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Evidence That Value-Based Insurance Can Be Effective

ABSTRACT Value-based insurance design reduces patient copayments to encourage the use of health care services of high clinical value. As employers face constant pressure to control health care costs, this type of coverage has received much attention as a cost-savings device. This paper's examination of one value-based insurance design program found that the program led to reduced use of nondrug health care services, offsetting the costs associated with additional use of drugs encouraged by the program. The findings suggest that value-based insurance design programs do not increase total systemwide medical spending.

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Value-based insurance design programs reduce patient copayments for services that provide important clinical benefit, relative to costs.[1–3] These services often relate to the management of chronic diseases, which are major drivers of clinical and health outcomes.[4,5] Commonly, although not exclusively, value-based insurance programs focus on prescription drugs.

These programs have received growing attention among employers, the press, and policy makers. For example, in 2002, Pitney Bowes reduced copayment rates for several classes of prescription medications important in the treatment of chronic diseases.[6] The *New York Times* subsequently documented similar efforts by other employers.[7] Several large employee benefit consulting firms and insurers have recently announced plans to offer value-based insurance products.[8–10] Public purchasers and unions have also expressed interest.[11] Recently, legislation supporting a value-based insurance demonstration was introduced in the Senate.[12]

Motivation for implementing these programs stems from a realization that different financial incentives in health care or health insurance may work at cross-purposes. On the one hand, there is evidence that even modest copayments for drugs and services discourage the use of services that greatly improve health outcomes.[13–16] On the other, in many cases, purchasers have adopted programs such as disease management or pay-for-performance, which are aimed at increasing the use of these services. The concept of value-based insurance design recognizes that because patient behavior is crucial to the management of chronic disease, programs that place financial barriers in front of consumers may be less effective and result in worse outcomes than might otherwise be obtained.

Reports in the press are often very supportive of these programs.[7,17,18] For example, a March 2007 headline in *Business Insurance* proclaimed: "Free Prescription Drugs Boost Usage, Cut Costs."[19] Pitney Bowes reported favorable results from its initiative, but the analysis was conducted without an external control group, and it is unclear whether the experience is replicable in other settings.[6]

The evidence relating prescription drug use to copay reductions is more ambiguous.[20] However, the preponderance of evidence using quasi-experimental designs suggests that patients do respond when copayments are reduced or eliminated.[15,21,22] However, optimistic claims of total medical spending reductions following decreases in patient copays are generally based

on evaluations that lack rigorous design.[6,23]

This paper examines the fiscal consequences of value-based insurance design, which has received much less scrutiny. It is based on analysis of one value-based insurance program. As in all existing value-based insurance programs, the set of high-value health care services was determined by the employer based on existing evidence. As is common, the services targeted are accepted as providing considerable clinical benefit, relative to cost, for patients with chronic diseases like diabetes and heart disease. The program evaluated here, like the Pitney Bowes initiative, lowered copayments for all patients using the specific services. Other programs, like the University of Michigan's Focus on Diabetes initiative, lower copayments only for patients with selected clinical conditions.

Our analysis suggests that it is likely that the value-based insurance program evaluated here broke even in the broadest sense—that is, when total employer and employee spending is examined, regardless of who paid. It is less likely that the program saved money from the employer's perspective. However, some peer-reviewed evidence suggests that reductions in nondrug spending by program participants may be large enough for the program to break even from the employer perspective.

Because value-based insurance programs vary, we do not claim that our findings would apply to all such initiatives. In fact, we argue that the fiscal consequences of the value-based insurance concept will depend on the details of the program, particularly the extent to which copayment changes are clinically targeted.

Conceptual Issues

The belief that a value-based insurance program will lower health care spending rests on the recognition that the use of high-value health care services reduces the probability of adverse events related to chronic disease and that on a population basis, these events are much more costly than the services aimed at preventing them. This reasoning is correct. However, the ability of the savings that accrue from preventing adverse events to offset the full cost of the extra spending on high-value services (and the administrative costs of such a program) depends on several factors. These include (1) the underlying clinical risks in the population treated, (2) the effectiveness of the program at increasing the use of high-value health care services, (3) the ability of those high-value services to mitigate the risks, and (4) the cost of the health care services averted. Depending on the relative magnitude of these factors, the number of people who must be treated to avoid one adverse event may be too large for the value-based insurance program to fully offset its costs.

