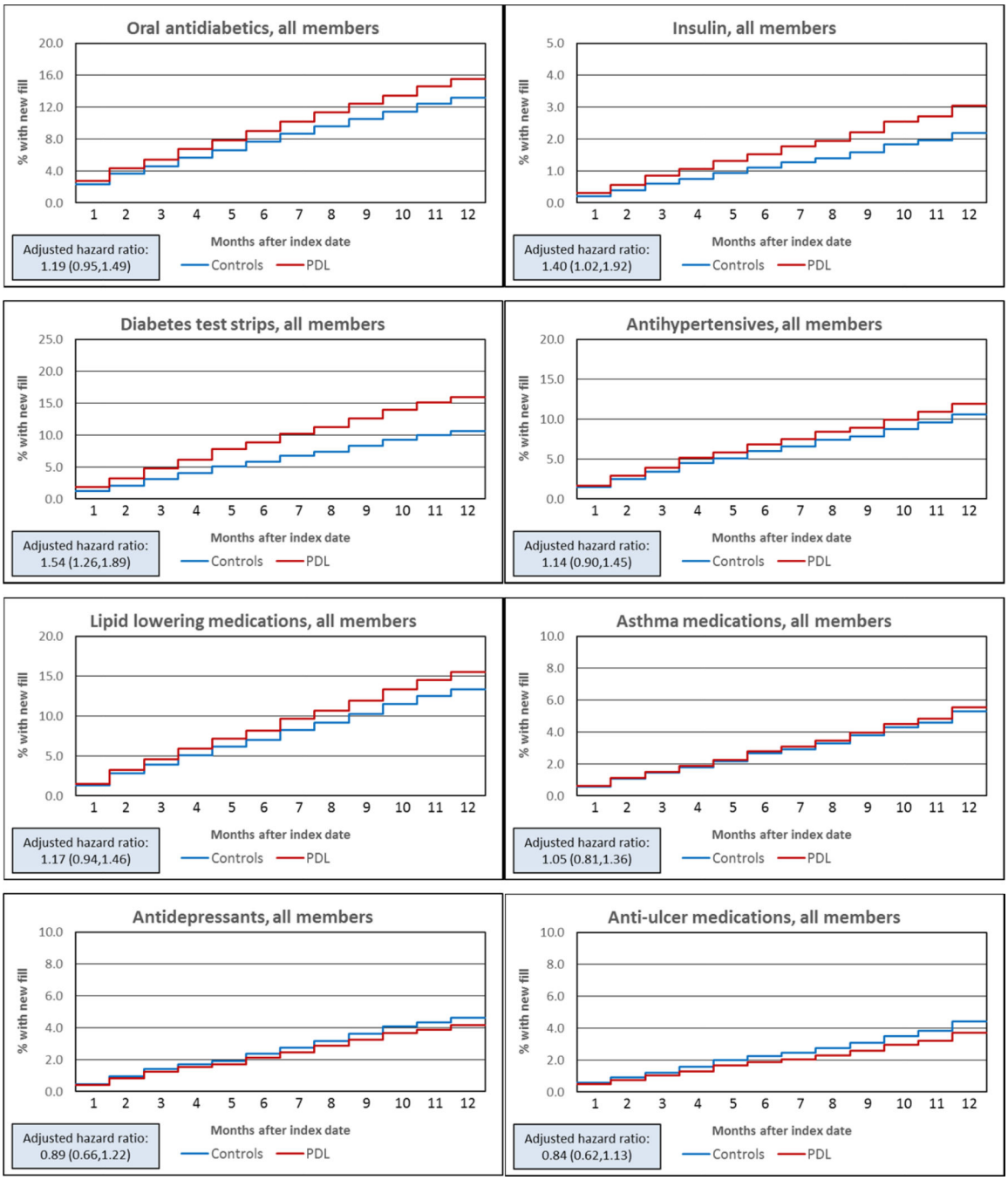

Figure 2.

