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Dear Health Care Professional:

Merck is pleased to provide you with the enclosed reprint, Value-Based Insurance Plus Disease Management Increased Medication Use And Produced Savings, by T.B. Gibson et al, as published in the January 2011 issue of *Health Affairs*, pages 100-108. Access to the complete appendix can be found at <http://content.healthaffairs.org/content/30/1/100.abstract>.

Sincerely,

A handwritten signature in black ink, appearing to read "C. Allen", written in a cursive style.

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TECHWATCH

Value-Based Insurance Plus Disease Management Increased Medication Use And Produced Savings

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ABSTRACT We evaluated the effects of implementing a value-based insurance design program for patients with diabetes in two groups within a single firm. One group participated in disease management; the other did not. We matched members of the two groups to similar enrollees within the company that did not offer the value-based program. We found that participation in both value-based insurance design and disease management resulted in sustained improvement over time. Use of diabetes medications increased 6.5 percent over three years. Adherence to diabetes medical guidelines also increased, producing a return on investment of \$1.33 saved for every dollar spent during a three-year follow-up period.

As health care costs continue to rise and the burden of chronic disease escalates, employers must innovate to overcome these impediments to economic sustainability. One creative strategy that is becoming popular among cutting-edge employers is value-based insurance design, sometimes known as value-based benefit design.

The National Business Coalition on Health has defined *value-based programs* as the explicit use of employee benefit incentives to encourage people to adopt appropriate use of high-value health services, adopt healthy lifestyles, and select high-performance providers.¹ Incentives can include plan-based rewards such as reduced premiums or adjustments to deductible and copayment levels. They can also be rewards that are outside of the plan design, such as contributions to health saving accounts or cash rewards for participating in biometric screening, completing a health risk assessment, or complying with a condition management program.

Pitney Bowes; the University of Michigan; and the municipality of Asheville, North Carolina,

are some of the organizations that have experimented with forms of value-based insurance design.² Pitney Bowes lowered copayments for all users of specific classes of drugs. Asheville and the University of Michigan lowered copayments for specific health services to people with specified conditions.

Background On Diabetes Management

Diabetes is a chronic condition affecting 7.8 percent of the US population.³ A costly condition for which treatment often requires medication, diabetes has been the focus of many value-based pharmacy programs. Evidence of the effects of various value-based insurance design programs for diabetes is now being compiled and disseminated.

EVIDENCE For instance, Michael Chernew and colleagues⁴ found that the diabetes medication possession ratio—the percentage of days when patients had their diabetes medications on hand—rose 5.79 percent within a year of reducing copayments for generic drugs to zero

and copayments for brand-name drugs by 50 percent. Feng Zeng and colleagues⁵ found that a value-based program charging a \$10 copayment for most diabetes medications and supplies resulted in a 30 percent reduction in the number of nonadherent patients—patients who did not follow prescribed drug regimens—in the first year, although the program only affected seventy-one patients.

Andrew Chang and colleagues⁶ found that in the first year of treatment, patients in a value-based insurance program were more likely to start taking medications and less likely to discontinue taking them, while the medication possession ratio increased. This program also lowered copayments for generic and certain brand-name diabetes medications.

GOALS OF DISEASE MANAGEMENT Like value-based insurance design, disease management programs (which are now often called care management programs) are interventions that aim to address chronic illness by promoting the effective use of health care interventions and preventive care and by providing employees with the resources they need to stay healthy. In the 2009 employer health benefits survey conducted by the Kaiser Family Foundation and the Health Research and Educational Trust, 23 percent of the firms surveyed indicated that disease management programs were “very effective” strategies for reducing health care spending.⁷ A 2007 review of the peer-reviewed literature on the effectiveness of disease management found consistent evidence that the programs improve the process of care, but no demonstrated impact on outcomes and an unclear impact on costs.⁸

Disease management programs that are targeted at specific conditions may be more effective. A meta-analysis focused on the effectiveness of diabetes management programs concluded that they improve health outcomes, particularly control of blood sugar levels.⁹ They also increase the likelihood that patients will obtain the diabetes screenings recommended by the National Committee for Quality Assurance, such as retinal eye exams, blood lipid monitoring, urine monitoring for leakage of small amounts of protein into the urine, and routine foot exams to identify potential vascular disease.^{10,11}

COMBINING DISEASE MANAGEMENT WITH VALUE-BASED STRATEGIES Additional evidence points to the importance of combining value-based strategies with disease management. Chernew and colleagues⁴ evaluated the effects of that combination; they found that patients who were in a disease management program and who had lower copayments had better medication adherence than patients in the program who had higher copayments.

