

# The Value of Value-Based Insurance Design: Savings From Eliminating Drug Co-Payments

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**T**he rising cost of healthcare has forced employers, payers, and policy makers to seek innovative ways to meet this challenge. Consequently, the concept of value-based insurance design (VBID) has gained popularity. VBID is generally characterized by the reduction of financial barriers to the purchase of services that provide “high value,” such as use of lower-cost medications and preventive screenings. In theory, the investment of providing such high-value benefits would be more than offset by the avoidance of more expensive medical events.<sup>1</sup> To the extent that consumer cost sharing limits access to the high-value care,<sup>2,3</sup> this is a plausible hypothesis.

To date, VBID—in the context of prescription drugs—has demonstrated improved medication adherence and certain health-related outcomes, but no obvious cost savings.<sup>4-7</sup> In this study, we examined a version of VBID designed by Geisinger Health System (GHS), in collaboration with Geisinger Health Plan (GHP), implemented as a part of its overall employee health and wellness program called MyHealth Rewards (MHR). The evaluation of MHR as a composite intervention has been published previously.<sup>8</sup> In our study, we focused on the VBID component of MHR that has eliminated co-payments of select prescription drugs for eligible GHS employees.

MHR includes the following key features: 1) health risk assessment—a Web-based questionnaire to identify opportunities for self-improvements; 2) disease and case management—employees with a confirmed diagnosis of selected chronic conditions are eligible to participate in disease management programs with nurses hired and supervised by GHP. Those experiencing more serious conditions are assigned to GHP’s case management programs, which provide more intensive care management services; 3) financial incentives; and 4) \$0 co-pay medications—GHS employees participating in MHR with the eligible chronic conditions may choose to receive \$0 co-pay medications from a list of approximately

## ABSTRACT

**Objectives:** To estimate the cost impact of a \$0 co-pay prescription drug program implemented by a large healthcare employer as a part of its employee wellness program.

**Study Design:** A \$0 co-pay program that included approximately 200 antihypertensive, antidiabetic, and antilipid medications was offered to Geisinger Health System (GHS) employees covered by Geisinger Health Plan (GHP) in 2007. Claims data from GHP for the years 2005 to 2011 were obtained. The sample was restricted to continuously enrolled members with Geisinger primary care providers throughout the study period.

**Methods:** The intervention group, defined as 2251 GHS employees receiving any of the drugs eligible for \$0 co-pay, was propensity score matched based on 2 years of pre-intervention claims data to a comparison group, which was defined as 3857 non-GHS employees receiving the same eligible drugs at the same time. Generalized linear models were used to estimate differences in terms of per-member-per-month (PMPM) claims amounts related to prescription drugs and medical care.

**Results:** Total healthcare spending (medical plus prescription drug spending) among the GHS employees was lower by \$144 PMPM (13%; 95% CI, \$38-\$250) during the months when they were taking any of the eligible drugs. Considering the drug acquisition cost and the forgone co-pay, the estimated return on investment over a 5-year period was 1.8.

**Conclusions:** This finding suggests that VBID implementation within the context of a wider employee wellness program targeting the appropriate population can potentially lead to positive cost savings.

*Am J Manag Care.* 2016;22(2):116-121

200 drugs designated for high blood pressure, cholesterol, and diabetes management after meeting the annual deductible of \$50 per member. The number of drugs eligible for the \$0 co-pay program has increased over time: in 2007, there were 133 such drugs for hypertension, 25 for cholesterol, and 42 for diabetes. By 2011, there were 142, 26, and 45, respectively (see [eAppendix 1](#) [eAppendices available at [www.ajmc.com](http://www.ajmc.com)] for the complete list of eligible drugs).

MHR participation is strictly voluntary. All GHS employees covered by GHP are eligible to participate in the health-risk assessment program; however, only those with the select chronic conditions are eligible to participate in the \$0 co-pay program, the disease management programs, and the financial incentives. Note, however, the nurse-based disease and case management programs are not unique to MHR; GHP uses these programs across all its membership, not just for the MHR participants. What is unique, is the fact that these programs are used in conjunction with other MHR program components. MHR is available to all GHS employees and their dependents as long as the employees maintain their health plan coverage through GHP.

We hypothesized that the introduction of the \$0 co-pay drug program increased patient adherence to medication therapies, which, in turn, led to reductions in exacerbations and use of acute care, such as hospitalization and emergency department (ED) visits. Thus, we tested the hypothesis that during the months when GHS employees were taking 1 or more of the drugs eligible for \$0 co-pay, their total cost of care was lower compared with those months when non-GHS employees were taking drugs from the same list of drugs eligible for the \$0 co-pay program (ie, the drugs that would have qualified for \$0 co-pay had these comparison employees been GHS employees at that time).

## Data

The data were obtained from GHP commercial claims data from 2005 through 2011, which include 2-year pre-intervention data (2005 and 2006), along with 5-year post-intervention follow-up data. The intervention group was defined as those GHP members who were employees of GHS throughout the study period (ie, in both the pre- and post-intervention periods). The control group was therefore defined as those GHP members who were not employees of GHS throughout the study period. More specifically, the following criteria were applied:

## Take-Away Points

- To date, value-based insurance design (VBID), in the context of prescription drugs, has demonstrated little to no cost savings.
- In this study, we examine a version of VBID implemented by Geisinger Health System, which was implemented as a part of its overall employee health and wellness program called MyHealth Rewards program.
- The results indicate that Geisinger's \$0 co-pay drug program for its chronically ill employee population was associated with positive cost savings and a 5-year return on investment of approximately 1.8.
- VBID implementation within the context of a wider employee wellness program targeting the appropriate population can potentially lead to positive cost savings.