It is likely that the value-based insurance program evaluated here broke even in the broadest sense.

Moreover, as Bruce Fireman and colleagues note in the context of disease management, if the services in question are very cost-effective but not cost-saving, programs to promote their increased use will not be cost-saving, either.[24] Cost-saving means that if you spend money on a health care service, total health care spending will go down (because other services will not be needed). Cost-effective means that if you spend money on a health care service, you will get a lot of health in return, but spending will still go up (even though some of the costs of the service will be offset by reduced use of other services). Most health care services, applied to most populations, are cost-effective but not cost-saving, although there are exceptions.[25] For this reason, the financial profile of a program will depend crucially on how it is targeted. The greater the focus on high-risk populations in whom high-value health care services are greatly underused, the greater the potential for medical cost savings.

Additionally, it is important to be clear about which perspective is being used when assessing the fiscal consequences of value-based insurance design. The broader perspective, preferred by economists and consistent with the methods commonly recommended for cost-effectiveness analysis, focuses on the costs to employers and employees of the additional utilization.[26] Reduced medical spending associated with adverse events (such as hospitalizations) would offset this cost.

The employer perspective would include the employer share of costs of the additional use and the costs associated with a greater employer share of the spending on services that would have been consumed anyway. For example, if value-based insurance increases the employer share of high-value prescriptions by $5.00, the costs of the program from the employer perspective would include the employer costs for any

additional prescriptions as well as $5.00 for prescriptions that would have been filled even without the program. This can result in value-based insurance programs' appearing less attractive from the employer's perspective. Following the cost-effectiveness literature, we focus on the broader employer and employee cost perspective.

When assessing the financial profile of value-based insurance design, it is also important to recognize that medical offsets are only one source of savings associated with better health. Fewer disability days, less absenteeism, and greater worker productivity are all important potential benefits. Yet these benefits are often hard to measure. For this reason, existing evaluations likely understate the savings associated with value-based insurance design.

Study Data And Methods

THE INTERVENTION In January 2005 a large employer reduced copayment rates for five classes of drugs used to treat serious chronic conditions: angiotensin-converting enzyme (ACE) inhibitors and angiotensin-receptor blockers (ARBs), or beta-blockers, all used in the treatment of hypertension; diabetes medications (including oral therapies and insulin); HMG-CoA reductase inhibitors (statins); and inhaled corticosteroids. Copayment rates for generic medications were reduced from $5.00 to $0. Preferred-brand drug copayments were decreased from $25.00 to $12.50, and copayments for nonpreferred-brand drugs fell from $45.00 to $22.50.

The "intervention"—or value-based insurance design program—was implemented by ActiveHealth Management, an integrated care management company that is an independent subsidiary of Aetna. The program was added to an existing disease management and clinical alerting program used by both the treatment and control firms evaluated in this paper and described elsewhere.[3,21,27]

All patients in the treatment firm who were already taking any of the specified medications without a contraindication were eligible for the copay reduction beginning with their next prescription fill. Copay relief was also available for people who were not currently taking the medication but who had previously received a prescription for the medication and were identified by the records as patients who would benefit from its use. Eligible patients received a letter explaining the importance of taking the recommended drug and an intervention letter notifying them of the copayment reduction program.

A previous publication reported the positive impact of this copayment reduction on patients' adherence to the prescribed drugs.[21] Adherence following the intervention lowered patient copayments. Nonadherence declined by about 10 percent in four of the five drug classes. These results were statistically significant. The magnitude of our findings was at the low end of the range reported in two recent literature reviews.[14,22]

ANALYSIS Preliminary statistical analysis of the spending data indicated considerable uncertainty surrounding estimates of the impact of the value-based insurance intervention on aggregate spending. This prevented us from using econometric analysis to reach any meaningful conclusions about the program's impact on overall spending. As a result, we based our conclusions on break-even analysis.

Break-even analysis solves a set of simultaneous equations to identify the assumptions necessary to justify the belief that the intervention broke even (net spending was zero).[28] The inputs were based on analysis of firm data for the baseline year (2004) and prior estimates of the impact of the intervention on adherence (Exhibit 1).