Cumulative percentage of members initiating a new medication in a therapeutic class not taken at baseline by month and hazard ratios from Cox proportional hazard models, comparing HSA-HDHP members with and without a PDL

Table 1.

Baseline characteristics of PDL and control patients in the overall study population, before and after the propensity score match

	Before Propensity Matching					After Propensity Matching				
	PDL Group (N=1760)		Control Group (N=32835)		Std. Diff. *	PDL Group (N=1744)		Control Group (N=3349)		Std. Diff. *
Female gender, No. (%)	745	(42.3)	14698	(44.8)	−0.05	740	(42.4)	1444	(43.1)	−0.01
Age on index date, Mean (SD)	51	(10.0)	51	(10.4)	−0.01	51	(10.0)	51	(10.5)	−0.02
Age > 45 on index date, No. (%)	1390	(79.0)	25695	(78.3)	0.02	1374	(78.8)	2639	(78.8)	0.00
Neighborhood below-poverty level, No. %					0.08					0.06
<5%[1]	484	(27.5)	8228	(25.1)		476	(27.3)	882	(26.3)	
5%–9.9%[1]	469	(26.6)	9259	(28.2)		465	(26.7)	884	(26.4)	
10%–19.9%[2]	527	(29.9)	9993	(30.4)		524	(30.0)	1002	(29.9)	
>=20%[2]	280	(15.9)	5324	(16.2)		279	(16.0)	579	(17.3)	
Race/ethnicity, No. (%)[5]					0.19					0.09
Hispanic	174	(9.9)	2542	(7.7)		172	(9.9)	315	(9.4)	
Asian	73	(4.1)	1106	(3.4)		71	(4.1)	158	(4.7)	
Black neighborhood	45	(2.6)	559	(1.7)		45	(2.6)	81	(2.4)	
Mixed neighborhood	406	(23.1)	6035	(18.4)		400	(22.9)	754	(22.5)	
White neighborhood	1062	(60.3)	22568	(68.7)		1056	(60.6)	2040	(60.9)	
Region, No. (%)					0.26					0.07
West	352	(20.0)	4308	(13.1)		345	(19.8)	608	(18.2)	
Midwest	528	(30.0)	12767	(38.9)		527	(30.2)	1063	(31.7)	
South	724	(41.1)	13648	(41.6)		718	(41.2)	1397	(41.7)	
Northeast	156	(8.9)	2082	(6.3)		154	(8.8)	280	(8.4)	
ACG score, Mean (SD) **	2.0	(3.1)	1.9	(2.9)	0.04	2.0	(3.1)	2.1	(3.1)	−0.03
ACG score ≥ 3.0, No. (%)	352	(20.0)	6105	(18.6)	0.04	349	(20.0)	729	(21.8)	−0.04
Baseline OOP on medicines, Mean $ (SD)	800	(907)	947	(1049)	−0.15	802	(908)	792	(913)	0.01
Any baseline use, No. (%)										
Any oral antidiabetic use	1050	(59.7)	18791	(57.2)	0.05	1036	(59.4)	1946	(58.1)	0.00
Any insulin use	435	(24.7)	6251	(19.0)	0.14	428	(24.5)	777	(23.2)	0.00
Any antihypertensive use	1085	(61.6)	19734	(60.1)	0.03	1072	(61.5)	2057	(61.4)	0.00
Any antihyperlipidemic use	971	(55.2)	16738	(51.0)	0.08	959	(55.0)	1777	(53.1)	0.04
Baseline medication fills, Mean (SD)										
Mean oral antidiabetic 30-day fills	7.2	(8.9)	6.2	(8.1)	0.12	7.1	(8.8)	7.1	(9.2)	0.00
Mean insulin 30-day fills	2.5	(5.3)	1.7	(4.5)	0.15	2.5	(5.3)	2.4	(5.4)	0.01