Inclusion criteria: 1) continuous GHP membership from January 1, 2005, through December 31, 2011, and 2) GHP commercial population aged 18 to 64 years.

Exclusion criteria: 1) switched employment between GHS and non-GHS employers at any point during the study period (this ensures that selection of the GHS-employee cohort is not correlated with the implementation of MHR), 2) had a non-GHS primary care provider at any point during the study period (this reduces variation in provider practice styles and referral patterns that may confound the comparison), and 3) did not use any drugs eligible for the \$0 co-pay program at any point during the study period (this increases the likelihood that the GHS and non-GHS cohorts are as close to each other as possible in terms of the presence of the relevant chronic conditions by effectively removing the population for whom the \$0 co-pay program was never intended).

After applying these inclusion and exclusion criteria, 2251 GHS employees in the intervention group, and 3857 non-GHS employees in the comparison group, were included in the final analytic sample.

## METHODS

First, we used a propensity score-matching method to stratify the sample into 7 mutually exclusive strata based on the following set of baseline (ie, pre-2007) characteristics: 2-year mean per-member-per-month (PMPM) total cost of care, age, and gender. Second, we estimated 2 generalized linear regression models with log-link function and gamma distribution: one for the prescription drug cost and the other for the medical cost measured on a PMPM basis. Cost of care was defined as the “allowed amount”—the sum of GHP's direct payment to providers and the members' out-of-pocket costs in terms of co-pays, deductibles, and coinsurance. Note, for the prescription drug costs for the GHS employees, their drug-allowed amounts reflected the \$0 co-pay if they were eligible and had participated in the program.

The main explanatory variables were the GHS-employee binary indicator variable, and the binary indicator variable that equals 1 if the member in each month received any drug that appeared in the list of those eligible for the \$0 co-pay program in a given month (as determined by the fill date in his or her pharmacy claims data) and 0 otherwise. Note that a value of 1 in the \$0 co-pay drug indicator variable does not indicate that the member actually paid \$0 co-pay for that drug; rather, it indicates that the member had received 1 or more of the drugs that would have been eligible for the \$0 if the member had participated in the \$0 co-pay program. Also, the variable does not take into consideration the days' supply information. That is, if a member had filled a 90-day supply, as opposed to a 30-day supply, it is not assumed that the member had continued to take the drug for the 2 months following the month of the fill because it is not possible to ascertain from the data whether the member had actually done so. This is likely to underestimate the \$0 co-pay drug impact and, therefore, may lead to more conservative estimates of the impact.

The key explanatory variable, therefore, is the interaction term between the GHS-employee variable and the \$0 co-pay-eligible drug indicator variable. This interaction effect captures any additional differences in cost of care between the GHS and non-GHS employees, above and beyond their baseline differences, and the general impact of receiving \$0 co-pay-eligible drugs observed in both groups. A negative coefficient in the interaction term will imply that the \$0 co-pay program was associated with a behavior change among the GHS employees in relation to how they use and interact with those \$0 co-pay-eligible drugs (ie, GHS employees, for instance, might have been not only more likely to fill their prescriptions for the \$0 co-pay-eligible drugs, but also less likely to skip or delay daily dose once the drugs were in their possession).

The effect of the \$0 co-pay drug program is confounded by the other components of MHR, as described above. To account for these confounders, the regression models include, as a covariate, an indicator variable for whether the individual was enrolled in MHR in each given month during the study period. This variable captures the composite MHR effect relative to the periods when the members were not enrolled in it. Because the \$0 co-pay drug program was a component of MHR, this MHR enrollment variable likely absorbs at least some of the \$0 co-pay drug program effect; as such, it may be considered a conservative approach to estimating the program effect.

Other covariates include indicator variables for whether the member was enrolled in GHP's disease/case management (DM/CM) program, medical home sta-

tus (ie, whether the member's primary care clinic was a medical home or not at each month of observation), age, age-squared, gender, presence of 9 comorbid conditions (chronic kidney disease, coronary artery disease, chronic obstructive pulmonary disease, hypertension, diabetes, asthma, cancer, congestive heart failure, and depression), year and month (to capture secular trends and seasonality), as well as the 7 propensity score strata and indicators for whether the individual had experienced any myocardial infarction, stroke, hospitalization, and/or ED visits during the pre-intervention period.

The regression-adjusted "observed" cost was obtained by calculating the regression-adjusted values for each GHS-employee member-month observations. The corresponding "expected" cost was then calculated by setting the interaction effect between the GHS employee and \$0 co-pay-eligible drug indicator variables to 0 and recalculating the regression-adjusted cost values. The difference between the observed and expected values represent the cost savings, if any. The standard errors around the differences between the observed and expected costs were obtained via a bootstrap method with 200 replications.

In addition, we estimated a logistic regression model that examined whether the GHS-employee cohort was more likely to obtain the \$0 co-pay-eligible drugs than the non-GHS-employee cohorts. Several earlier studies<sup>5,7,9,10</sup> already established the positive association between VBID and medication adherence. Nevertheless, we used this logistic regression model to confirm this association. The covariates included in the logistic regression model were identical to the ones included in the cost models, except the DM/CM and MHR enrollment indicator variables. These 2 covariates were not included because, as noted earlier, enrollment in MHR and DM/CM was a requirement for the \$0 co-pay program eligibility and, as a result, these variables were highly correlated with the \$0 co-pay drug indicator variable by definition. (See [eAppendix 2](#) for the full regression model specification and the output. For a more detailed description of the methodology, see [eAppendix 2](#) "Note on Methodology" and "Sensitivity Analysis.")

