REVIEW ARTICLE

Value-Based Insurance Design and Medication Adherence: Opportunities and Challenges

Kevin A. Look, PharmD, PhD

ABSTRACT

Objectives

To evaluate the quality of existing value-based insurance design (V-BID) program evaluations on medication adherence, and to identify areas of expansion for future V-BID policy research.

Study Design

Literature review.

Methods

A structured search of the peer-reviewed literature was performed using healthcare and economic databases for studies evaluating the impact of V-BID programs on medication adherence. Characteristics of V-BID programs that may result in biased estimates for V-BID effectiveness were assessed and evaluated.

Results

A total of 20 studies assessing the effects of 17 V-BID programs were identified. Medication adherence generally improved after V-BID implementation (mean effect size 3.4% after 1 year). The V-BID evaluation literature suffers from several methodological issues, such as a lack of reporting on baseline and final adherence rates, or absolute adherence changes. Factors that may influence observed effect sizes include program characteristics, baseline adherence rates, disease category, and disease management programs. Effect sizes were much higher in studies where the primary author reported employment by the study firm or sponsor.

Conclusions

Many of the studies evaluating V-BID programs suffered from a lack of clarity when describing the methods used, or a lack of transparency when reporting results, and much of the evidence comes from studies where potential conflicts of interest exist. Authors should ensure that baseline and/or final adherence values are reported in addition to effect sizes, consistent terminology is used throughout a study, results are assessed for potential bias due to confounding factors, and due diligence has been performed to eliminate alternative explanations.

Am J Manag Care. 2015;21(1):e78-e90

Medication adherence represents a major public health concern in the United States, as poor adherence can result in increased morbidity, mortality, hospitalizations, and healthcare costs—especially among patients with chronic diseases.[1-5] Due to rising healthcare costs, patients have experienced an increasingly larger burden of their medication costs, which is associated with nonadherence to prescribed medications.[3,6-10] Value-based insurance design (V-BID) attempts to maximize healthcare quality and efficiency by reducing patient out-of-pocket costs for high-value treatments in order to increase medication adherence and reduce overall healthcare costs.[11-14] A systematic review evaluating the effects of V-BID programs concluded that these programs were consistently associated with improved adherence and lower out-of-pocket spending for drugs, although significant changes in overall medical spending were not observed.[15]

Despite the rapidly growing literature evaluating V-BID programs, concerns have been expressed about the quality of the empirical evidence supporting V-BID.[16-20] A 2011 review of V-BID evidence outlined several weaknesses of the studies available at the time, and a 2013 systematic review provided an overview of V-BID effect sizes and the impact on health expenditures.[15,18] However, the number of studies evaluating V-BID programs has nearly doubled since this last systematic review was performed. Additionally, recent studies have focused on the relationship between co-payment reductions and medication adherence, the cost neutrality of V-BID programs, and the adoption of V-BID policies, with minimal discussion of study quality. The current review was undertaken to evaluate the quality of existing V-BID program evaluations on medication adherence and to identify areas of expansion for future V-BID policy research.

METHODS

An extensive review was conducted to identify published studies that reported adherence outcomes as a result of a V-

BID approach to financing prescription drug coverage. A structured search of peer-reviewed journals was performed using PubMed, International Pharmaceutical Abstracts, EconLit, and the National Bureau of Economic Research for studies published or in press before May 2014, using the following search terms: "value based insurance design," "VBID," and "benefit based copay." The inclusion criteria for articles in this review were: 1) published in English, 2) availability of abstract and full-text publications in the databases, 3) use of a value-based insurance design approach for prescription drug coverage, and 4) reported outcome of medication adherence. Literature reviews, commentaries, and meeting extracts were excluded.

Preliminary selection of articles was made according to title and abstract, with final selection based on the manual review of full-text publications. References listed in articles that met the inclusion criteria were assessed, and if relevant, were retrieved and reviewed. Specific information extracted from the selected articles included V-BID implementation year, study population, study firm or sponsor, presence of a disease management (DM) program, sample sizes, targeted drug classes, length of study period, adherence measure used, baseline adherence rates, and adherence effect sizes. Particular attention was paid to whether the evaluation studies contained abnormally low baseline adherence rates, characteristics of included DM programs, or potential conflicts of interest, as these factors may result in biased or misleading estimates for V-BID effectiveness.