In this study we evaluated the effects of a pharmacy program for diabetes that lowered out-of-pocket costs for antidiabetic medications. Two units of a large, multi-industry firm offered the program to employees, spouses, and dependents covered under the medical plan. The remainder of the firm’s units had a traditional three-tier pharmacy plan, with 10 percent copayments for generic drugs, 20 percent for preferred brand-name drugs, and 35 percent for nonpreferred brand-name drugs. All of the firm’s covered enrollees could also participate in a diabetes disease management program, based on care guidelines.¹¹ The authors agreed to the firm’s request not to be identified.

This implementation strategy allowed comparisons of pharmacy use, guideline use, and the financial effects of the value-based pharmacy program, with and without disease management. Most previous evaluations have studied only one year of experience after the implementation of a value-based insurance design plan.⁴⁻⁶ However, we used a time-series cross-sectional design to evaluate the cost effects of the value-based insurance design and disease management programs and their effects on use for the three years after implementation, at the beginning of 2006.

Study Data And Methods

We used information from the Thomson Reuters Advantage Suite data warehouse for this firm as the basis of our analysis.¹² The data warehouse contains outpatient prescription drug and medical claims; inpatient medical claims; and enrollment databases with patients’ characteristics including age and sex, health plan selection, and length of enrollment.

PROGRAM INTERVENTION On January 1, 2006, the firm implemented a diabetes disease management program for those covered under its medical plan. The program was voluntary, so that people who did not want to participate could opt out. Like similar plans offered by most major employers, the program consisted of targeted mailings, a workbook about the disease, telephone outreach by a nurse, additional educational mailings, coaching, and periodic monitoring. An initial letter to employees explained the program’s components, which did not change during the course of the study. Participants received additional communications reinforcing the diabetes management goals (such as testing for HbA1c, or glycemia) as well as medication adherence for the duration of the study.

At the same time, the firm offered its employees and their dependents in two large, US-based units a diabetes value-based pharmacy design

program. In all, 33,160 people were eligible for this program. The two programs were administered separately, and the vendor of the disease management program did not know which beneficiaries enrolled in the pharmacy program.

The pharmacy program lowered coinsurance for all diabetes medications to 10 percent, from a tiered structure that had charged coinsurance ranging from 10 percent for generic medications to 35 percent for nonpreferred brand-name drugs. (See Appendix Exhibit 1 for a list of the diabetes medications.)¹³

Our baseline year was 2005, before the intervention began. Each subsequent year (2006, 2007, and 2008) was in the post-intervention period. We included in our study all enrollees under age sixty-five who had at least four consecutive quarters of enrollment in the period 2005–08.

We focused our analysis on the effects of the value-based pharmacy program in two groups of enrollees with diabetes: those who participated in the disease management program, and those who opted out of it. We considered these groups separately to avoid the possibility of selection bias, which could arise because patients with diabetes who chose to participate in disease management might be different from the patients who opted out.

These variations in program implementation also allowed us to exploit the presence of a comparison group within the firm: the 59,038 enrollees in its medical plan who worked in business units where the value-based pharmacy plan was not offered. We matched enrollees in the value-based program and the disease management program with similar enrollees in the disease management program only. In addition, we matched enrollees with diabetes in the value-based program only to enrollees with diabetes who were not in either program.

To match enrollees, we used a summarized propensity score.¹⁴ We first estimated a propensity score—or the probability of being in a specific program—based on certain variables for each enrollee. These were sociodemographic variables (age, sex, census region, residence in an urban or rural area, relationship to the employee, employee classification, employment status, median income of the ZIP code of residence, and percentage of college graduates in the ZIP code of residence); plan type; health status according to the Charlson Comorbidity Index,¹⁵ a measure of how many chronic conditions a person has, and the number of psychiatric diagnosis groups for each employee;¹⁶ and the length of enrollment by number of quarters.