## RESULTS

**Table 1** suggests that, at the baseline, there were statistically significant unadjusted differences between the GHS- and the non-GHS-employee cohorts: the proportion of females, the percent overall who were admitted to a hospital at any point during the baseline period, and the mean total PMPM cost of care were slightly higher among the GHS-employee cohort, whereas the non-GHS-employee

cohort was on average slightly older than the GHS-employee cohort, had slightly higher number of comorbid conditions, and had higher prevalence of hypertension and diabetes. During the follow-up period between 2007 and 2011, there was a large increase in the proportion of GHS employees enrolled in DM/CM as a result of the MHR implementation (Table 1).

Furthermore, due to the implementation of Geisinger's advanced patient-centered medical homes (PCMHs) at around the same time, Table 1 shows that a greater proportion of the non-GHS-employee cohort in our data was exposed to PCMHs than the GHS-employee cohort (30% vs 16%). It also suggests that there were statistically significant differences in the proportions of the sample obtaining the \$0 co-pay-eligible drugs, although the differences are small in magnitude.

Table 2 shows the regression-adjusted odds ratio of the GHS-employee cohort obtaining \$0 co-pay-eligible drugs in a given month of observation, relative to the non-GHS-employee cohort, as obtained from the logistic regression model described earlier. Consistent with the prior expectation, it indicates that over the study period, the GHS employees had 8% higher odds of obtaining \$0 co-pay-eligible drugs than their non-GHS counterparts, which was statistically significant at 5% level. In particular, in 2009 and 2010, the GHS employees had 11% and 16% higher odds of obtaining \$0 co-pay-eligible drugs, respectively.

Table 3 shows selected key regression coefficient estimates obtained from the main model. The positive and significant coefficients on the \$0 co-pay-eligible drug indicator variable, in both the prescription drug and medical costs, suggest that during the months when the GHS- and non-GHS-employee cohorts had received the \$0 co-pay-eligible drugs, their corresponding costs were significantly higher than in other months. This suggests either incidence of the chronic conditions for which the drugs were intended to treat, or occurrence of some adverse events associated with the chronic conditions. Table 3 also shows that the GHS-employee cohort incurred higher drug and medical costs than the non-GHS-employee cohort, as indicated by the positive and statistically significant coefficient estimates on the GHS-employee indicator variable (0.18 and 0.24 in the main prescription drug cost and the medical cost models, respectively;  $P < .5$ ).

Yet, we find negative and statistically significant coefficient estimates on the interaction term between the GHS-employee indicator and the \$0 co-pay-eligible drug indicator variables. This implies that during the months when the GHS-employee cohort received the \$0 co-pay-eligible drugs, their cost of care was lower than that of the

■ **Table 1. Descriptive Statistics**

Sample Characteristics (2005-2006 unadjusted)	Non-GHS Employees	GHS Employees	P
Unique members, <sup>a</sup> n	3857	2251	
Mean medical cost \$PMPM	300	372	<.01
Mean Rx cost \$PMPM	131	100	<.01
Age, years	48	47	<.01
Female	48.9%	55.0%	<.01
Enrolled DM/CM	4.6%	3.8%	.13
Any hospital admission	9.5%	11.6%	.01
Any emergency visits	24.2%	24.3%	.89
Had MI	6.1%	8.4%	.20
Had stroke	8.0%	8.6%	.76
Average count of comorbidities <sup>b</sup>	0.75	0.65	<.01
CKD	0.4%	0.4%	.86
CAD	5.2%	4.6%	.25
COPD	1.6%	1.1%	.10
Hypertension	37.9%	31.3%	<.01
Diabetes	11.8%	9.3%	<.01
Asthma	5.8%	6.8%	.14
Cancer	2.5%	2.7%	.60
Depression	9.9%	8.8%	.14
CHF	0.5%	0.6%	.87

Sample Characteristics (2007-2011 unadjusted)	Non-GHS Employees	GHS Employees	P
PMPM observations, <sup>a</sup> n	231,420	135,060	
Enrolled in DM/CM	4.5%	25.6%	<.01
Enrolled in MHR	0.0%	25.1%	<.01
Eligible med: hypertension	32.4%	33.6%	<.01
Eligible med: cholesterol	22.5%	20.3%	<.01
Eligible med: diabetes	8.4%	8.6%	.05
Any eligible med was used	46.6%	46.3%	.06
In PCMH	30.1%	15.8%	<.01

CAD indicates coronary artery disease; CHF, congestive heart failure; CKD, chronic kidney disease; DM/CM, case/disease management; COPD, chronic obstructive pulmonary disease; GHS, Geisinger Health System; med, medication; MHR, MyHealth Rewards; MI, myocardial infarction; PCMH, patient-centered medical home; \$PMPM, cost per-member-per-month.

<sup>a</sup>Sample is restricted to Geisinger Health Plan members who took any eligible medication at any point during the observation period.

<sup>b</sup>Minimum count was 0 and maximum was 9.

non-GHS-employee cohort when they also received the \$0 co-pay-eligible drugs.

Table 4 summarizes the estimated cost savings associated with the \$0 co-pay program for the GHS-employee cohort as calculated based on the coefficients shown in Table 3. The estimated average drug cost savings across

**Table 2. Odds Ratio of Obtaining \$0 Co-Pay–Eligible Drugs: Non-GHS Versus GHS Employees**

	Odds Ratio	P
2007	1.03	.45
2008	1.09	.04
2009	1.11	.01
2010	1.16	<.01
2011	1.04	.34
Overall	1.08	.02

GHS indicates Geisinger Health System.

all years between 2007 and 2011 was about \$29 PMPM, which is not statistically significant at 5% level. There is, however, a statistically significant medical cost savings of \$115 PMPM. Combining the estimated drug and medical cost savings, there is an estimated total cost savings of \$144 PMPM (about 13%), which is also statistically significant at 5% level.