	Before Propensity Matching					After Propensity Matching				
	PDL Group (N=1760)		Control Group (N=32835)		Std. Diff. *	PDL Group (N=1744)		Control Group (N=3349)		Std. Diff. *
Mean antihypertensive 30-day fills	9.2	(11.8)	8.6	(10.8)	0.06	9.2	(11.7)	9.3	(11.6)	−0.01
Mean antihyperlipidemic 30-day fills	5.4	(6.6)	4.9	(6.6)	0.08	5.4	(6.6)	5.3	(6.8)	0.01
Calendar year of index date, No. (%)					0.70					0.17
2006–2008	108	(6.1)	4914	(15.0)		108	(6.2)	145	(4.3)	
2009–2011	196	(11.1)	10858	(33.1)		196	(11.2)	528	(15.8)	
2012–2014	1456	(82.7)	17052	(51.9)		1440	(82.6)	2675	(79.9)	
Baseline deductible amount, No (%)	−				0.36					0.08
$1000-$2499	501	(28.5)	12984	(39.5)		501	(28.7)	1038	(31.0)	
$2500+	443	(25.2)	9750	(29.7)		440	(25.2)	888	(26.5)	
$1000+ (level uncertain)	816	(46.4)	10101	(30.8)		803	(46.0)	1423	(42.5)	
Employer size, (No. %)					0.72					0.05
Less than 100 Employees	382	(21.7)	13917	(42.4)		382	(21.9)	746	(22.3)	
101–500 Employees	263	(14.9)	9004	(27.4)		263	(15.1)	546	(16.3)	
501–2500 Employees	435	(24.7)	5371	(16.4)		433	(24.8)	850	(25.4)	
2500+ Employees	680	(38.6)	4543	(13.8)		666	(38.2)	1207	(36.0)	

Abbreviations: ACG, Adjusted Clinical Group; PDL, Preventive Drug List; OOP, out of pocket.

[1] Defined as high-income.

[2] Defined as lower income.

[3] See manuscript for definition of race/ethnicity categories.

* Lower standardized differences indicate greater similarity.

** An ACG Score of 1.0 represents the mean score of the reference population

Table 2.

Number of baseline users, baseline out-of-pocket spending and number of 30-day fills among baseline users, and relative adjusted difference in difference estimates, by study group (all members, higher income, lower income) and therapeutic class