Specifically, we created a sample of employees and dependents ages 18–64 who were clinically eligible to use any of the target medications (and thus receive the intervention). People were included in the sample if they used a medication in any of the targeted drug classes within three months prior to the start of the study year, or if they were identified by ActiveHealth Management as having a clinical indication for their use but had not filled prescriptions in the previous six months and did not have a contraindication for its use.

For this sample, we computed spending in aggregate and separate for prescription drug and nondrug services by combining paid amounts by the employer and the beneficiary. We included the employer payment only for analysis based on the employer perspective, but we included both employer and beneficiary payment for the societal analysis. Spending variables were converted to per member per month figures based on the sample of enrollees eligible for the study (the per member per month numbers reflect only the study sample, not the entire population). Based on this sample, we assumed that average baseline per member per month spending (combining both adherers and non-adherers) was $420, of which 85 percent would be paid for by the firm. Sensitivity analysis explored the effects of higher nondrug spending ($500 per member per month).

Finally, based on the design of the program and treatment-firm data measuring the mix of brand-name and generic medications, we as-

EXHIBIT 1

Value-Based Insurance Design (VBID) Input Variables

Variable	Baseline assumption	Source
Adherence prior to VBID	70%	2004 firm data
VBID effectiveness	3 percentage points	Econometric analysis[a]
Baseline nondrug spending per member per month	$420	2004 firm data
Increased drug spending, society	$2.50	2004 firm data, based on cost per Rx and Rx per complier, copay change, and brand-generic distribution
Increased drug spending, employer	$7.75	2004 firm data, based on cost per Rx and Rx per complier, copay change, and brand-generic distribution
Employer share of nondrug spending	85%	2004 firm data

SOURCE Authors' analysis. [a]See Note 21 in text.

sumed that the intervention increased monthly spending on prescriptions per member by $2.50 from the broader employer and employee cost perspective and by $7.75 from the employer perspective (which includes the extra employer share of costs for prescriptions that would have been filled without the intervention).

Our assumptions about utilization were based on data from the treatment firm and from a previous analysis that examined the impact of the intervention on use of the target medications.[21] Specifically, that analysis examined the use of target medications for patients taking the medications and for those identified by ActiveHealth Management as candidates for use of the medications and thus eligible for the intervention.

We concluded that the impact on use was consistent with the intervention, increasing the number of eligible patients taking their medications from 70 percent to 73 percent. This effect reflects greater adherence among existing users and the initiation of therapy by new users, but the analysis is simplified by assuming patients either take their medication as directed, or not at all. We assumed that the effects operate by increasing the percentage of patients taking their medications as directed. Sensitivity analysis explored the impact of assuming a greater impact of the intervention on the share of users (four or five percentage points as opposed to three).

The key insight is that if we know baseline adherence, the impact of the intervention on adherence, and baseline spending, we can determine how much adherence must lower other, nondrug spending for the program to break even. We can then compare that threshold to evidence from the clinical literature to assess the plausibility that the program broke even.

Study Results

The analysis suggests that with baseline assumptions, the intervention would break even from a broader employer and employee cost perspective if adherence to drug regimens reduced nonmedical spending by 17 percent (Exhibit 2). Sensitivity analysis suggests that this threshold could be as low as 9 percent if the program was more effective (our point estimate for effectiveness was at the low end of other literature) or nonmedical costs were higher.

The comparable threshold from the employer perspective is 48 percent (Exhibit 2). That figure drops to 29 percent with more optimistic assumptions and could drop even further if one included increased productivity or decreasing disability benefits.

We have relatively little existing literature to use in assessing the reasonableness of these thresholds. Michael Sokol and colleagues report that for patients with diabetes, nondrug spending by the most adherent patients was 58 percent lower than nondrug spending for the least adherent patients. Comparable numbers for hypertensive patients, patients with high cholesterol, and patients with congestive heart failure suggest savings of 26 percent, 51 percent, and 13 percent, respectively.[29] These are generally above our estimated thresholds for break-even from the broader employer and employee cost perspective and in the ballpark of our estimated figures for break-even from the employer perspective.