Based on the estimated cost savings shown in Table 4, we calculated the return on investment (ROI), as shown in Table 5. Note that cost savings shown in Table 4 were estimated for the months when GHS employees obtained \$0 co-pay–eligible drugs. Thus, to calculate the return portion of ROI, the estimated PMPM cost savings in Table 4 were multiplied by the total counts of the member-month observations during which the GHS employees received \$0 co-pay–eligible drugs in each year (Table 5, second column). This yields the total savings, which is shown in the fourth column of Table 5. To calculate the investment portion of the ROI, the total forgone co-pay amount for each year was combined with the total drug acquisition cost (ie, the cost paid by GHP to purchase the drugs) for that year. Dividing total savings by the total drug spending yielded an overall ROI of about 1.8.

## DISCUSSION

A recent study<sup>11</sup> suggests that even relatively low out-of-pocket cost sharing can be a significant source of patient nonadherence with the drug therapies that can effectively prevent exacerbations and, thus, reduce utilization of high-cost care. Geisinger’s experience with its VBID design—which effectively makes some of these medications free to the targeted high-risk population—demonstrates that the promise of VBID as not only a quality

improvement, but also a cost-saving strategy, may indeed be real if implemented within the right setting. The observed cost savings of the VBID in this study is likely to be attributable to the fact that, rather than implementing the VBID as a stand-alone strategy, the employer (GHS) had specifically aimed at changing the patient behavior and engagement with their medications within the context of a comprehensive employee wellness program.

It is important to note that the drugs that were selected to be eligible for the \$0 co-pay program were those that are largely preventive in nature of acute exacerbations associated with unmanaged chronic conditions. For such drugs to be effective, they need to be taken by patients at the required dose and timing.<sup>12</sup> This study reports significant cost of care savings despite the fact that GHS employees were only moderately more likely to fill \$0 co-pay–eligible drug prescriptions than non-GHS employees (Table 2). This likely implies a change in the behavior among GHS employees during the period when the drugs were in their possession in terms of greater compliance with required dose and timing—a phenomenon that cannot accurately be captured by pharmacy fill-data alone.<sup>12</sup>

## Limitations

This study has several imitations. First, the analysis relies on observational data from artificially constructed cohorts. Second, because the VBID was implemented as a part of a wider employee health and wellness program, it is inherently difficult to separate the pure VBID effect from that of other components. Also, our results may be

**Table 3. Selected Generalized Linear Model Regression Results**

	Rx Cost		Medical Cost	
	GLM Coefficient	Standard Error*	GLM Coefficient	Standard Error*
Eligible med	0.90	0.05	0.23	0.04
GHS employee	0.18	0.08	0.24	0.05
GHS × eligible	−0.14	0.08	−0.14	0.06

GHS indicates Geisinger Health System; GLM, generalized linear model; med, medication.  
\*Clustered standard errors are reported to reflect repeated observations of each member.

**Table 4. Estimated Cost of Care Among GHS Employees When Receiving \$0 Co-Pay–Eligible Drugs**

	Observed Mean \$PMPM	Expected Mean \$PMPM	Difference (95% Bootstrap CI)
Rx cost	189	218	−29 (−64 to 6)
Medical cost	774	890	−115 (−214 to −17)
Total cost	964	1108	−144 (−250 to −38)

GHS indicates Geisinger Health System; \$PMPM, cost per-member-per-month.

■ **Table 5.** Calculation of Return on Investment

Year	Member-Month Observations, n	Total Cost PMPM Savings (\$)	Total Savings (\$)	Drug Spending <sup>a</sup> (\$)	ROI
2007	24,952	98	2,451,783	1,802,391	1.4
2008	28,804	123	3,537,125	2,362,420	1.5
2009	32,703	143	4,668,667	2,736,266	1.7
2010	35,113	160	5,633,217	2,814,831	2.0
2011	37,814	177	6,675,105	2,904,496	2.3
All years	159,386	144	22,963,302	12,620,404	1.8

PMPM indicates per-member-per-month; ROI, return on investment.  
<sup>a</sup>Sum of drug acquisition cost and the forgone co-pay amounts.

construed as an “intention-to-treat” effect rather than a pure treatment effect because it is not possible from our data to explicitly account for the member selection effect of lower-cost drugs.

## CONCLUSIONS

This finding suggests that VBID implementation within the context of a wider employee wellness program targeting the appropriate population can potentially lead to net positive cost savings. We note, however, this study does not examine the long-term impact of VBID. To do so, a different methodological approach is necessary to account for the employees’ choice to enroll and disenroll from the program, as well as its changing design (eg, changes in the number of \$0 co-pay–eligible drugs) over time. This is an important area for future research, as the long-term success of VBID depends on its ability to induce permanent changes in patient behaviors.

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**Source of Funding:** None; all work related to this study was done as a part of the authors’ employment with Geisinger Health System.

**Author Disclosures:** Drs Maeng and Snyder and Mr Pitcavage are employees of Geisinger Health System. Dr Davis reports no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

**Authorship Information:** Concept and design (DDM, SRS); acquisition of data (JMP); analysis and interpretation of data (DDM); drafting of the manuscript (DDM, JMP, SRS, DED); critical revision of the manuscript for important intellectual content (DDM, JMP, SRS, DED); statistical analysis (DDM); administrative, technical, or logistic support (JMP); and supervision (DED).