An effect size was determined for each therapeutic or drug class (eg, diuretics, beta-blockers) or drug group (eg, oral antidiabetics vs insulin) within each study. The effect size was defined as the adherence change in the treatment group minus the adherence change in the control group (if applicable). An effect size was calculated by the author for studies that did not use this definition or did not report one.

RESULTS

Of the 390 nonduplicate articles identified by the search, a total of 20 studies were selected that evaluated the effects of V-BID programs (**Figure**).[10,21-39] One study evaluated 2 separate V-BID programs,[21] while 4 studies were additional analyses of programs that had previously been evaluated and published,[29,31,34,35] for a total of 17 unique V-BID programs (**Table 1**).

V-BID Program Characteristics

Just over half (12) of the published evaluation studies were of V-BID programs implemented by 1 large employer group, with the remainder evaluating programs offered to multiple employer groups (Table 1). To date, only 1 randomized controlled trial has been performed,[10] and 1 study each has been performed in a managed care setting,[27] a preferred provider organization (PPO),[36] and solely among small employer groups (≤50 employees).[37] Five studies were of V-BID programs administered by Blue Cross Blue Shield, although 3 were analyses of the same program.[33-35,37-38]

Disease Management Programs

In total, 10 of the 17 unique V-BID programs included some type of mandatory or voluntary DM program in addition to co-payment reductions (Table 1). Four of these programs were implemented separately prior to the V-BID program,[23,24,33-36] and 6 were implemented at the same time as the program or required beneficiary enrollment as a condition for V-BID eligibility.[21,25,28-32,38] Member participation was mandatory for all but 1 of the newly implemented DM programs; participation was not mandatory in any of the DM programs implemented prior to V-BID implementation. The DM programs described in the literature varied extensively, including components such as educational mailings, nurse case management, and beneficiary requirements (eg, the completion of labs, health and wellness screenings, or questionnaires).

Sample Sizes

Intervention and control group sample sizes had great variability, ranging from 71 to 190,889 beneficiaries (**Table 2**). However, sample size reporting was not clear in several studies.[33,34,37] For example, Maciejewski et al reported 747,300 program participants and 652,161 nonparticipants.[33] However, the authors stated that the control group consisted of 176 self-funded employers representing 638,091 enrollees, which is less than the number of included nonparticipants. Additionally, actual participant and nonparticipant sample sizes used in the unmatched analysis were less than 10% of the reported sample sizes, and approximately 5% in the propensity score–matched analysis.

Targeted Drug Classes

Adherence has been measured for a limited number of medications in V-BID programs. In the 20 published V-BID evaluation studies, medication adherence has been measured in only 4 main disease categories: antidiabetics (17 studies), antihyperlipidemics (10 studies),

antihypertensives (9 studies), and medications to treat asthma (4 studies). The only exception to this categorization is 1 study that included the platelet inhibitor clopidogrel.[24]

Study Characteristics

All but 3 studies used at least 1 year of baseline adherence data,[10,21,26] with 2 studies using more than 1 year of baseline data.[25,37] Study follow-up periods ranged from 3 months to 3 years post V-BID implementation—with a 1-year follow-up period being the most common (9 studies). Prescription drug claims were used to calculate medication adherence using the medication possession ratio (MPR; 12 studies) or proportion of days covered (PDC; 7 studies), while 1 study relied on self-reported adherence data.[26] All but 2 studies reported adherence by therapeutic class or drug group: 1 study used self-reported cost-related nonadherence to diabetes medications,[26] and a second study reported overall adherence for all medications taken by beneficiaries with selected cardiovascular medical conditions.[35]

Baseline Adherence Reporting and Measurement

Baseline adherence rates could not be accurately determined for nearly half of the studies, and was particularly pronounced in earlier evaluations of V-BID programs (**Table 3**). These studies either did not report baseline adherence rates, included them only in figures or online appendices, provided 1 rate without specifying which group it applied to (ie, treatment or control), or provided only general adherence ranges.[10,22-24,27,28,31,33,34,37] Additionally, many studies only reported effect sizes and did not include final adherence rates or the change in adherence for the treatment and/or control groups.[23,24,27,28,30,31,33-35]