Then we matched enrollees in the programs with enrollees in the relevant comparison group,

as described above, according to the propensity score. To obtain the best matches, we required a close match in propensity scores between the enrollees in the program and their counterparts from the comparison group.

We constructed a panel data file with each enrollee as the cross-sectional unit and each calendar quarter as the unit of time. We captured enrollees' experience in quarterly increments through the end of their participation in a particular program or through the end of December 2008, whichever was later. We continued to collect data on enrollees who switched plans.

MEDICATION USE AND ADHERENCE We calculated the medication possession ratio—which can range from 0 percent to 100 percent—based on the percentage of days that an enrollee had his or her prescribed medication available within each quarter. We used the dates when prescriptions were filled and the number of days supplied on the prescription drug claims to determine how many days' medications were on hand. We calculated the ratio separately for oral anti-diabetic medications and insulin.

Information about filling prescriptions prior to 2005 was not available. Because the number of days that medications were on hand early in 2005 is probably the result of prescriptions filled in 2004, we did not include the possession ratios for the first quarter of 2005 in our analyses. Had we done so, our results would probably have understated patients' adherence to their medication regimens.

As a second measure of drug use, we calculated the percentage of patients who had medication on hand for at least 80 percent of the days in each quarter. This level is generally accepted as a threshold for clinical benefits to occur.^{17,18} Patients at or above this level are considered to be adherent, while those below this level are considered to be nonadherent.

USE OF DIABETES GUIDELINES We created a set of indicator variables to measure the percentage of enrollees receiving medical services recommended by the guidelines^{10,11} in each quarter. The services included three laboratory exams—tests for HbA1c, lipid tests, and urinalysis—and professional services such as visits to a primary care physician and eye exams. (See Appendix Exhibit 2 for a full list of the services.)¹³

PAYMENTS In this study we defined *payments* as the allowed or actual total reimbursement that the provider of care received. Payments could come from the patient; his or her health plan or employer; or another payer, such as a spouse's employer, through "coordination of benefits" procedures to determine which plan should bear the costs.

We calculated payments for all inpatient and

outpatient medical services, prescription drugs, and any combination of medical services and prescription drugs. We also calculated payments for diabetes-related services¹⁹ and for all conditions, including diabetes. (See Appendix Exhibit 1 for a list of diabetes-related prescription drugs.)¹³

STATISTICAL METHODS After we matched enrollees in a particular program with those in the comparison group, we used multivariate generalized estimating equations to estimate the effects of the program on health care use and spending in each quarter. The models identified two types of effects of the program: changes that occurred immediately and lasted over time; and changes developing over time. (For further details on the modeling, see the Appendix.)¹³

Results

We identified 1,876 enrollees in the value-based insurance design program who participated in the disease management program, and 328 enrollees in the value-based program who opted out of disease management. These enrollees met

all other inclusion criteria. We matched them with the same number of the firm's enrollees who were not eligible for the value-based program and who either participated or did not participate in the disease management program—the comparison groups.

PRE-INTERVENTION CHARACTERISTICS Exhibit 1 describes selected characteristics of the subjects enrolled in the two programs—the intervention groups—and their matched comparison groups before the intervention. Similar characteristics for the two groups were used in the matching regressions. Of all characteristics examined, there was only one statistically significant difference (patients in the Northeast region in the disease management group), which indicates that the matching procedure produced very similar groups of enrollees. (See Appendix Exhibit 3 for additional characteristics.)¹³

The average age of patients who opted for the disease management program was about 48 years. A total of 59 percent were male, and almost half were enrolled in a preferred provider organization plan. More than half resided in the South, and more than 63 percent were employ-

EXHIBIT 1

Characteristics Of Patients In The Study Groups, Value-Based Insurance Design Study