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**eAppendix 1.** List of Drugs Eligible for \$0 Co-Pay Program (1 = eligible for the given year; 0 = ineligible for the given year)

<b>Hypertension Drugs</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
ACEBUTOLOL HCL	1	1	1	1	1
ACETAZOLAMIDE	1	1	1	1	1
AMILIDE HCL	1	1	1	1	1
AMILIDE HCL W/HCTZ	1	1	1	1	1
AMLODIPINE	0	1	1	1	1
ATENOLOL	1	1	1	1	1
ATENOLOL W/CHLTHALIDONE	1	1	1	1	1
BENAZEPRIL HCL	1	1	1	1	1
BENAZEPRIL HCL-HCTZ	1	1	1	1	1
BISOPROLOL AND HCTZ	1	1	1	1	1
BUMETANIDE	1	1	1	1	1
CAPTOPRIL	1	1	1	1	1
CAPTOPRIL/HYDROCHLOTHIAZIDE	1	1	1	1	1
CARVEDILOL	0	1	1	1	1
CHLOTHIAZIDE	1	1	1	1	1
CHLTHALIDONE	1	1	1	1	1
CLONIDINE HCL	1	1	1	1	1
DILTIAZEM ER	1	1	1	1	1
DILTIAZEM HCL	1	1	1	1	1
DOXAZOSIN MESYLATE	1	1	1	1	1
ENALAPRIL	1	1	1	1	1
ENALAPRIL AND HCTZ	1	1	1	1	1
FELODIPINE	1	1	1	1	1
FOSINOPRIL SODIUM	1	1	1	1	1
FOSINOPRIL-HYDROCHLOTHIAZIDE	1	1	1	1	1
FUROSEMIDE	1	1	1	1	1
GUANABENZ ACETATE	1	1	1	1	1
GUANFACINE HCL	1	1	1	1	1
HYDRALAZINE HCL	1	1	1	1	1
HYDROCHLOTHIAZIDE	1	1	1	1	1
INDAPAMIDE	1	1	1	1	1
ISOSBIDE DINITRATE	1	1	1	1	1
ISOSBIDE MONONITRATE	1	1	1	1	1
LABETALOL HCL	1	1	1	1	1
LISINOPRIL	1	1	1	1	1
LISINOPRIL-HCTZ	1	1	1	1	1
LISINOPRIL-HYDROCHLOTHIAZIDE	1	1	1	1	1
LOSARTAN	0	0	0	0	1

LOSARTAN WITH HCTZ	0	0	0	0	1
METHYLDOPA	1	1	1	1	1
METHYLDOPA/HYDROCHLOTHIAZIDE	1	1	1	1	1
METOLAZONE	1	1	1	1	1
METOPROLOL SUCCINATE	1	1	1	1	1
METOPROLOL TARTRATE	1	1	1	1	1
METOPROLOL-HYDROCHLOTHIAZIDE	1	1	1	1	1
MINOXIDIL	1	1	1	1	1
MOEXIPRIL HCL	1	1	1	1	1
NADOLOL	1	1	1	1	1
NICARDIPINE HCL	1	1	1	1	1
NIFEDIPINE	1	1	1	1	1
NIFEDIPINE ER	1	1	1	1	1
PINDOLOL	1	1	1	1	1
PRAZOSIN HCL	1	1	1	1	1
PROPRANOLOL HCL	1	1	1	1	1
PROPRANOLOL HCL W/HCTZ	1	1	1	1	1
QUINAPRIL	1	1	1	1	1
QUINAPRIL AND HCTZ	1	1	1	1	1
RAMIPRIL	0	0	0	0	1
SOTALOL	1	1	1	1	1
SOTALOL AF	1	1	1	1	1
SOTALOL HCL	1	1	1	1	1
SPIRONOLACTONE	1	1	1	1	1
SPIRONOLACTONE AND HCTZ	1	1	1	1	1
TERAZOSIN HCL	1	1	1	1	1
TIMOLOL MALEATE	1	1	1	1	1
TSEMIDE	1	1	1	1	1
TRANDOLAPRIL	0	0	0	0	1
TRIAMTERENE W/HCTZ	1	1	1	1	1
TRIAMTERENE-HCTZ	1	1	1	1	1
VERAPAMIL	0	0	0	0	1
VERAPAMIL HCL	1	1	1	1	1
ACCUPRIL	1	1	1	1	1
CARDIZEM CD	1	1	1	1	1
INDERAL LA	1	1	1	1	1
PROCARDIA XL	1	1	1	1	1
ACCURETIC	1	1	1	1	1
CARDIZEM SR	1	1	1	1	1
INSPIRA	1	1	1	1	1
SECTRAL	1	1	1	1	1

ACEON	1	1	1	1	1
CARDURA	1	1	1	1	1
ISOPTIN SR	1	1	1	1	1
TARKA	1	1	1	1	1
ADALAT CC	1	1	1	1	1
CEG	1	1	1	1	1
KERLONE	1	1	1	1	1
TEKTURNA	0	0	0	1	1
ALDACTAZIDE	1	1	1	1	1
CEG CR	0	0	0	0	1
LASIX	1	1	1	1	1
TENMIN	1	1	1	1	1
ALDACTONE	1	1	1	1	1
CGARD	1	1	1	1	1
LEXXEL	1	1	1	1	1
TEVETEN	1	1	1	1	1
ALTACE	1	1	1	1	1
COZAAR	1	1	1	1	1
LOPRESS	1	1	1	1	1
TOPROL XL	1	1	1	1	1
ATACAND	1	1	1	1	1
DEMADEX	1	1	1	1	1
LOPRESS HCT	1	1	1	1	1
TRANDATE	1	1	1	1	1
ATACAND HCT	0	0	0	1	1
DILAC XR	1	1	1	1	1
LOTENSIN	1	1	1	1	1
UNIVASC	1	1	1	1	1
AVALIDE	1	1	1	1	1
DIOVAN	1	1	1	1	1
LOTENSIN HCT	1	1	1	1	1
VALTURNA	0	0	0	0	1
AVAPRO	1	1	1	1	1
AZOR	0	0	0	1	1
DIOVAN HCT	1	1	1	1	1
LOTREL	1	1	1	1	1
VASERETIC	1	1	1	1	1
VASERETIC AZ	0	0	0	0	1
DIURIL	1	1	1	1	1
MAVIK	1	1	1	1	1
VASOTEC	1	1	1	1	1