Baseline adherence measured using MPR or PDC in the treatment groups ranged from 9.7% to 88%. The majority of studies used some type of adjustment or matching technique to minimize baseline differences in participant demographics between the 2 groups; however, the significance of differences in baseline adherence between the treatment and control groups was not assessed in many studies, and statistically significant differences were seen in several studies despite the use of these techniques.[21,22,30] Additionally, several studies used different measures for baseline adherence, final adherence, and outcome adherence rates. For example, 3 studies provided unadjusted baseline adherence rates prior to matching, whereas the results were obtained using adjusted analyses after matching.[33-35] An additional study reported baseline adherence as the proportion of the study population with an MPR >80%, but reported an outcome of mean change in adherence between the treatment and control groups.[22]

V-BID Effect Sizes

Table 3 shows the estimated effect size of the V-BID programs on medication adherence after 1, 2, and 3 years. Effect sizes after 1 year ranged from –3% to 22.6%, with a mean improvement of 3.4%. Although decreased adherence after 1 year was seen in 6 of the V-BID programs studied, only 1 of these findings was statistically significant.[28] Likewise, the decreases in adherence seen after 2 years (3 studies) and 3 years (1 study) were nonsignificant. Effect sizes generally improved over time, with mean effect sizes of 3.5% and 4% after 2 and 3 years, respectively; however, 2 studies did find slight decreases over time.[29,36] The statistical significance of the effect sizes could not be determined for several studies, either because a final effect size was not calculated,[38] or because statistical significance was not assessed.[28,32]

The findings for V-BID programs within DM initiatives were inconsistent, and the mean effect size was identical (3.4%) after 1 year among studies with or without associated DM programs. However, the mean effect size was 2.3% with existing DM programs and 4.2% with newly implemented DM programs; this difference was also seen after 2 years (mean of 2.5% in existing programs, 4.2% in new programs). No studies were found that evaluated a V-BID program without a DM program beyond 1 year, and all studies with 3 years of post implementation data incorporated newly implemented DM programs (mean 4%).

The primary author reported employment by the study firm or study sponsor in 6 studies,[22,25,26,28,32,37] and in 6 additional studies, the study sponsor was also the study firm or involved as a research collaborator.[10,29,33-35,38] Mean effect sizes in these studies were nearly twice as large as in studies that did not report such relationships. The highest effect sizes (>6.5%) were seen in those studies in which the primary author reported employment by the study firm or study sponsor.

DISCUSSION

High-quality evidence demonstrating a meaningful impact of V-BID programs on outcomes such as medication adherence is of particular importance, as recent evidence suggests V-BID programs may not result in cost savings, or may even result in increased costs.[35,40] In

accordance with prior research, V-BID programs were consistently associated with improved adherence, with a mean increase in adherence of 3.4 percentage points over 1 year.[15,40] However, concerns about the quality of evidence available to support the V-BID concept are valid, and several study design and reporting elements were consistently identified as being in need of improvement.

Methods: Lacking Detail and Transparency

Many of the studies evaluating V-BID programs suffered from a lack of clarity when describing the methods used, or a lack of transparency when reporting results. Baseline and/or final adherence rates could not be accurately determined for nearly half of the included studies, which are particularly important when evaluating the magnitude of a change in medication adherence. This is concerning because several studies showing large effect sizes had low baseline adherence levels (<55%),[22,29,31,32] which may be evidence of "regression to the mean" instead of a clinically meaningful improvement in adherence.[41] Authors should clearly disclose baseline and/or final adherence values in addition to effect sizes.

Also of concern, several studies have utilized treatment and control groups with differing plan characteristics that are not accounted for. For example, 1 study compared treatment members enrolled in small employer group plans with control group members enrolled in large employer group plans.[37] Similarly, 3 studies used a treatment group consisting of 32,032 underwritten employers and 51 self-insured employers, of which 49% had fewer than 50 subscribers; the control group consisted of 176 self-insured employers, with 84% having more than 1000 subscribers.[33-35] If the 2 groups differed in their health characteristics or medication-taking behavior (ie, adherence), these nonequivalent control groups would result in biased treatment effects.[42] When reasonable, authors should utilize treatment and control groups with plan characteristics as similar as possible, and report the size and direction of any bias detected between the 2 groups.