	In the disease management program (n = 1,876)			Not in the disease management program (n = 328)		
	VBID	No VBID	p value	VBID	No VBID	p value
VARIOUS CHARACTERISTICS						
Mean length of enrollment (quarters)	12.4	12.5	0.706	13.0	12.8	0.639
Mean age (years)	48.4	47.9	0.203	47.1	46.9	0.779
Sex						
Male	59.4%	58.5%	0.550	58.2%	57.9%	0.937
Female	40.6%	41.5%	0.550	41.8%	42.1%	0.937
TYPE OF INSURANCE PLAN						
Comprehensive	12.6%	13.3%	0.528	6.7%	7.0%	0.877
EPO/POS	8.1	7.8	0.763	— ^a	— ^a	— ^a
HMO	33.2	32.8	0.781	68.9	68.6	0.933
PPO	46.1	46.1	1.000	24.4	24.4	1.000
REGION						
Northeast	24.5%	21.3%	0.020	42.7%	40.2%	0.527
North Central	10.4	11.0	0.527	9.8	12.2	0.318
South	55.5	57.4	0.249	42.7	43.0	0.937
West	9.6	10.3	0.478	4.9	4.6	0.854
RELATION TO EMPLOYEE						
Self	63.7%	63.1%	0.709	61.6%	61.0%	0.873
Spouse	32.0	32.2	0.889	33.8	34.5	0.869
Dependent	4.3	4.7	0.582	4.6	4.6	1.000
CLINICAL CHARACTERISTICS						
Charlson Comorbidity Index	0.17	0.17	0.842	0.20	0.19	0.779
Number of psychiatric diagnosis groups	0.09	0.09	0.929	0.05	0.09	0.105

SOURCE Authors' analysis of health plan data. **NOTES** For Charlson Comorbidity Index, see Note 15 in the text. For psychiatric diagnosis groups, see Note 16 in the text. VBID is the value-based insurance design pharmacy program. EPO/POS is exclusive provider organization with payments at point of service. HMO is health maintenance organization. PPO is preferred provider organization. ^aNot applicable.

ees. The remainder were spouses or dependents. Comorbidities and psychiatric diagnoses were rare.

For the patients who opted out of the disease management program, the average age was about 47 years, 58 percent were male, and 69 percent were enrolled in a health maintenance organization (HMO). Most resided in the South and Northeast regions (about 40 percent in each region), and about 61 percent were employees. Comorbidities and psychiatric diagnoses were also rare in this group.

The pre-intervention levels of each measure were very similar between the program and comparison groups (see Appendix Exhibit 4).¹³

PROGRAM EFFECTS Estimated effects of the programs are displayed in Exhibit 2.

► **PRESCRIPTION USE:** The effects on prescription oral and insulin drug use, and the receipt of medical services that are recommended in guidelines, for patients in the value-based program who participated in disease management were higher in each year than for patients without the value-based intervention. The difference was also statistically significant.

For example, in the third year after the program was implemented, the medication possession ratio for all antidiabetic medication rose 6.5 percentage points higher in the group with the value-based program plus disease management compared to the disease management-only group. Although the rates for HbA1c testing, lipid tests, primary care physician visits, and urinalysis were higher in the group with the value-based program plus disease management, the rate of retinal exams did not appear to be affected.

In contrast, for patients in the value-based program but without disease management, the effects on prescription drug use and receipt of medical services recommended in guidelines were largely insignificant. However, the rate of patients who reached a medication possession ratio of 0.8 or above for oral antidiabetic medications was 3.8 percentage points higher for the value-based program group in the first year after the program was implemented and rose in each subsequent year.

► **SPENDING:** In the group with the value-based insurance design plus disease manage-

EXHIBIT 2

Effects of The Value-Based Insurance Design Program On Diabetes Medication And Guidelines For Participants And Insurers