BENICAR	1	1	1	1	1
DYAZIDE	1	1	1	1	1
MICARDIS	1	1	1	1	1
VERELAN	1	1	1	1	1
BENICAR HCT	0	0	0	1	1
DYNACIRC	1	1	1	1	1
MICARDIS HCT	0	0	0	1	1
VERELAN PM	1	1	1	1	1
BYSTOLIC	0	0	0	0	1
DYNACIRC CR	1	1	1	1	1
MONOPRIL	1	1	1	1	1
ZAROXOLYN	1	1	1	1	1
CALAN SR	1	1	1	1	1
EXFGE*	0	0	0	1	1
NIMOTOP	1	1	1	1	1
ZEBETA	1	1	1	1	1
CAPOTEN	1	1	1	1	1
EXFGE HCT	0	0	0	1	1
NVASC	1	1	1	1	1
ZESTETIC	1	1	1	1	1
CARDENE	1	1	1	1	1
HYTRIN	1	1	1	1	1
PLENDIL	1	1	1	1	1
ZESTRIL	1	1	1	1	1
CARDENE SR	1	1	1	1	1
HYZAAR	1	1	1	1	1
PRINIVIL	1	1	1	1	1
ZIAC	1	1	1	1	1
CARDIZEM	1	1	1	1	1
INDERAL	1	1	1	1	1
PRINZIDE	1	1	1	1	1

<b>Cholesterol Drugs</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
CHOLESTYRAMINE	1	1	1	1	1
LOVASTATIN	1	1	1	1	1
CHOLESTYRAMINE LIGHT	1	1	1	1	1
PRAVASTATIN SODIUM	1	1	1	1	1
COLESTIPOL	1	1	1	1	1
SIMVASTATIN	1	1	1	1	1
GEMFIBROZIL	1	1	1	1	1

ADVIC	1	1	1	1	1
MEVAC	1	1	1	1	1
ANTARA	1	1	1	1	1
PRAVACHOL	1	1	1	1	1
CADUET	1	1	1	1	1
QUESTRAN	1	1	1	1	1
COLESTID	1	1	1	1	1
SIMC	0	0	0	0	1
CREST	1	1	1	1	1
TRIC	1	1	1	1	1
LESCOL	1	1	1	1	1
TRILIPIX	0	0	0	1	1
LESCOL XL	1	1	1	1	1
VYTIN	1	1	1	1	1
LIPIT	1	1	1	1	1
WELCHOL	1	1	1	1	1
LIVALO	0	0	0	0	1
ZETIA	1	1	1	1	1
LOFIBRA	1	1	1	1	1
ZOC	1	1	1	1	1
LOPID	1	1	1	1	1

<b>Diabetes Drugs</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
ACARBOSE	0	0	0	1	1
GLYBURIDE	1	1	1	1	1
CHLPROPAMIDE	1	1	1	1	1
GLYBURIDE MICRONIZED	1	1	1	1	1
GLIMEPIRIDE	1	1	1	1	1
GLYBURIDE-METFORMIN HCL	1	1	1	1	1
GLIPIZIDE	1	1	1	1	1
METFORMIN HCL	1	1	1	1	1
GLIPIZIDE ER	1	1	1	1	1
METFORMIN HCL ER	1	1	1	1	1
GLIPIZIDE XL	1	1	1	1	1
NATEGLINIDE	0	0	0	0	1
GLIPIZIDE-METFORMIN	1	1	1	1	1
TOLBUTAMIDE	1	1	1	1	1
ACTOPLUS MET	1	1	1	1	1
HUMALOG	1	1	1	1	1
ACTOS	1	1	1	1	1

HUMULIN INSULINS-ALL	1	1	1	1	1
AMARYL	1	1	1	1	1
JANUMET	0	0	0	1	1
APIDRA	1	1	1	1	1
JANUVIA	1	1	1	1	1
AVANDAMET	1	1	1	1	1
LANTUS	1	1	1	1	1
AVANDARYL	1	1	1	1	1
LEVEMIR	1	1	1	1	1
AVANDIA	1	1	1	1	1
METAGLIP	1	1	1	1	1
BYETTA	1	1	1	1	1
MICRONASE	1	1	1	1	1
DIABETA	1	1	1	1	1
NOVOLIN INSULINS-ALL	1	1	1	1	1
DIABINESE	1	1	1	1	1
NOVOLOG	1	1	1	1	1
GLUCOPHAGE	1	1	1	1	1
ONGLYZA	0	0	0	1	1
GLUCOPHAGE XR	1	1	1	1	1
PRANDIN	1	1	1	1	1
GLUCOTROL	1	1	1	1	1
PRECOSE	1	1	1	1	1
GLUCOTROL XL	1	1	1	1	1
STARLIX	1	1	1	1	1
GLUCOVANCE	1	1	1	1	1
SYMLIN	1	1	1	1	1
GLYNASE	1	1	1	1	1
VICTOZA	0	0	0	0	1
GLYSET	1	1	1	1	1

