

# Evaluation of Value-Based Insurance Design With a Large Retail Employer

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**Objectives:** To measure adherence and assess medical utilization among employees enrolled in a disease management (DM) program offering copayment waivers (value-based insurance design [VBID]).

**Study Design:** Retrospective matched case-control study.

**Methods:** Cases were defined as those enrolled in DM, of whom 800 received health education mailings (HEMs) and 476 received telephonic nurse counseling (NC). Controls were eligible for the DM program but did not enroll. Cases and controls were matched 1:1 based on propensity score ( $n = 2552$ ). Adherence, defined by proportion of days covered, was calculated for 4 diseases using incurred drug claims 1 year before and after the DM program was implemented. Unadjusted and adjusted linear regression compared changes in adherence. Costs and utilization were compared at 1 year and 1.5 years after versus 1 year before implementation.

**Results:** Members receiving NC had improved adherence for antihypertensives, diabetes medications, and statins ( $\beta = 0.050$ ,  $P = .025$ ;  $\beta = 0.108$ ,  $P < .001$ ;  $\beta = 0.058$ ,  $P = .017$ ). Members receiving HEMs had improved adherence only for diabetes medications ( $\beta = 0.052$ ,  $P = .019$ ). Total healthcare costs for NC members increased by  $\$44 \pm \$467$  versus  $\$1861 \pm \$401$  per member per year (PMPY) for controls ( $P = .003$ ) at 1.5 years post-implementation. Total healthcare costs for HEM members significantly increased ( $\$1261 \pm \$199$  vs  $\$182 \pm \$181$  PMPY for controls;  $P < .001$ ) at 1.5 years.

**Conclusion:** VBID may be effective in improving medication adherence and reducing total healthcare costs when active counseling is provided to high utilizers of care.

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As healthcare costs continue to rise, employers have been searching for interventions that reduce costs. Early efforts focused on shifting cost to employees, but recent literature suggests that employees may forgo needed medical care to reduce out-of-pocket costs, negatively impacting their health and increasing healthcare costs.<sup>1,2</sup> Therefore, employers have been working to implement more clinically sensitive approaches to reduce cost. One such approach is value-based insurance design (VBID).

Value-based insurance design programs reduce patient cost-sharing for chronic disease-related services. The goal of VBID is to encourage the use of services that more efficiently manage disease and to avoid the high cost of noncompliance.<sup>3,4</sup> Pitney Bowes was the first large employer to implement a value-based prescription benefit. As a result of reduced employee copayments for asthma, diabetes, and hypertension medications, total annual costs for asthma and diabetes patients decreased by 15% and 6%, respectively, over a 3-year period.<sup>5</sup>

Due to research indicating that adherence is most effectively addressed with multifaceted interventions, some employers have paired VBID with other interventions, including disease management (DM).<sup>6</sup> In 2005, Marriot International, Inc, combined VBID and DM. Marriott offered a voluntary, nurse-managed, telephonic DM program and reduced copayments for 5 classes of medications. Adherence was assessed 1 year before and after the copayment change for employees of Marriott (intervention group) and for a second large employer (control group). The study reported a statistically significant increase in adherence by 4% to 7% for angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs), beta blockers, diabetic therapies, and HMG-CoA reductase inhibitors (statins).<sup>5,7</sup> While this research contributed to the body of evidence supporting the combination of VBID and DM to improve medication adherence, the authors did not determine the effect of medication adherence on utilization or cost. In addition, the intervention and control groups shared significant differences in baseline characteristics. The results of these studies and others are promising,<sup>8-11</sup> but more research is needed to understand the impact of VBID on medication adherence, utilization, cost, and health outcomes.<sup>12</sup>

This study used data from a large retail employer who implemented a value-based benefit product as of April 1, 2008. In

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this program, employees and their dependents were eligible for reduced cost sharing on their diabetes, asthma, coronary artery disease, and heart failure medications if they had these diagnoses and if they agreed to enroll in the employer-sponsored DM program. This study compared the change in adherence for DM enrollees with the change for those who were eligible but not enrolled. The impact on utilization and healthcare costs was also evaluated.