Evidence from randomized clinical trials examining the impact of medications on outcomes is a bit less optimistic. Studies report reductions in adverse events as high as 45 percent and as low as 19.5 percent, depending on the medications

EXHIBIT 2

Value-Based Insurance Design (VBID) Simulation Analysis: Estimated Reduction In Nondrug Spending Associated With Adherence Necessary To Break Even

VBID effectiveness = 0.03	Employer, employee cost perspective	Firm perspective
Baseline nondrug PMPM = $420	17%	48%
Baseline nondrug PMPM = $500	15%	43%
VBID effectiveness = 0.04		
Baseline nondrug PMPM = $420	13%	39%
Baseline nondrug PMPM = $500	11%	35%
VBID effectiveness = 0.05		
Baseline nondrug PMPM = $420	11%	33%
Baseline nondrug PMPM = $500	9%	29%

SOURCE Authors' calculations based on formulas. **NOTES** "VBID effectiveness" denotes the increase in adherence due to the intervention. A parameter of 0.03 indicates a three-percentage-point increase in the number of employees adhering to their medications; and so on. For purposes of the simulation, we simplified the calculations by assuming that employees either perfectly adhere to their medications or do not adhere at all. "Baseline nondrug PMPM" (per member per month) denotes the spending on nondrug services per member per month, prior to the intervention (a weighted average of employees who adhere and those who do not). The numbers in the exhibit refer to the reduction in spending associated with adherence necessary for the intervention to break even. For example, "17%" denotes that an adherent employee spends 17 percent less on nondrug health care services than a non-adherent employee spends.

being tested and the patient population under observation.[30–38] Yet even effects of this magnitude suggest that the program may have a favorable financial profile from the broader employer and employee cost perspective and that a substantial portion of the employer costs could be offset.

Discussion

Many articles in the lay and industry media have reported favorable financial returns associated with value-based insurance. This optimism conflicts with academic studies of copayment changes, but the academic studies have focused on untargeted copayment increases.[39]

Our analysis suggests that the intervention by the large employer described above broke even (or even saved money) from a broader employer and employee cost perspective. A more targeted intervention, focusing on high-risk patients, would likely have a more favorable financial profile because nearly the same number of averted clinical adverse events would be spread over the smaller higher-risk denominator.

Yet even if the quality-enhancing value-based intervention does increase employer medical costs, there are other potential savings, such as productivity gains, that could further offset the additional prescription drug spending associated with lower copayments. Moreover, the intervention undoubtedly increased the value of medical benefits. If cost-neutrality from the employer perspective was required, this goal can be accomplished in ways that minimize harm to employee health. For example, copay increases could be implemented only for other less valuable clinical services. As the benefit design is more "clinically nuanced" to encourage high-value services and discourage low-value ones, employer costs could be controlled and health improved.

LIMITATIONS There are several limitations in these analyses. First, we did not incorporate the costs of the intervention. Any savings would have to cover the costs of the program, which we believe will not be large relative to the other costs described. Second, the analysis required a number of simplifying assumptions, such as treating all patients as either adherent or not, and assuming that existing averages for prescriptions per person and cost per prescription would persist following the intervention. It is possible that compositional changes would affect these specifications. However, this crude analysis provides a benchmark for the reasonableness of estimated savings.

Finally, we only addressed short-term effects. If the impact of value-based insurance design intervention on medication adherence grows, the needed reduction in costs to break even would decline over time. Similarly, if the effect of adherence on the risk of adverse outcomes grows, the financial profile of the intervention will improve over time.

CONCLUSIONS Despite these limitations, it seems reasonable to conclude that the effects of this intervention were worthwhile from a broader employer and employee cost perspective. The costs to employers and employees appear low, perhaps equal to zero, and the increased use of high-value health care services

is likely to improve health.

Employers face considerable pressure to control health care costs. "Across-the-board" increases in copayments—a common and tempting way to lower employer costs—may lead to negative health consequences. Value-based insurance design, through its targeted copayment changes, could mitigate those adverse effects at a low (or even negative) cost to employers and employees and thus be an important component of a broader cost containment strategy. ■

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NOTES

1 Fendrick AM, Smith DG, Chernew ME, Shah SN. A benefit-based copay for prescription drugs: patient contribution based on total benefits, not drug acquisition cost. Am J Manag Care. 2001;7(9):861–7.