	Number of Baseline users		Total OOP (CPI-adjusted)						30d fills per year					
			Baseline		Follow-up		Relative change &		Baseline		Follow-up		Relative change &	
	PDL	Control	PDL	Control	PDL	Control	Percent	p-value	PDL	Control	PDL	Control	Percent	p-value
All members &&														
All medications	1667	3121	$1,249	$1,295	$1,107	$1,766	**−34.9%**	**0.000**	47.7	47.7	59.4	53.4	**11.2%**	**0.000**
Oral antidiabetic	1036	1946	$387	$364	$276	$611	**−57.5%**	**0.000**	12.6	12.5	15.6	13.7	**12.7%**	**0.000**
Insulin	428	777	$718	$787	$317	$1,047	**−66.9%**	**0.000**	10.7	10.6	12.8	10.7	**17.8%**	**0.000**
Diabetes test strip	657	1298	$162	$179	$55	$154	**−60.6%**	**0.000**	5.3	5.9	5.0	4.5	**22.5%**	**0.000**
Lipid lowering	959	1777	$206	$256	$122	$273	**−44.4%**	**0.000**	10.3	10.2	11.8	10.8	**8.2%**	**0.001**
Antihypertensive	1072	2057	$131	$177	$85	$197	**−41.3%**	**0.000**	15.9	16.2	18.9	17.8	**8.5%**	**0.001**
Other cardiovascular	141	320	$201	$290	$100	$256	**−43.5%**	**0.003**	10.0	9.4	11.0	8.8	17.4%	0.057
Asthma	219	387	$174	$178	$90	$137	**−32.9%**	**0.004**	5.6	5.4	5.8	4.7	**20.6%**	**0.042**
Antidepressant	380	736	$146	$133	$160	$149	−2.0%	0.852	10.2	9.6	10.0	9.4	0.1%	0.983
Ulcer	265	518	$181	$114	$150	$109	−12.6%	0.351	7.6	7.3	7.4	6.9	4.0%	0.422
All other	1456	2795	$332	$302	$391	$397	**−10.4%**	**0.036**	13.8	13.8	15.9	14.4	**9.8%**	**0.000**
Higher income &&														
All medications	896	1650	$1,399	$1,486	$1,231	$2,010	**−34.9%**	**0.000**	48.1	47.2	58.3	54.4	**5.1%**	**0.024**
Oral antidiabetic	555	1027	$416	$368	$301	$592	**−55.0%**	**0.000**	12.9	13.0	15.4	14.9	4.7%	0.204
Insulin	226	393	$755	$815	$311	$1,209	**−72.3%**	**0.000**	10.4	10.5	12.2	11.5	6.6%	0.220
Diabetes test strip	343	687	$177	$206	$61	$155	**−54.0%**	**0.000**	5.5	5.6	5.3	4.2	**31.7%**	**0.000**
Lipid lowering	530	966	$234	$317	$129	$328	**−46.9%**	**0.000**	10.8	10.6	12.0	11.4	3.0%	0.326
Antihypertensive	564	1055	$145	$212	$89	$217	**−40.1%**	**0.000**	15.7	16.2	18.6	18.0	6.3%	0.059
Other cardiovascular	79	161	$247	$258	$134	$253	**−44.4%**	**0.028**	9.7	9.0	10.7	9.3	7.2%	0.517
Asthma	118	199	$307	$222	$169	$196	**−37.9%**	**0.011**	6.3	5.6	6.0	5.3	2.0%	0.867
Antidepressant	207	389	$152	$167	$177	$176	11.2%	0.537	10.0	9.9	9.9	9.5	3.0%	0.551
Ulcer	141	250	$214	$133	$158	$156	**−36.7%**	**0.003**	8.0	7.6	7.9	7.4	2.1%	0.747
All other	766	1463	$373	$347	$440	$439	−6.6%	0.342	14.3	13.3	16.2	14.4	4.7%	0.109
Lower income &&														
All medications	756	1446	$1,158	$1,201	$1,031	$1,593	**−32.8%**	**0.000**	45.9	45.9	58.9	52.2	**12.6%**	**0.000**
Oral antidiabetic	478	898	$346	$391	$241	$520	**−47.4%**	**0.000**	11.4	11.5	14.5	12.5	**16.8%**	**0.000**
Insulin	199	329	$684	$767	$308	$957	**−63.9%**	**0.000**	10.1	9.8	12.1	10.2	**15.6%**	**0.027**
Diabetes test strip	307	567	$166	$160	$52	$137	**−63.2%**	**0.000**	5.0	5.7	4.5	4.3	**20.2%**	**0.024**

	Number of Baseline users		Total OOP (CPI-adjusted)						30d fills per year					
			Baseline		Follow-up		Relative change &		Baseline		Follow-up		Relative change &	
	PDL	Control	PDL	Control	PDL	Control	Percent	p-value	PDL	Control	PDL	Control	Percent	p-value
Lipid lowering	419	774	$224	$249	$146	$274	**−41.0%**	**0.000**	9.9	9.7	11.8	10.5	**11.4%**	**0.008**
Antihypertensive	504	984	$115	$160	$80	$193	**−42.3%**	**0.000**	15.6	15.7	18.8	17.4	**8.7%**	**0.015**
Other cardiovascular	65	150	$177	$199	$72	$184	**−56.0%**	**0.001**	10.1	9.1	11.0	8.5	16.0%	0.221
Asthma	101	181	$110	$168	$37	$152	**−62.8%**	**0.000**	5.9	6.0	5.8	5.1	16.1%	0.269
Antidepressant	174	333	$144	$118	$136	$119	−6.6%	0.625	10.0	9.5	10.0	9.6	−1.1%	0.840
Ulcer	122	225	$145	$99	$119	$101	−19.8%	0.180	7.3	7.0	6.8	6.7	−1.8%	0.819
All other	678	1280	$321	$313	$377	$383	−4.1%	0.581	13.2	14.2	15.3	14.6	**12.3%**	**0.002**

Abbreviations: HDHP, high deductible health plan; HSA, health savings account, PDL, Preventive Drug List.