### Take-Away Points

There is insufficient peer-reviewed evidence that value-based insurance design (VBID) can improve outcomes or reduce healthcare costs.

- Our study with a closely matched control group showed the potential for VBID to improve adherence, but the type of intervention and patient population played important roles.
- The results indicate that number of hospitalizations and their costs trended downward in those who received more rigorous nurse counseling.
- The disease management program may be effective in improving medication adherence and in reducing total healthcare costs when active counseling is provided to high utilizers of care.

## METHODS

### Intervention

The DM service vendor identified potential DM participants among the employees using a proprietary risk stratification tool. Those with lower risk scores were offered health education materials (HEMs). Those with higher risk scores were enrolled in telephonic nurse counseling (NC) to set goals and care plans based on personal priorities and gaps in care. Members who enrolled in the program had reduced copayments for their medications (Table 1). If an enrollee refused to participate in DM or could not be contacted after 3 attempts, he/she was dropped from the program and was no longer eligible for reduced copayments.

### Study Population

A large retail employer implemented a value-based DM program in April 2008. The cases included employees with diabetes, coronary artery disease, heart failure, or asthma who enrolled in the DM program between April and October 2008. The control group consisted of employees from the same employer who were contacted for DM participation prior to October 2008 but who did not enroll. Members were required to be 19 years or older and continuously enrolled in the same health plan.

Each case was matched 1:1 to a control with the same targeted diagnosis for DM enrollment, sex, and age range. To account for selection bias, cases and controls were subsequently matched using a propensity score based on variables that potentially explained the subject's program participation. Using this method, employees were assigned a predicted probability (propensity score) that they would enroll in the DM program based on clinical, utilization, and insurance coverage characteristics (Table 2). Cases were then matched to controls by minimizing the distance between their respective propensity scores.<sup>13-15</sup>

We analyzed the adherence, utilization, and costs using these matched cases and controls, and compared adherence

and utilization in the 2 groups with regression analyses using the unpaired data. Costs were analyzed by a paired difference-in-difference design with 1:1 comparisons of the matched pairs.

### Adherence Calculation

Adherence was defined as proportion of days covered (PDC).<sup>16,17</sup> The index date for the cases was the date that members enrolled in DM (rolling enrollment between April 1, 2008, and October 31, 2008), and the index date for the controls was July 1, 2008. The pre-implementation time period was from the date of the first filled prescription 1 year prior to the index date. The post-implementation time period was from the date of the first filled prescription after the index date to 1 year after the index date. Intervals less than 30 days were excluded. The proportion of days covered was calculated for any member who had at least 1 filled prescription in the pre-implementation period. If the member did not fill the medication in the post-implementation period, PDC was assumed to be zero. The 1 exception was diabetes patients who transitioned from oral hypoglycemics to insulin therapy. We assumed that patients switched therapy if they initiated therapy with insulin and did not take oral hypoglycemics for 180 days. All "as-needed" medications, such as inhaled short-acting  $\beta$ -agonists, were excluded. Adherence to short-acting insulin was not calculated, as patients often titrate therapy. Only medications matched with the DM diagnosis were included in the PDC calculation. Some members were enrolled in more than 1 DM program on different dates due to multiple eligible diseases; in order to maximize follow-up time for the analysis, the member was considered to be enrolled in the program with the earliest enrollment date associated with the DM diagnosis. Drug classes considered for diabetics included oral hypoglycemics, intermediate and long-acting insulins, ACE inhibitors or ARBs, and statins. We averaged adherence for members taking multiple oral hypoglycemics. For coronary artery disease, drugs of interest included beta blockers, ACE inhibitors/ARBs, and statins. Adherence was calculated for ACE inhibitors/ARBs and beta blockers for members with heart failure. Inhaled steroids were considered in the PDC calculation for patients with asthma.