	In the disease management program			Not in the disease management program		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
MEDICATION POSSESSION RATIO (MPR)						
All antidiabetic medications	0.037***	0.051***	0.065***	0.015	0.025	0.036
Insulin	0.010*	0.018**	0.027**	0.001	0.004	0.008
Oral antidiabetic medications	0.037***	0.048***	0.058***	0.024	0.033	0.041
PERCENT ADHERENT (MPR 0.80 OR MORE)						
All antidiabetic medications	0.037***	0.049***	0.061***	0.023	0.033	0.044
Insulin	0.011*	0.018**	0.025**	-0.003	0.004	0.011
Oral antidiabetic medications	0.036***	0.046***	0.056***	0.038*	0.047*	0.056
PERCENT GUIDELINE RECIPIENTS						
HbA1c tests	0.021*	0.033**	0.045**	-0.052**	-0.030	-0.007
Lipid tests	0.020*	0.035**	0.050***	-0.035	-0.013	0.009
PCP visits	0.040***	0.058***	0.077***	-0.011	0.027	0.065
Retinal exams	-0.009	0.002	0.014	-0.013	0.000	0.013
Urinalysis	0.019*	0.029**	0.040**	-0.031*	-0.011	0.008
PAYMENTS						
Medical						
All causes	-0.019	-0.010	-0.002	-0.306***	-0.272*	-0.235
Diabetes	-0.264*	-0.338*	-0.405**	-0.043	0.096	0.256
Rx drugs						
All causes	0.125***	0.169***	0.216***	0.083	0.155	0.232
Diabetes	0.157***	0.167***	0.177**	-0.058	-0.110	-0.158
Total (medical + Rx)						
All causes	0.033	0.059	0.085	-0.203***	-0.162	-0.118
Diabetes	-0.066	-0.110	-0.153	-0.040	-0.004	0.034

SOURCE Authors' analysis of health plan data. **NOTES** Sample sizes for participants in the disease management program and not in the disease management program are in Exhibit 1. Effect sizes reflect the effect of the value-based program above (or below) the comparison group in each year following program implementation. PCP is primary care provider. *p ≤ 0.10 **p ≤ 0.05 ***p ≤ 0.01

ment, spending rose after the program was implemented for all-cause prescription drugs. But total medical spending was unchanged, and the net effect on medical plus drug spending was cost-neutral. Diabetes-related prescription drug spending also rose, and diabetes-related medical spending dropped each year after the program was implemented. The effects of higher prescription drug spending and lower medical spending were cost-neutral.

Spending effects for the value-based group without disease management were largely insignificant and were therefore cost-neutral.

Estimated effects for patients in the group with the value-based program plus disease management compared to a predicted effect for patients in the disease management-only group are displayed graphically in Exhibits 3 and 4. For patients in the former group, in the first year after implementation the medication possession ratio for oral medications rose 3.7 percentage points above the ratio for those not in the value-based program. In the second year the ratio rose 4.8 percentage points, and in the third year it was 5.8 percentage points above the ratio for patients not in the value-based program. Similarly, patients in the group with the value-based program plus disease management received more HbA1c, urine, and lipid tests than those in the disease management-only group, and the effects increased with time.

We calculated the effects of annual spending to

estimate a return on investment in terms of diabetes-related costs for patients with value-based insurance design and disease management (Exhibit 5). For the first year of the program the diabetes-related return on investment was 0.82, which means that for every additional dollar spent on diabetes medications, \$0.82 was saved in diabetes-related medical costs. Diabetes-related medical cost savings exceeded prescription drug spending in the subsequent years. For the first two years of the program combined—2006 and 2007—the diabetes-related return on investment was \$1.08 per dollar spent. In the first three years of the program combined, the diabetes-related return on investment was \$1.33 per dollar spent.

Discussion

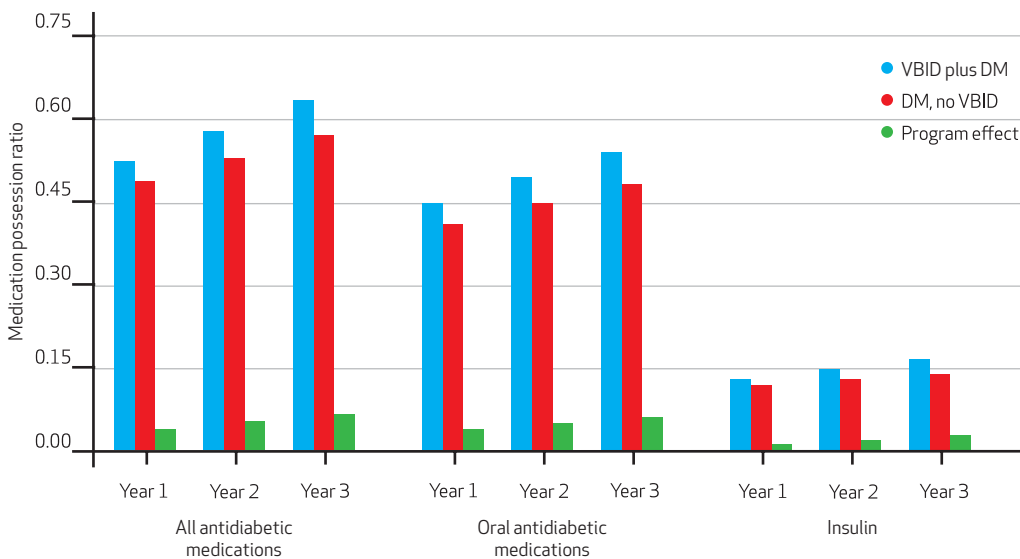
Value-based benefit design has been proposed as a way to improve patients' adherence to care for chronic medical conditions by lowering their out-of-pocket expenses for high-value medical services. A number of employer plan sponsors have adopted this type of program, and evidence is beginning to emerge regarding the short- and long-term effects of this plan design on cost and outcomes.