2 Hensley S. From "one size fits all" to tailored copayments. Wall Street Journal. 2004 Jun 16.

3 Chernew ME, Rosen AB, Fendrick AM. Value-based insurance design. Health Aff (Millwood). 2007;26(2): w195–203.

4 Thorpe KE, Howard DH. The rise in spending among Medicare beneficiaries: the role of chronic disease prevalence and changes in treatment intensity. Health Aff 2006;25(5): w378–88.

5 Thorpe KE. Cost sharing, caps on benefits, and the chronically ill—a policy mismatch. N Engl J Med. 2006;354(22):2385–6.

6 Mahoney JJ. Reducing patient drug acquisition costs can lower diabetes health claims. Am J Manag Care. 2005;11:S170–6.

7 Freudenheim M. To save later, some employees are offering free drugs now. New York Times. 2007 Feb 21.

8 Hewitt Associates. Lincolnshire (IL): Hewitt Associates; 2007 Aug 14. Press release, Hewitt launches new tool to help companies quantify cost impact of value-based health care designs.

9 Mercer [Internet]. New York (NY): Mercer; c2009. Press release, Mercer creates advanced pharmacy benefit design based on latest medical evidence; 2008 Jan 23 [cited 2010 Jan 8]. Available from: http://www.mercer.com/summary.htm?siteLanguage=100&idContent=1293605

10 Aetna. Hartford (CT): Aetna; 2007 Dec 5. Press release, New Aetna Rx-savings program cuts cost for medications used to treat chronic health conditions.

11 Demand grows for value-based Rx plans; as insurers expand offerings, ROI is elusive. Drug Benefit News [serial on the Internet]. 2008 Jul 15 [cited 2010 Jan 8]. Available from: http://www.sph.umich.edu/vbidcenter/pdfs/dbn062708.pdf

12 Seniors' Medication Copayment Reduction Act of 2009, S 1040. 111th Cong., 1st sess. (2009).

13 Goldman DP, Joyce GF, Escarce JJ, Pace JE, Soloman MD, Laouri M, et al. Pharmacy benefits and the use of drugs by the chronically ill. JAMA. 2004;291(19):2344–50.

14 Gibson TB, Ozminkowski RJ, Goetzel RZ. The effects of prescription drug cost sharing: a review of the evidence. Am J Manag Care. 2005;11(11):730–4.

15 Gibson TB, Mark TL, McGuigan KA, Axelsen K, Wang S. The effects of prescription drug copayments on statin adherence. Am J Manag Care. 2006;12(9):509–17.

16 Roblin DW, Platt R, Goodman MJ, Hsu J, Nelson WW, Smith DH, et al. Effect of increased cost-sharing on oral hypoglycemic use in five managed care organizations: how much is too much? Med Care. 2005;43(10):951–9.

17 Japsen B. Diabetes care: employers save money after lowering costs for employees' preventative care. Chicago Tribune. 2009 May 7.

18 Fuhrmans V. New tack on copays: cutting them. Wall Street Journal. 2007 May 8.

19 Wojcik J. Free presciption drugs boost usage, cut costs: program targeting chronic conditions improves health. Business Insurance [serial on the Internet]. 2007 [cited 2010 Jan 8]. Available from: http://www.businessinsurance.com/cgi-bin/article.pl?articleId=21450

20 Sedjo RL, Cox ER. Lowering copayments: impact of simvastatin patent expiration on patient adherence. Am J Manag Care. 2008;14(12):813–8.

21 Chernew ME, Shah MR, Wegh A, Rosenberg SN, Juster IA, Rosen AB, et al. Impact of decreasing copayments on medication adherence within a disease management environment. Health Aff (Millwood). 2008;27(1):103–12.

22 Goldman DP, Joyce GF, Zheng Y. Prescription drug cost sharing: associations with medication and medical utilization and spending and health. JAMA. 2007;289(1):61–9.