■ **Table 1.** Copayment Structure for Controls and Disease Management Enrollees

Prescription Tier	Control Group Copayment		Reduced Copayment for DM Enrollees	
	Retail <sup>a</sup>	Mail <sup>b</sup>	Retail <sup>a</sup>	Mail <sup>b</sup>
Tier 1	\$8	\$20	\$0	\$0
Tier 2	\$25	\$55	\$8	\$20
Tier 3	35%, \$35 min/\$40 max	35%, \$70 min/\$140 max	\$25	\$55
Tier 4	35%, \$70 min/\$140 max	35%, \$140 min/\$280 max	35%, \$45 min/\$105 max	35%, \$90 min/\$210 max

DM indicates disease management.  
<sup>a</sup>For 30-day supply.  
<sup>b</sup>For 90-day supply.

■ **Table 2.** Demographic Characteristics for Disease Management Enrollees and Controls

Baseline Characteristic	DM Enrollees (n = 1276)	Controls (n = 1276)	P <sup>a</sup>
<b>Preliminary matching<sup>b</sup></b>			
<b>Condition</b>			
Diabetes	843	843	—
Asthma	127	127	—
CAD	278	278	—
HF	28	28	—
<b>Male/female</b>	717/559	717/559	—
<b>Age, y</b>			
<24	14	14	—
25-49	439	439	—
50-64	790	790	—
≥65	33	33	—
<b>After propensity score matching</b>			
<b>Medical vendor</b>			
BCBSAL	1066	1073	.706
Aetna	210	203	
<b>Coverage tier</b>			
Self	461	482	.045
Self + spouse	552	580	
Family	263	214	
<b>CCI score, mean ± SD</b>	1.11 ± 0.99	1.14 ± 0.98	.196
<b>No. of condition-related ED visits/hospitalizations</b>	36	28	.317
<b>Total cost, mean ± SD</b>	\$8805 ± \$22,685	\$7463 ± \$11,558	.832 <sup>c</sup>
<b>Drug classes per member, mean ± SD</b>	8.00 ± 4.82	8.17 ± 4.68	.278
<b>Drug classes per condition per member, mean ± SD</b>	1.36 ± 1.25	1.42 ± 1.18	.138

BCBSAL indicates Blue Cross and Blue Shield of Alabama; CAD, coronary artery disease; CCI, Charlson Comorbidity Index; DM, disease management; ED, emergency department; HF, heart failure; SD, standard deviation.

<sup>a</sup>χ<sup>2</sup> Test for categorical variables; *t* test for continuous variables.

<sup>b</sup>Cases and controls were matched 1:1 on these variables; *P* values not reported.

<sup>c</sup>*P* value for log (total costs).

### Adherence Analysis

Unadjusted and adjusted regression analysis compared changes in adherence for cases versus controls for 4 different classes of medications: antihypertensives (ACE inhibitors/ARBs and  $\beta$ -blockers), diabetes medications (oral hypoglycemics and insulin), statins, and inhaled corticosteroids. We used this unpaired regression analysis to increase the statistical power because adherence measures had more missing observations than other outcomes. We combined the HEM and NC groups into 1 regression and also analyzed them separately. Due to evidence of heteroscedasticity in the models for antihypertensives, diabetes medications, and statins, robust standard errors and confidence intervals were calculated.

### Utilization Analysis

We compared changes in healthcare utilization and costs between cases and controls 1 year before and after enrollment. For members who enrolled prior to June 1, 2008, and their matched controls, changes in medical utilization and cost were also analyzed 1 year before and up to 1.5 years after enrollment or index date.

To assess medical utilization, we looked at emergency department (ED) visits and hospitalizations in the NC and HEM groups versus ED visits and hospitalizations in their matched controls in the pre- and post-implementation periods. Utilization was assessed using a zero-inflation negative binomial regression model; the number of hospitalizations or ED visits was the dependent variable, with post-implementation versus pre-implementation as the covariate. Subsequently,  $z$  test analysis compared the regression coefficients from the case versus the control models.