Other problems related to the reporting of results were identified in V-BID program evaluations. Final treatment and control group sample sizes could not be accurately determined in several studies.[33,34,37] Additionally, several studies did not report the statistical significance of their findings,[28,32,38] or drew positive conclusions from limited study findings.[36-38] Finally, several studies[22,33-36] used different measures of baseline adherence and effect size, which can cause misleading results. For example, 1 study reported the V-BID effect size as the percentage change in adherence; actual adherence changes were approximately half as large.[36] This approach could potentially mislead readers to believe that the V-BID program studied was more effective at improving medication adherence than it actually was. Study authors should take care to ensure that consistent terminology and definitions are used throughout a study, that methods are thoroughly described, and that results (positive, neutral, and negative) are fully disclosed.

Disease Management and Other Confounders

Although nearly two-thirds of all V-BID programs studied have included a DM program, few studies have evaluated how these DM programs impact medication adherence. One such study found a significant increase in adherence in the DM group, but nonsignificant increases in the non-DM group.[30] A related study found that V-BID in combination with DM was significantly better than DM alone.[31] In contrast, a recent study of 76 V-BID plans found that plans which did not offer DM programs had a significantly greater impact on adherence than plans with DM programs when adjusting for other plan design characteristics, although the reverse was true for benefits offering wellness programs.[40]

Characteristics of the DM programs may affect how they impact medication adherence within a V-BID initiative. Factors including the intensity of DM program interactions (eg, nurse phone call vs targeted mailing), the timing of DM implementation (eg, existing vs newly implemented), and enrollment requirements (eg, mandatory vs voluntary) may impact the adherence estimates seen in V-BID studies. One study found that members receiving nurse counseling had more adherence improvements than members receiving health education mailings.[32] Additionally, research has shown that programs with barriers to enrollment (eg, laboratory testing and survey completion) may have significant implications for the overall effectiveness of V-BID initiatives.[43] This review found that V-BID programs with newly implemented DM programs had effect sizes nearly twice those of ones with existing programs, potentially due to the mandatory nature of these newly implemented DM programs. Further research is warranted into the impact of DM programs and how their characteristics impact medication adherence when used in combination with V-BID initiatives.

The impact of other potential confounding factors seen in studies of V-BID programs is still unclear. For example, 2 studies evaluated a V-BID program offered by Novartis Pharmaceuticals, which did not require cost-

sharing for Novartis products.[28,29] Although the authors reported that about one-fifth of the medications dispensed prior to program implementation were Novartis products, neither study evaluated how inclusion of these no-cost medications affected their results. Another V-BID program included member incentives valued at over $500 annually per enrollee.[38]

Mail order and 90-day medication supplies may also impact medication adherence changes in V-BID evaluations. Maciejewski et al found that adherence rates were 17 to 22 percentage points higher in every therapeutic class analyzed among enrollees who had filled at least 1 prescription for a 90-day supply of medication.[33] This is particularly concerning in that 1 study found an approximately 20% increase in mail order utilization in response to V-BID co-pay reductions.[36] Other potential issues include pharmacy auto-refill and medication synchronization programs. The majority of studies do not assess the impact of such factors and do not control for their presence, which may artificially inflate the effects of V-BID programs on medication adherence when using prescription drug claims.

Conflicts of Interest

Of particular concern, much of the evidence for the V-BID approach comes from studies in which the primary author is employed by the study firm or study sponsor, or in which the study sponsor was involved as the study firm or as a research collaborator. Although the extent of the influence study firms or sponsors have on the results of such research is unknown, this review found that these relationships may impact reported effect sizes. Authors need to ensure the transparency and independence of their research, and ensure thorough and accurate disclosure of potential conflicts of interest.