## eAppendix 2.

### Note on Methodology

The odds ratios shown in Table 2 were estimated via the following logistic regression model:

$$\Pr(\text{Elig}_{it} = 1) = \text{logit}(\beta_0 + \beta_1 \text{GHS}_{it} + \beta_2(\text{GHS}_{it} \times \text{Year}_t) + \beta_3 \text{Age}_{it} + \beta_4 \text{Age}_{it}^2 + \beta_5 \text{Female}_i + \beta_6 \text{PCMH}_{it} + \beta_7 \text{MIAny}_{it=0} + \beta_8 \text{StrokeAny}_{it=0} + \beta_9 \text{IPAny}_{it=0} + \beta_{10} \text{ERAny}_{it=0} + \beta_{11} \text{Chronic}_{it} + \beta_{12} \text{PSSstrata}_{it=0} + \beta_{13} \text{Month}_t)$$

where  $\text{Elig}_{it}$  equals 1 if member  $i$  had received any of the \$0 co-pay eligible drugs in a given month  $t$  and 0 otherwise;  $\text{GHS}_{it}$  equals 1 if member  $i$  was a GHS employee in month  $t$  and 0 otherwise;  $\text{GHS}_{it} \times \text{Year}_t$  represents a set of interaction effects between  $\text{GHS}_{it}$  and a set of year dummy variables;  $\text{Age}_{it}$  represents member  $i$ 's age in month  $t$ ;  $\text{Female}_i$  equals 1 if member  $i$  was female and zero if male;  $\text{PCMH}_{it}$  equal 1 if member  $i$  was in a patient-centered medical home in month  $t$  and 0 otherwise;  $\text{MIAny}_{it=0}$  equals 1 if member  $i$  had any MI during the pre-intervention period and 0 otherwise;  $\text{StrokeAny}_{it=0}$  equals 1 if member  $i$  had any stroke during the pre-intervention period and 0 otherwise;  $\text{IPAny}_{it=0}$  equals 1 if member  $i$  had any inpatient hospital admission during the pre-intervention period and 0 otherwise;  $\text{ERAny}_{it=0}$  equals 1 if member  $i$  had any ER visit during the pre-intervention period and 0 otherwise;  $\text{Chronic}_{it}$  represents a set of nine chronic condition dummy variables (chronic kidney disease, coronary artery disease, chronic obstructive pulmonary disease, hypertension, diabetes, asthma, cancer, depression, and congestive heart failure) for member  $i$  in month  $t$ ;  $\text{PSSstrata}_{it=0}$  represents a set of 8 indicator variables that represent the propensity score stratum (calculated based on the pre-intervention period characteristics) to which member  $i$  belongs; and  $\text{Month}_t$  represents a set of calendar month dummy variables.

To calculate the year-specific odds ratios, a linear combination of  $\beta_1$  and  $\beta_2$  corresponding to each calendar were calculated using the post-estimation LINCOM command in Stata version 13 (StataCorp, College Station, Texas). Because interaction effects in nonlinear models can be difficult to interpret,<sup>1</sup> a linear probability model in which the binary outcome variable  $\text{Elig}_{it}$  was treated as a continuous variable and the coefficients were estimated via the ordinary least square regression method was also estimated as a sensitivity check. The results (available upon request) were virtually identical to the results reported in Table 2. To obtain the overall all-year odds ratio (ie, the last row in Table 2), the same model was estimated without the  $\text{GHS}_{it} \times \text{Year}_t$  interaction effects but with the  $\text{Year}_t$  dummy variables entered separately; and only  $\beta_1$  was reported.

To obtain the estimated cost impact of the \$0 co-pay drug program, the following generalized linear regression model with log link and gamma distribution was estimated, with the variables defined same as above:

$$\text{Cost}_{it} = \alpha_0 + \alpha_1 \text{GHS}_{it} + \alpha_2 \text{Elig}_{it} + \alpha_3(\text{GHS}_{it} \times \text{Elig}_{it}) + \alpha_4 \text{CM/DM}_{it} + \alpha_5 \text{MHR}_{it} + \alpha_6 \text{Age}_{it} + \alpha_7 \text{Age}_{it}^2 + \alpha_8 \text{Female}_i + \alpha_9 \text{PCMH}_{it} + \alpha_{10} \text{MIAny}_{it=0} + \alpha_{11} \text{StrokeAny}_{it=0} + \alpha_{12} \text{IPAny}_{it=0} + \alpha_{13} \text{ERAny}_{it=0} + \alpha_{14} \text{Chronic}_{it} + \alpha_{15} \text{PSSstrata}_{it=0} + \alpha_{16} \text{Year}_t + \alpha_{17} \text{Month}_t + \varepsilon_{it}$$

where  $\text{MHR}_{it}$  equals 1 if member  $i$  had enrolled in Geisinger's MyHealth Rewards program in month  $t$  and 0 otherwise; and  $\text{CM/DM}_{it}$  equals 1 if member  $i$  had enrolled in GHP's case or disease management program in month  $t$  and 0 otherwise.  $\alpha_3$  is the coefficient of interest.

### **Sensitivity Analysis**

To check the robustness of our results, we estimated 2 alternative models. In the first alternative model, we examined whether the CM/DM impact was greater among the GHS employees than among the non-GHS employee, because the fact that CM/DM was offered in conjunction with other MHR program components may have increased its effectiveness, hence further confounding our results. To examine this, we included an interaction effect between the GHS employee indicator variable and the CM/DM indicator variable as an additional covariate to the main model. In the second alternative model, we excluded those observations during which the individuals were exposed to medical homes, which may have interaction effects with the MHR components and in turn confound the results. Also in this second model, the same covariates as those in the main model were used.