### Cost Analysis

We used a difference-in-difference analysis to compare changes in costs between groups. Changes in costs (post-implementation period minus baseline paid claims incurred during the study period) were analyzed separately by type of service (inpatient, outpatient, professional, and prescription costs) and summed to assess change in total medical and total overall costs. Total medical costs included inpatient, outpatient, and professional claims. Total overall costs included total medical costs and prescription costs. Costs from 2007 and 2008 were adjusted by 3% inflation to 2009 US dollars. Due to the distribution with long, thin tails, presence of extreme outliers, and skewed distribution, the differences in mean costs (defined as per member per year [PMPY]) during the follow-up period vs baseline PMPY) for each group and service were trimmed by 20%. The mean differences in inpatient PMPY costs were trimmed by 10% since many members did not incur any inpatient claims.<sup>18</sup> The mean differences in costs were bootstrapped,

and paired  $t$  tests were used to compare the bootstrapped differences between groups. The difference-in-difference analysis adjusted for unobserved fixed differences between groups and bootstrapping was used to mitigate regression to the mean.

All data manipulations were done using SAS version 9.1 software (SAS Institute Inc, Cary, North Carolina), and statistical analyses were conducted using STATA 11 (StataCorp LP, College Station, Texas).

## RESULTS

### Study Population

Table 2 shows the patient population after matching. A total of 2552 patients were included in the study, with 1276 patients in each group. After matching, none of the differences between groups were statistically significant, except for coverage tier (employee only, employee plus spouse, or family,  $P = .045$ ).

### Adherence

Table 3 shows the change in adherence in the 1 year pre-implementation and 1 year post-implementation periods for cases and controls by drug class for members who received NC and members who received HEMs.

We combined the HEM and NC groups into 1 regression and also analyzed them separately. The separated and combined regressions indicated similar results for the impact of the type of intervention; however, other covariates (eg, change in out-of-pocket cost) lost significance when the HEM and NC groups were analyzed separately. To maximize statistical power, we reported the results from the combined analysis (Table 4).

For members receiving NC, PDC improved for antihypertensives, diabetes medications, and statins ( $\beta = 0.050$ ,  $P = .025$ ;  $\beta = 0.108$ ,  $P < .001$ ; and  $\beta = 0.058$ ,  $P = .017$ , respectively). Among members who received HEMs, PDC was only significantly higher for diabetes medications ( $\beta = 0.052$ ,  $P = .019$ ). Adherence did not significantly improve for those taking inhaled corticosteroids in those receiving either HEMs or NC. Other variables that affected the change in adherence included age, PDC in the pre-implementation period, and change in out-of-pocket cost between the pre-implementation and post-implementation periods (Table 4).

### Utilization

In the utilization analyses of the NC group, the number of hospitalizations did not significantly change for enrollees or controls at 1 year compared with baseline. At 1.5 years, the number of hospitalizations decreased by 27.3% in the NC group and increased by 91.9% in its matched control group

■ **Table 3.** Change in Adherence 12 Months Postenrollment Versus Baseline by Group for Those Who Received Health Education Materials and Nurse Counseling