23 Cranor CW, Bunting BA, Christensen DB. The Asheville project: long-term clinical and economic outcomes of a community pharmacy diabetes care program. J Am Pharm Assoc. 2003;43(2):173–84.

24 Fireman B, Bartlett J, Selby J. Can disease management reduce health care costs by improving quality? Health Aff (Millwood). 2004;23(6):63–75.

25 Cohen JT, Neumann PJ, Weinstein MC. Does preventive care save money? Health economics and the presidential candidates. N Engl J Med. 2008;358:661–3.

26 Economic analysis would focus on the marginal cost of the service, but in practice many analysts focus on the price of the service which often exceeds marginal cost. Moreover, a true societal perspective would include costs and benefits outside of the health care system, such as increased worker productivity.

27 The disease management program was a comprehensive, telephonic, nurse-staffed program. This is a fairly typical telephonic disease management program, except for its broad scope—covering thirty-two clinical conditions—and its linkage to a system of "clinical alerts," in which medical, drug, and lab claims; lab results; and a large electronic database of clinical recommendations from the medical literature are used to identify opportunities to improve clinical care. When the clinical data provided indication for the use of a specific test or medication (or a contraindication against a specific medication), the physician and patient were notified. This "clinical alerting" program was run against the employer's entire insured population several times a month. Physicians were notified of

potential clinical improvement opportunities via telephone, fax, or mail, as appropriate to the urgency of the clinical alert; and members were notified by telephone and mail if enrolled in the disease management program or by mail alone if not enrolled. To permit physicians to respond first to any clinical alerts, member notification was lagged by two to three weeks.

28 The ratio of adherer to non-adherer costs (adherence effectiveness) that would allow the firm to break even can be computed by simultaneously solving the equations for the following: (1) pre-VBID cost, (2) post-VBID cost, (3) the percentage who adhere post-VBID, (4) an effectiveness impact equation that produces dollars spent on adherers, and (5) increased drug cost. Complete equations are available in an Online Appendix; to access this appendix, click the Online Appendix link in the box to the right of the article online.

29 Sokol MC, McGuigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. Med Care. 2005;43(6):521–30.

30 Heart Protection Study Collaborative Group. MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20,536 high-risk individuals: a randomised, placebo-controlled trial. Lancet. 2002;360:7–22.

31 The SOLVD Investigators. Effect of enalapril on survival in patients with reduced left ventricular ejection fraction and congestive heart failure. N Engl J Med. 1991;325:293–302.

32 The SOLVD Investigators. Effect of enalapril on mortality and the development of heart failure in asymptomatic patients with reduced left ventricular ejection fractions. N Engl J Med. 1992;327:685–91.

33 Heart Outcomes Prevention Evaluation Study Investigators. Effects of an angiotensin converting-enzyme inhibitor, ramipril, on cardiovascular events in high-risk patients. N Engl J Med. 2000;342:145–53.

34 The EURopean trial on reduction of cardiac events with perindopril in stable coronary artery disease investigators. Efficacy of perindopril in reduction of cardiovascular events among patients with stable coronary artery disease: randomized, double-blind, placebo-controlled, multicentre trial (the EUROPA study). Lancet. 2003;362:782–8.

35 Beta-blocker Heart Attack Study Group. A randomized trial of propranolol in patients with acute myocardial infarction. II. Morbidity results. JAMA. 1983;250:2814–9.

36 Brophy JM, Joseph L, Rouleau JL. Beta-blockers in congestive heart failure: a Bayesian meta-analysis. Ann Intern Med. 2001;134:550–60.

37 Sacks FM, Pfeffer MA, Moye LA, Rouleau JL, Rutherford JD, Cole TG, et al. The effect of pravastatin on coronary events after myocardial infarction in patients with average cholesterol levels. N Engl J Med. 1996;335:1001–09.

38 Long Term Intervention with Pravastatin in Ischemic Disease (LIPID) Study Group. Prevention of cardiovascular events and death with pravastatin in patients with coronary heart disease and a broad range of initial cholesterol levels. N Engl J Med. 1998;339:1349–57.

39 Chandra A, Gruber J, McKnight R. Medical price sensitivity and optimal health insurance for the elderly. Mimeo. Boston (MA): Massachusetts Institute of Technology; 2009.