### **REFERENCES**

1. Ai C, Norton EC. Interaction terms in logit and probit models. *Economics Letters*. 2003;80(1):123-129.

**Table A1.** Selected Generalized Linear Model Regression Results with Sensitivity Analysis

	<b>Main Analysis</b>		<b>Sensitivity Analysis #1<sup>a</sup></b>		<b>Sensitivity Analysis #2<sup>b</sup></b>	
	<b>Rx Cost</b>		<b>Rx Cost</b>		<b>Rx Cost</b>	
	<b>GLM Coefficient</b>	<b>Standard Error</b>	<b>GLM Coefficient</b>	<b>Standard Error</b>	<b>GLM Coefficient</b>	<b>Standard Error</b>
Eligible med	0.90	0.05	0.88	0.05	0.93	0.05
GHS employee	0.18	0.08	0.20	0.08	0.18	0.09
GHS × eligible	-0.14	0.08	-0.15	0.08	-0.20	0.08
	<b>Medical Cost</b>		<b>Medical Cost</b>		<b>Medical Cost</b>	
	<b>GLM Coefficient</b>	<b>Standard Error</b>	<b>GLM Coefficient</b>	<b>Standard Error</b>	<b>GLM Coefficient</b>	<b>Standard Error</b>
Eligible med	0.23	0.04	0.23	0.04	0.22	0.04
GHS employee	0.24	0.05	0.25	0.05	0.24	0.06
GHS × eligible	-0.14	0.06	-0.14	0.06	-0.15	0.07

GHS indicates Geisinger Health System; GLM, generalized linear model; med, medication.

<sup>a</sup>Includes an interaction effect between GHS employee indicator and disease/case management indicator variables as an additional covariate.

<sup>b</sup>Excludes observations in which members were exposed to medical home.

Clustered standard errors are reported to reflect repeated observations of each member.

**Table A2.** Full Regression Results

	Pr(Elig <sub>it</sub> = 1)		Rx Cost		Medical Cost	
	Odds Ratio	<i>P</i>	GLM Coef	<i>P</i>	GLM Coef	<i>P</i>
GHS employee	1.032	.452	0.182	.028	0.244	.000
Eligible med			0.896	.000	0.229	.000
GHS × eligible			<b>-0.142</b>	<b>.078</b>	<b>-0.143</b>	<b>.017</b>
Enrolled in CM/DM			0.465	.000	1.342	.000
Enrolled in MHR			-0.398	.001	-1.099	.000
GHS × 2008	1.055	.078				
GHS × 2009	1.071	.079				
GHS × 2010	1.125	.009				
GHS × 2011	1.008	.875				
Age, years	1.102	.000	0.007	.809	0.003	.884
Age × age	0.999	.004	0.000	.138	0.000	.095
Female	0.783	.001	-0.740	.000	-0.155	.078
In PCMH	0.982	.582	0.042	.473	-0.156	.000
PS strata 2	0.998	.987	0.945	.000	0.254	.042
PS strata 3	1.255	.133	1.443	.000	0.334	.026
PS strata 4	1.209	.232	1.830	.000	0.488	.003
PS strata 5	1.222	.237	2.004	.000	0.668	.000
PS strata 6	1.375	.108	2.806	.000	1.063	.000
PS strata 7	0.541	.491	2.848	.000	4.183	.000
MI in pre-period	1.276	.100	-0.224	.086	-0.352	.031
Stroke in pre-period	1.310	.022	0.041	.664	0.161	.136
Any IP in pre-period	0.937	.263	0.247	.012	0.321	.000
Any ED in pre-period	0.988	.753	0.188	.003	0.296	.000
CKD	1.214	.269	0.636	.000	0.879	.000
CAD	1.585	.000	0.484	.000	0.434	.000
COPD	0.990	.936	0.294	.003	0.359	.045
Hypertension	2.781	.000	-0.059	.258	-0.006	.861
Diabetes	2.551	.000	0.580	.000	0.031	.496
Asthma	0.998	.968	0.570	.000	0.276	.000
Cancer	0.879	.089	0.587	.000	1.015	.000
Depression	1.106	.052	0.528	.000	0.295	.000
CHF	1.725	.009	0.076	.660	0.499	.001
Year 2008	1.121	.000	0.032	.136	0.173	.000
Year 2009	1.283	.000	0.001	.973	0.307	.000
Year 2010	1.357	.000	-0.009	.849	0.391	.000
Year 2011	1.587	.000	0.005	.935	0.454	.000
February	0.927	.000	-0.070	.000	0.033	.558
March	1.086	.000	0.037	.025	0.034	.535
April	1.024	.039	0.004	.767	-0.009	.868

May	1.037	.006	0.022	.463	-0.004	.951
June	1.062	.000	0.016	.374	-0.052	.327
July	1.055	.000	0.009	.571	0.009	.867
August	1.064	.000	0.022	.204	0.112	.041
September	1.047	.001	0.022	.278	0.089	.116
October	1.102	.000	0.050	.026	0.143	.007
November	1.067	.000	0.021	.425	0.063	.261
December	1.147	.000	0.083	.000	0.120	.024
Constant	0.014	.000	0.754	.298	3.880	.000

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CAD indicates coronary artery disease; CHF, congestive heart failure; CKD, chronic kidney disease; CM/DM, case/disease management; coef, coefficient; COPD, chronic obstructive pulmonary disease; ED, emergency department; GHS, Geisinger Health System; GLM, generalized linear model; IP, inpatient; med, medication; MHR, MyHealth Rewards; MI, myocardial infarction; PCMH, patient-centered medical home;  $\Pr(\text{Elig}_{it} = 1)$ , probability that the member  $i$  had purchased a \$0 co-pay-eligible drug in month  $t$ ; PS, propensity score; \$PMPM, cost per-member-per-month.