Prescription Agent	DM Enrollees				Controls			
	No.	Baseline, mean ± SD	Postenrollment, mean ± SD	Change	No.	Baseline, mean ± SD	Postenrollment, mean ± SD	Change
<b>Nurse Counseling</b>								
Oral hypoglycemics	213	0.80 ± 0.18	0.84 ± 0.21	3.3%	122	0.75 ± 0.21	0.68 ± 0.29	-6.8%
Insulin	68	0.64 ± 0.27	0.67 ± 0.29	3.2%	46	0.58 ± 0.27	0.57 ± 0.29	-0.4%
ACE inhibitor/ARB	267	0.81 ± 0.24	0.78 ± 0.24	-3.1%	167	0.77 ± 0.24	0.70 ± 0.32	-6.5%
Beta blockers	82	0.84 ± 0.20	0.77 ± 0.33	-6.8%	70	0.75 ± 0.25	0.68 ± 0.30	-7.3%
Statins (HMG-CoA reductase inhibitor)	253	0.79 ± 0.22	0.80 ± 0.28	1.0%	189	0.74 ± 0.25	0.67 ± 0.34	-6.5%
Inhaled corticosteroid	25	0.40 ± 0.23	0.53 ± 0.34	13.2%	17	0.44 ± 0.30	0.35 ± 0.31	-9.4%
<b>Health Education Mailings</b>								
Oral hypoglycemics	285	0.74 ± 0.23	0.71 ± 0.31	-3.3%	220	0.75 ± 0.22	0.63 ± 0.32	-11.9%
Insulin	35	0.65 ± 0.28	0.65 ± 0.33	-0.7%	79	0.60 ± 0.26	0.54 ± 0.34	-6.1%
ACE inhibitor/ARB	339	0.81 ± 0.21	0.72 ± 0.33	-8.5%	276	0.77 ± 0.24	0.67 ± 0.33	-10.1%
Beta blockers	89	0.76 ± 0.26	0.71 ± 0.23	-5.2%	115	0.77 ± 0.23	0.68 ± 0.33	-8.7%
Statins (HMG-CoA reductase inhibitor)	328	0.74 ± 0.26	0.72 ± 0.33	-1.7%	278	0.72 ± 0.26	0.65 ± 0.33	-7.0%
Inhaled corticosteroid	30	0.48 ± 0.27	0.43 ± 0.37	-5.1%	29	0.52 ± 0.27	0.49 ± 0.33	-3.1%

ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; DM, disease management; SD, standard deviation.

( $P < .001$ ). There were no changes in ED visit counts at 1 or 1.5 years postenrollment.

In contrast, analyses of the HEM group showed an increase in the number of hospitalizations at 1 year versus baseline by 92.5%, while the number of hospitalizations remained steady in their matched controls ( $P = .004$ ). After 1.5 years, the hospitalizations more than doubled (factor of 2.53) in enrollees and again remained steady in controls ( $P = .002$ ) compared with baseline. Similarly to the NC group, the number of ED visits did not change in either group at 1 or 1.5 years postenrollment versus baseline.

**Cost**

Among those in the NC group, prescription drug costs significantly increased after 1 year; the costs for those enrolled in NC increased by  $\$623 \pm \$52$  ( $\pm$  bootstrapped standard error) while costs increased by  $\$168 \pm \$32$  PMPY in the control group ( $P < .001$ ). No other service categories had significant cost changes at 1 year. After 1.5 years, the difference in total overall cost was significantly lower in the cases versus their matched controls ( $\$44 \pm \$467$  increase in intervention group vs  $\$1861 \pm \$401$  PMPY increase in control group,  $P = .003$ ), mainly due to the lower professional and inpatient claims for the cases. The untrimmed results trended similarly to the trimmed results but did not show

significant differences for changes in prescription drug or total costs, mainly due to the lower professional and inpatient claims for the cases (Table 5).

Unlike the downward trend seen in the NC group, the costs in the HEM group trended upward. After 1 year, inpatient costs and prescription drug costs increased significantly; consequently, total overall costs increased by  $\$637 \pm \$136$  in the HEM group and decreased by  $\$129 \pm \$122$  PMPY in their matched controls ( $P < .001$ ). After 1.5 years, the costs for inpatient and professional claims, as well as total medical costs, continued to increase significantly for patients who received HEMs compared with their matched controls. Consequently, the total overall costs for these patients significantly increased compared with costs for their controls ( $\$1261 \pm \$199$  increase in enrollees,  $\$182 \pm \$181$  PMPY increase in controls,  $P < .001$ ). The untrimmed results did not indicate significant changes in inpatient, total medical costs, or total costs, but showed significant increases in professional and prescription drug claims (Table 5).