Further Research and Expansion of the V-BID Concept

Based upon the characteristics of the studies included in this review, several opportunities exist for further research on and expansion of the V-BID concept. This review found little published research in settings such as managed care organizations (MCOs), PPOs, and health maintenance organizations (HMOs), or among small employer groups.[27,36-37] The impact of a V-BID program may be greater in tightly managed settings (eg, MCOs or HMOs), and insurers that are responsible for both prescription drug and medical spending may realize a higher return on investment from a V-BID program than an insurer responsible only for prescription drug spending. Additionally, although several simulation studies exist,[44-46] no empirical studies have been performed in Medicare or Medicaid populations. Piloting and evaluating V-BID programs in different health systems may help identify where V-BID initiatives are most effective.

Previous V-BID programs in the literature have focused on treatments for a small number of diseases that have multiple low-cost generic drug options available. No published studies have included medications used in the treatment of conditions such as cancer, organ transplant, human immunodeficiency virus/AIDS, and end-stage renal disease. Patients with these conditions may greatly benefit from improved adherence and realize greater medical cost savings; however, these conditions may be less desirable from a payer perspective, as they tend to have very high drug costs and few generic alternatives. Furthermore, few studies have evaluated outcomes such as lab values or patient-centered outcomes such as member satisfaction, disease control, and affordability.[26,38] Finally, more longer-term evaluations are needed to determine the sustainability of V-BID programs on medication adherence and costs, as recent evidence suggests V-BID programs may not result in short-term cost savings or may even result in increased costs.[35,40]

CONCLUSIONS

Many of the studies evaluating V-BID programs suffered from a lack of clarity when describing the methods used or a lack of transparency when reporting results, and much of the evidence comes from studies where potential conflicts of interest exist. Authors should ensure that baseline and/or final adherence values are reported in addition to effect sizes, that consistent terminology is used throughout a study, that results are assessed for potential bias due to confounding factors, and that due diligence has been performed to eliminate alternative explanations. Improving the quality and expanding the scope of the V-BID evidence base will serve to better inform healthcare system change.

Acknowledgments

The author would like to acknowledge the helpful comments of Michelle Chui, PharmD, PhD, and David Mott, PhD, on earlier versions of this manuscript.

Author Affiliations: Social and Administrative Sciences Division, University of Wisconsin School of Pharmacy (KAL), Madison, WI.

Source of Funding: None.

Author Disclosures: The author reports no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design, acquisition of data, analysis and interpretation of data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical

analysis, administrative, technical, or logistic support, and supervision (KAL).

Address correspondence to: Kevin A. Look, PharmD, PhD, Assistant Professor, Social and Administrative Sciences Division, University of Wisconsin School of Pharmacy, 777 Highland Ave, Madison, WI 53705-2222. E-mail: Kevin.Look@wisc.edu.

REFERENCES

1. DiMatteo MR, Giordani PJ, Lepper HS, Croghan TW. Patient adherence and medical treatment outcomes: a meta-analysis. *Med Care*. 2002;40(9):794-811.

2. World Health Organization. Adherence to Long Term Therapies: Evidence for Action. Geneva, Switzerland: World Health Organization; 2003.

3. Sokol MC, McGuigan KA, Verbrugge RR, Epstein RS. Impact of medication adherence on hospitalization risk and healthcare cost. *Med Care*. 2005;43(6):521-530.

4. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med*. 2005;353(5):487-497.

5. Cramer JA, Roy A, Burrell A, et al. Medication compliance and persistence: terminology and definitions. *Value Health*. 2008;11(1):44-47.

6. Goldman DP, Joyce GF, Zheng Y. Prescription drug cost sharing: associations with medication and medical utilization and spending and health. *JAMA*. 2007;298(1):61-69.

7. Soumerai SB, Pierre-Jacques M, Zhang F, et al. Cost-related medication nonadherence among elderly and disabled Medicare beneficiaries: a national survey 1 year before the Medicare drug benefit. *Arch Intern Med*. 2006;166(17):1829-1835.

8. Choudhry NK. Copayment levels and medication adherence: less is more. *Circulation*. 2009;119(3):365-367.

9. Newhouse JP, Insurance Experiment Group. *Free for All? Lessons from the RAND Health Insurance Experiment*. Cambridge, MA: Harvard University Press; 1993.