*Rate per 100 person-years; & marginal estimates of adjusted relative difference in difference from GEE models; **&&** Overall group and income subgroups were separately propensity matched; **Bold** = p-value ≤ 0.05

Table 3:

Sample sizes, unadjusted rates of use at 12 months post, and hazard ratios * (95% CIs) for time until starting a new medication class in the follow-up year, comparing HSA-HDHP members with and without PDLs, by therapeutic category and population subgroup

Medication Class		All members	Higher income	Lower income	ACG <3.0	ACG ≥3.0	Severe DM	Non-severe DM	White	Non-white
Oral antidiabetics	n of PDL, control	708, 1403	374, 718	323, 679	572, 1127	134, 257	202, 345	502, 1031	423, 861	287, 531
	rates at 12 months	15.5, 13.2	10.2, 8.7	15.3, 12.9	13.8, 11.4	8.6, 3.8	1.0, 0.4	11.0, 9.3	16.1, 12.8	7.7, 7.1
	HR (95% CI)	1.19 (0.95,1.49)	1.18 (0.84,1.68)	1.20 (0.87,1.66)	1.23 (0.95,1.60)	**2.36 (1.22,4.55)**	**2.43 (1.22,4.84)**	1.19 (0.92,1.53)	1.28 (0.95,1.73)	1.07 (0.73,1.57)
Insulin	n of PDL, control	1316, 2572	703, 1352	602, 1248	1087, 2113	228, 434	123, 269	NA	789, 1574	525, 1009
	rates at 12 months	3.0, 2.2	0.7, 0.6	1.1, 0.6	2.2, 1.4	0.0, 0.0	1.0, 0.5	2.8, 2.1	2.8, 2.1	1.8, 1.0
	HR (95% CI)	**1.40 (1.02,1.92)**	1.23 (0.77,1.94)	**1.86 (1.16,3.00)**	**1.60 (1.11,2.30)**	1.47 (0.71,3.07)	1.96 (0.93,4.10)	1.34 (0.93,1.93)	1.36 (0.89,2.08)	**1.70 (1.03,2.82)**
Diabetes test strips and supplies	n of PDL, control	1087, 2051	586, 1058	494, 1010	909, 1712	180, 325	188, 330	897, 1715	644, 1253	442, 831
	rates at 12 months	16.0, 10.7	15.2, 11.8	10.4, 7.4	15.6, 11.6	5.3, 2.6	3.8, 2.6	13.9, 9.7	18.6, 13.2	12.0, 9.1
	HR (95% CI)	**1.54 (1.26,1.89)**	**1.31 (1.01,1.69)**	**1.42 (1.04,1.95)**	**1.37 (1.10,1.71)**	**2.07 (1.23,3.47)**	1.44 (0.98,2.12)	**1.48 (1.16,1.87)**	**1.46 (1.14,1.85)**	1.35 (0.95,1.91)
Antihyperlipidemic	n of PDL, control	785, 1572	399, 779	382, 803	646, 1343	140, 254	188, 362	596, 1207	457, 915	328, 673
	rates at 12 months	15.5, 13.4	9.9, 9.7	14.0, 12.4	14.0, 13.2	0.7, 0.5	6.7, 7.4	15.7, 13.1	17.6, 13.2	10.5, 12.3
	HR (95% CI)	1.17 (0.94,1.46)	1.03 (0.74,1.42)	1.14 (0.84,1.55)	1.07 (0.84,1.36)	1.62 (0.94,2.79)	0.90 (0.55,1.47)	1.22 (0.94,1.57)	**1.37 (1.03,1.81)**	0.85 (0.58,1.23)
Antihypertensive	n of PDL, control	672, 1292	365, 690	297, 593	581, 1206	91, 148	155, 311	515, 1008	397, 764	272, 548
	rates at 12 months	11.9, 10.6	9.2, 7.1	11.2, 11.1	14.3, 15.3	2.0, 1.4	4.1, 2.9	8.8, 7.7	12.2, 11.7	6.1, 5.4
	HR (95% CI)	1.14 (0.90,1.45)	1.31 (0.93,1.84)	1.02 (0.72,1.44)	0.93 (0.72,1.20)	1.43 (0.70,2.91)	1.44 (0.85,2.46)	1.14 (0.87,1.49)	1.05 (0.76,1.44)	1.15 (0.78,1.70)