**DISCUSSION**

The results show the potential for VBID to improve adherence, although the type of intervention and the target population played important roles. With the exception of an-

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**Table 4.** Regression Analysis to Predict Change in Proportion of Days Covered at 12 Months Postenrollment Versus Baseline by Drug Class

Variable	Coefficient	SE	P	95% CI
<b>Antihypertensives<sup>a</sup></b>				
Age	0.019	0.006	.001 <sup>b</sup>	0.008-0.030
Sex	0.013	0.017	.457	-0.021 to 0.046
Charlson Comorbidity Index score	-0.003	0.008	.676	-0.019 to 0.013
No. of drug classes per member	-0.001	0.002	.474	-0.005 to 0.002
PDC at baseline	0.681	0.039	<.001 <sup>b</sup>	0.605-0.757
Change in out-of-pocket cost	-0.001	0.001	.440	-0.003 to 0.001
Diabetes vs CAD	0.020	0.018	.276	-0.016 to 0.055
Heart failure vs CAD	0.016	0.037	.675	-0.057 to 0.089
Health education mailings vs no intervention	0.001	0.020	.962	-0.038 to 0.040
Nurse counseling vs no intervention	0.050	0.022	.025 <sup>b</sup>	0.006-0.093
Constant	-0.043	0.066	.516	-0.173 to 0.087
<b>Diabetes Medications<sup>a</sup></b>				
Age	0.022	0.005	<.001 <sup>b</sup>	0.012-0.032
Sex	0.014	0.017	.396	-0.019 to 0.048
Charlson Comorbidity Index score	0.006	0.010	.525	-0.013 to 0.026
No. of drug classes per member	0.000	0.002	.904	-0.005 to 0.004
PDC at baseline	0.656	0.039	<.001 <sup>b</sup>	0.579-0.733
Change in out-of-pocket cost	-0.002	0.001	.017 <sup>b</sup>	-0.003 to -0.000
Insulin only	-0.018	0.023	.443	-0.064 to 0.029
Insulin + oral hypoglycemics	0.010	0.025	.698	-0.039 to 0.058
Health education mailings vs no intervention	0.052	0.022	.019 <sup>b</sup>	0.009-0.094
Nurse counseling vs no intervention	0.108	0.021	<.001 <sup>b</sup>	0.067-0.149
Constant	-0.069	0.049	.158	-0.166 to 0.027
<b>Statins<sup>a</sup></b>				
Age	0.017	0.006	.006 <sup>b</sup>	0.005-0.030
Sex	0.014	0.019	.457	-0.023 to 0.051
Charlson Comorbidity Index score	0.003	0.009	.709	-0.014 to 0.021
No. of drug classes per member	0.002	0.002	.240	-0.002 to 0.006
PDC at baseline	0.681	0.039	<.001 <sup>b</sup>	0.604-0.759
Change in out-of-pocket cost	-0.003	0.001	.004 <sup>b</sup>	-0.005 to -0.001
Diabetes vs CAD	-0.007	0.019	.720	-0.044 to 0.030
Health education mailings vs no intervention	0.039	0.022	.072	-0.004 to 0.082
Nurse counseling vs no intervention	0.058	0.024	.017 <sup>b</sup>	0.010-0.106
Constant	-0.051	0.068	.456	-0.184 to 0.082
<b>Inhaled Corticosteroids<sup>a</sup></b>				
Age	0.023	0.013	.076	-0.002 to 0.048
Sex	0.015	0.072	.841	-0.128 to 0.157
Charlson Comorbidity Index score	0.005	0.049	.924	-0.092 to 0.101
No. of drug classes per member	-0.009	0.007	.194	-0.021 to 0.004
PDC at baseline	0.679	0.125	<.001 <sup>b</sup>	0.431-0.928
Change in out-of-pocket cost	-0.002	0.004	.569	-0.010 to 0.005
Health education mailings vs no intervention	-0.055	0.088	.531	-0.229 to 0.119
Nurse counseling vs no intervention	0.107	0.085	.212	-0.062 to 0.277
Constant	-0.010	0.134	.939	-0.277 to 0.256

CAD indicates coronary artery disease; CI, confidence interval; PDC, proportion of days covered; SE, standard error.