We add to the evidence by offering this study of the effects of a value-based pharmacy program in two business units of a large, multisite firm where disease management was introduced to

\$1.33
Return On Investment
 In the first three years of the program combined, the firm received a diabetes-related return on investment of \$1.33 for every \$1.00 it spent.

EXHIBIT 3

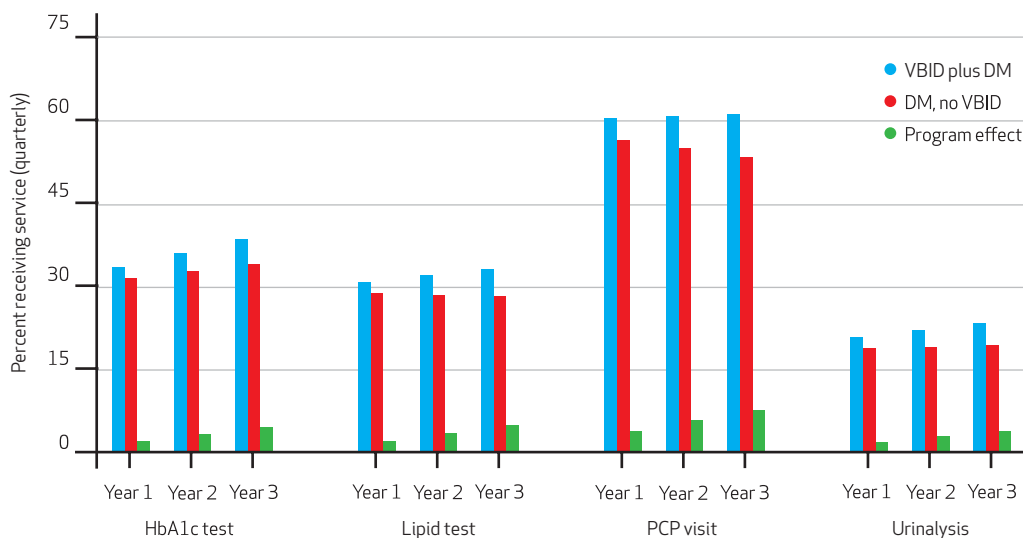
Estimated Effects Of Value-Based Insurance Design Plus Disease Management On Medication Possession Ratio After Program Implementation



SOURCE Authors' analysis of health plan data. **NOTES** All $p < 0.05$. VBI is the value-based insurance design pharmacy program. DM is disease management.

EXHIBIT 4

Estimated Effects Of Value-Based Insurance Design Plus Disease Management On Diabetes Guideline Measures After Program Implementation



SOURCE Authors' analysis of health plan data. NOTES All $p < 0.05$. VBID is the value-based insurance design pharmacy program. DM is disease management. PCP is primary care provider.

all employees and their dependents. We constructed four study cohorts consisting of (1) people who participated in disease management combined with the value-based insurance pharmacy plan, (2) people who participated in disease management only, (3) people with diabetes who opted out of the disease management program but still were eligible for the value-based pharmacy plan, and (4) people who opted out of the disease management program and were not eligible for the value-based pharmacy plan.