Medication Class		All members	Higher income	Lower income	ACG <3.0	ACG ≥3.0	Severe DM	Non-severe DM	White	Non-white
Other cardiovascular	n of PDL, control	1603, 3029	850, 1584	736, 1427	1330, 2526	268, 494	488, 876	1116, 2125	968, 1878	631, 1167
	rates at 12 months	1.0, 1.0	0.5, 0.5	0.7, 0.8	0.5, 0.4	0.0, 0.0	0.0, 0.0	0.4, 0.6	0.3, 0.3	0.0, 0.0
	HR (95% CI)	1.02 (0.70,1.48)	0.89 (0.54,1.46)	0.92 (0.52,1.63)	1.14 (0.72,1.78)	1.40 (0.63,3.13)	**2.23 (1.16,4.26)**	0.66 (0.40,1.11)	1.03 (0.67,1.60)	0.92 (0.43,1.96)
Asthma	n of PDL, control	1525, 2962	811, 1546	700, 1396	1256, 2434	265, 530	488, 876	1036, 2080	929, 1839	594, 1140
	rates at 12 months	5.6, 5.3	4.6, 4.2	4.1, 4.7	4.5, 4.4	1.5, 1.1	1.6, 1.6	4.1, 3.2	3.9, 2.9	0.5, 0.7
	HR (95% CI)	1.05 (0.81,1.36)	1.11 (0.78,1.58)	0.88 (0.59,1.30)	1.02 (0.75,1.40)	1.38 (0.82,2.33)	1.01 (0.64,1.60)	1.29 (0.93,1.78)	1.37 (0.99,1.88)	0.77 (0.46,1.28)
Antidepressant	n of PDL, control	1364, 2613	722, 1356	627, 1244	1139, 2181	221, 438	406, 765	958, 1861	802, 1574	560, 1024
	rates at 12 months	4.2, 4.6	2.9, 2.8	2.0, 2.2	3.4, 3.6	0.2, 0.1	0.2, 0.2	1.7, 1.7	4.5, 4.4	0.3, 0.3
	HR (95% CI)	0.89 (0.66,1.22)	1.04 (0.67,1.60)	0.91 (0.58,1.42)	0.94 (0.65,1.36)	1.33 (0.72,2.45)	1.04 (0.60,1.81)	1.04 (0.71,1.53)	1.03 (0.71,1.51)	0.82 (0.47,1.43)
Ulcer	n of PDL, control	1479, 2831	788, 1495	679, 1352	1238, 2362	241, 468	460, 826	1021, 1985	897, 1738	583, 1095
	rates at 12 months	3.7, 4.4	1.1, 1.3	1.8, 1.8	1.9, 1.8	0.0, 0.0	3.8, 3.5	1.3, 1.4	1.2, 1.6	1.5, 1.2
	HR (95% CI)	0.84 (0.62,1.13)	0.86 (0.55,1.34)	0.97 (0.64,1.49)	1.04 (0.73,1.47)	0.75 (0.39,1.43)	1.11 (0.66,1.86)	0.95 (0.65,1.39)	0.79 (0.53,1.15)	1.28 (0.76,2.14)

Abbreviations: HDHP, high deductible health plan; HSA, Health Savings Account; PDL: Preventive Drug List; DM, diabetes mellitus; ACG, Adjusted Clinical Groups score.

*Estimates from Cox proportional hazards models that compare time until initiation of a medication class in the follow-up year in PDL vs. control members, adjusted for age, gender, race, poverty, diabetes severity, and ACG score. **bold** = PDL vs. non-PDL controls p<0.05