<sup>a</sup>SE and CIs are from robust regression results.

<sup>b</sup>P < .05.

■ **Table 5.** Change in per Member per Year Costs 1.5 Years Postenrollment Versus Baseline by Type of Medical Service and Group for Those Who Received Nurse Counseling and Health Education Mailings<sup>a</sup>

Service	DM Enrollees		Controls		P
	Baseline PMPY ± SD	1.5-Year Postenrollment Change ± SE <sup>b</sup>	Baseline PMPY ± SD	1.5-Year Postenrollment Change ± SE <sup>b</sup>	
<b>Nurse Counseling</b>					
<b>Medical</b>					
Professional	\$2400 ± \$2248	−\$172 ± \$124	\$1582 ± \$1515	\$330 ± \$101	.002 <sup>c</sup>
Outpatient	\$1425 ± \$2536	−\$72 ± \$131	\$760 ± \$1339	\$98 ± \$102	.306
Inpatient	\$1735 ± \$5359	−\$853 ± \$381	\$383 ± \$1729	\$1152 ± \$240	<.001 <sup>c</sup>
<b>Total medical</b>	<b>\$5356 ± \$7670</b>	<b>−\$484 ± \$426</b>	<b>\$2861 ± \$4092</b>	<b>\$1289 ± \$312</b>	<b>.001<sup>c</sup></b>
<b>Prescription</b>	<b>\$2751 ± \$2611</b>	<b>\$666 ± \$60</b>	<b>\$1828 ± \$1608</b>	<b>\$179 ± \$43</b>	<b>&lt;.001<sup>c</sup></b>
<b>Overall total</b>	<b>\$8499 ± \$8755</b>	<b>\$44 ± \$467</b>	<b>\$4995 ± \$4703</b>	<b>\$1861 ± \$401</b>	<b>.003<sup>c</sup></b>
<b>Health Education Mailings</b>					
<b>Medical</b>					
Professional	\$1223 ± \$1080	\$294 ± \$69	\$1349 ± \$1411	\$16 ± \$62	.002 <sup>c</sup>
Outpatient	\$678 ± \$1204	\$127 ± \$62	\$535 ± \$969	\$58 ± \$54	.763
Inpatient	\$6 ± \$124	\$684 ± \$107	\$249 ± \$1287	\$178 ± \$86	<.001 <sup>c</sup>
<b>Total medical</b>	<b>\$2270 ± \$2738</b>	<b>\$849 ± \$184</b>	<b>\$2469 ± \$3433</b>	<b>\$96 ± \$162</b>	<b>.002<sup>c</sup></b>
<b>Prescription</b>	<b>\$1464 ± \$1496</b>	<b>\$286 ± \$36</b>	<b>\$1720 ± \$1788</b>	<b>\$34 ± \$36</b>	<b>&lt;.001<sup>c</sup></b>
<b>Overall total</b>	<b>\$3899 ± \$3559</b>	<b>\$1261 ± \$199</b>	<b>\$4372 ± \$4267</b>	<b>\$182 ± \$181</b>	<b>&lt;.001<sup>c</sup></b>

DM indicates disease management; PMPY, per member per year; SD, standard deviation; SE, standard error.  
<sup>a</sup>Costs were trimmed by 20% for each service, with the exception of inpatient costs, which were trimmed by 10%.  
<sup>b</sup>Bootstrapped SE.  
<sup>c</sup>P < .05.

tidiabetic medications, adherence improved only in patients receiving NC. The significant differences between groups were often due to stopping further reductions in adherence instead of increasing average adherence. At the very least, the intervention prevented patients from cutting back on prescription drug usage.