Other than the pharmacy plan offered in the two business units, all other elements of the medical plan design were identical for the entire covered population. Eligibility for the value-based insurance design program was not contingent on participation in the disease management program. The impact of the value-based insurance program could thus be assessed both for a population with disease management and for those who opted out of the program.

IMPROVED ADHERENCE We found that individuals who opted out of the diabetes disease management program but had the value-based pharmacy program adhered to their medication regimens with a 0.8 medication possession ratio threshold or higher, but there were no other lasting effects among the available measures. Among those who opted out of the disease management program, the sample size was smaller ($n = 328$), which may have reduced statistical power, and the majority were enrolled in an HMO. Typically, HMOs have tighter medical management, and that may have led participants to opt out because they were already exposed to some form of disease management and may have felt that a telephonic disease management program was redundant.

In order to determine whether the effects of the disease management program were similar to those of other programs, we compared patients who participated in disease management only but did not have value-based insurance to patients from the Thomson Reuters MarketScan Database, who received health care benefits from firms with a similar workforce composition. Patients from the database were matched to the intervention group based on one-to-one propensity scores. We found no substantial differences in the two groups. This fact suggests that the diabetes disease management program was probably equivalent to the standard of care for comparable firms that offer disease management to their patients with diabetes (see Appendix

EXHIBIT 5

Estimated Effects Of Value-Based Insurance Design Plus Disease Management On Annual Diabetes-Related Medical And Prescription Drug Spending After Program Implementation

Year after implementation	Medical spending (\$)	Prescription drug spending (\$)
Year 1	-211	116
Year 2	-316	138
Year 3	-444	164

SOURCE Author's analysis of health plan data. NOTE All $p < 0.05$.

Not only were the effects on prescription drug use and adherence to guidelines sustained over time, they also grew over time.

Exhibit 5 for results).¹³

Our results show that the combination of value-based insurance and disease management is more powerful than disease management alone when measured by patients' prescription drug use and adherence to recommended medical service guidelines. The group with the value-based program plus disease management increased their medication possession ratio by 3.7 percentage points in the first year of their enrollment—a magnitude similar to the 4.02-percentage-point increase reported by Chernew and colleagues.⁴

POSSIBLE LIMITATIONS For the patients in the group with the value-based insurance plus disease management program, the only recommended medical service that appeared unaffected by the program was retinal eye exams. However, patients may have been using vision care benefits, not medical benefits, to receive eye exams, so we might not have captured all of those services.

We may also be underestimating the effects of the value-based insurance program on the possession of insulin medications. The enrolled population, who are most likely to have type 2 diabetes, tend to underuse insulin. There are no generic insulin medications, so lowering a copayment could have substantial effects on insu-

lin use, and our results reinforce this contention.

Our results may differ from those of other studies because we analyzed the program effects on patients who self-selected into a disease management program. As a by-product of our selection criteria, our enrollee pool may have included patients who were using diet and exercise to manage their condition. Accordingly, the medication possession ratio during the pre-implementation period was lower than found in other studies that focused solely on patients with antidiabetic medication use. However, our results suggest that patients opting into a diabetes disease management program may be responsive to financial incentives.

We compared patients in disease management programs who had value-based insurance to those who participated in disease management but did not have value-based insurance. Therefore, the costs of the disease management program were held constant in both comparison groups. In order to obtain a full cost estimate, some form of assignment into disease management, to measure disease management program effects and costs, would be necessary.

EFFECTS OVER TIME We followed the program effects over a three-year period, and we found that not only were the effects on prescription drug use and adherence to guidelines sustained over time, they also grew over time. As with many innovative programs, patients may need time to understand the program, coordinate with their care providers, and gain health benefits.

Conclusion

We found that the combination of value-based insurance design and a diabetes disease management program produced distinct and sustained improvements in the use of diabetes medications and adherence to medical guidelines over time. In addition, the program featured modest cost savings, with a return on investment over three years of \$1.33 for every dollar spent. These findings should be of interest to employers, providers, and patients as we continue to search for quality and value in our health care system. ■

Merck and Co. provided funding for this study. The authors acknowledge the programming efforts of Sara Wang, and research assistance from Emily Kelly and Erin Bagalman. The authors thank the firm that implemented this program for access to the data.

NOTES

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