The results indicate that number of hospitalizations and their costs trended downward in those who received NC. Chernew et al estimated that costs for VBID would break even if nondrug costs decreased by 9% to 17%, depending on program effectiveness.<sup>19</sup> The cost results in the NC group concur with these findings, as nondrug costs decreased in the NC group by 9% while the overall costs remained steady. In contrast, the HEM participants showed a significant increase in costs both at 1 and 1.5 years, an increase also reflected in the utilization results. The increase in prescription drug and professional claims in the HEM group were expected because the educational materials encouraged HEM patients to seek these services. The increase in inpatient claims was unexpected, but perhaps longer follow-up is required to accurately evaluate hospitalizations and ED visits, given their infrequency. The increased utilization seen in the short-term analyses may have

been medically necessary, and long-term analyses may reveal improved health outcomes as a result.

Due to the design of the intervention, we were only able to assess the impact of copayment reductions in the context of a DM program (NC or HEMs). Regression analyses indicated that change in out-of-pocket cost significantly impacted changes in adherence for certain classes of medications. The coupling of copay waivers and clinical interventions is becoming more prominent given the research demonstrating that 1 intervention alone is not sufficient to effectively manage a chronic condition.<sup>20</sup> This study contributes to the literature assessing a combined DM and reduced-copayment program. Future studies will further explore the factors contributing to the success of the interventions, such as copayment reduction amounts, targeting the right patients, and the intensity and length of the DM program.

**Limitations**

Because this study used observational data from a non-randomized intervention, there may have been unobservable differences that our methods cannot account for. In addition to perfect matching on diagnosis and demographic charac-

teristics, cases and controls were matched using a propensity score on characteristics that might predict program enrollment, including variables that predict disease severity and utilization. To explore the impact of these variables on the unpaired adherence and utilization analyses, we included the propensity score as an independent variable in the unpaired regression analyses. This produced results almost identical to those reported in this study, indicating that random selection effects that might be correlated with treatment effectiveness had little impact on these results.

Despite matching, baseline costs in the NC group versus cost in their matched controls (Table 5) remained numerically (though not significantly) higher. Trimming removed outliers, but more patients in the NC group than in the matched control group had larger (>\$20,000) claims: 10 patients in NC group versus 3 patients in the control group. The difference-in-difference analysis adjusted for fixed unobservable differences between groups; however, other unobservable differences, such as health-seeking behavior, may not have remained constant during the study period. Our methods did not account for these unobservable differences, which were not fixed. Despite the differences, the NC group still had a reduction in costs and utilization compared with the baseline values, and the pre-post design allowed each group to serve as its own control.

Another limitation is that we could not account for interactive or differential effects of treatment for comorbidities within and across groups. In order to maximize follow-up time for the analysis, the member was considered to be enrolled in the program with the earliest enrollment date associated with the DM diagnosis. In addition, the cost analyses did not include the cost of the intervention or account for indirect costs to the employer, such as absenteeism or presenteeism. Inclusion of these costs would be important for assessing the financial impact of these programs from the employer perspective, and future analyses will include these costs. Lastly, although this study demonstrated the potential for this program to improve adherence, we did not have access to clinical data (eg, blood pressure, glycosylated hemoglobin levels) and could not assess the impact of the program on clinical outcomes. Despite these limitations, we were able to assess the impact of the program on healthcare utilization and cost, which has rarely been done in assessments of VBID.

## CONCLUSIONS

Evidence supporting the benefits of VBID is limited.<sup>12</sup> This study contributes to the current knowledge on VBID by its rigorous analysis with a matched comparator group to control for external bias.

Our results indicate that VBID combined with DM has the potential to improve adherence and ultimately reduce costs. We demonstrated that more active counseling rather than passive mailings directed toward patients who are high utilizers of healthcare may be more successful at accomplishing these aims. Future research will include a longer study period with more exploration of the extent of the intervention and evaluation of important indirect costs of chronic disease. We will also consider identification of potential instrumental variables that can be used to provide another approach to correct for potential selection effects.

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