10. Choudhry NK, Avorn J, Glynn RJ, et al; Post-Myocardial Infarction Free Rx Event and Economic Evaluation (MI FREEE) Trial. Full coverage for preventive medications after myocardial infarction. *N Engl J Med*. 2011;365(22):2088-2097.

11. 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):861-867.

12. Fendrick AM, Chernew ME. Value-based insurance design: a "clinically sensitive" approach to preserve quality of care and contain costs. *Am J Manag Care*. 2006;12(1):18-20.

13. Fendrick AM, Smith DG, Chernew ME. Applying value-based insurance design to low-value health services. *Health Aff (Millwood)*. 2010; 29(11):2017-2021.

14. Chernew ME, Rosen AB, Fendrick AM. Value-based insurance design. *Health Aff (Millwood)*. 2007;26(2):w195-w203.

15. Lee JL, Maciejewski M, Raju S, Shrank WH, Choudhry NK. Value-based insurance design: quality improvement but no cost savings. *Health Aff (Millwood)*. 2013;32(7):1251-1257.

16. Fendrick AM, Martin JJ, Weiss AE. Value-based insurance design: more health at any price. *Health Serv Res*. 2012;47(1, pt 2):404-413.

17. Choudhry NK, Rosenthal MB, Milstein A. Assessing the evidence for value-based insurance design. *Health Aff*. 2010;29(11):1988-1994.

18. Fairman KA, Curtiss FR. Still looking for health outcomes in all the wrong places? misinterpreted observational evidence, medication adherence promotion, and value-based insurance design. *J Manag Care Pharm*. 2009;15(6):501-507.

19. Melnick SJ, Motheral BR. Is value-based value wasted? examining value-based insurance designs through the lens of cost-effectiveness. *J Manag Care Pharm*. 2010;16(2):130-133.

20. Fairman KA, Curtiss FR. What do we really know about VBID? quality of the evidence and ethical considerations for health plan sponsors. *J Manag Care Pharm*. 2011;17(2):156-174.

21. Barron JJ, Cai Q, Turner RM, White JT, Amirpoor LW. Analyzing the impact of different value-based insurance design programs. *Am J Pharm Benefits*. 2012;4(1):29-36.

22. Chang A, Liberman JN, Coulen C, Berger JE, Brennan TA. Value-based insurance design and antidiabetic medication adherence. *Am J Pharm Benefits*. 2010;2(1):39-44.

23. Chernew ME, Shah MR, Wegh A, et al. Impact of decreasing copayments on medication adherence within a disease management environment. *Health Aff (Millwood)*. 2008;27(1):103-112.

24. Choudhry NK, Fischer MA, Avorn J, et al. At Pitney Bowes, value-based insurance design cut copayments and increased drug adherence. *Health Aff (Millwood)*. 2010;29(11):1995-2001.

25. Clark B, Duchane J, Hou J, Rubinstein E, McMurray J, Duncan I. Evaluation of increased adherence and cost savings of an employer value-based benefits program targeting generic antihyperlipidemic and antidiabetic medications. *J Manag Care Pharm*. 2014;20(2):141-150.

26. Elliott DJ, Robinson EJ, Anthony KB, Stillman PL. Patient-centered outcomes of a value-based insurance design program for patients with diabetes. *Popul Health Manag*. 2013;16(2):99-106.

27. Frank MB, Fendrick AM, He Y, et al. The effect of a large regional health plan's value-based insurance design program on statin use. *Med Care*. 2012;50(11):934-939.

28. Kelly EJ, Turner CD, Frech-Tamas FH, Doyle JJ, Mauceri EG. Value-based benefit design and healthcare utilization in asthma, hypertension, and diabetes. *Am J Pharm Benefits*. 2009;1(4):217-221.

29. Gibson TB, Wang S, Kelly E, et al. A value-based insurance design program at a large company boosted medication adherence for employees with chronic illnesses. *Health Aff (Millwood)*. 2011;30(1):109-117.

30. Gibson TB, Mahoney J, Ranghell K, Cherney BJ, McElwee N. Value-based insurance plus disease management increased medication use and produced savings. *Health Aff (Millwood)*. 2011;30(1):100-108.

31. Gibson TB, Mahoney JJ, Lucas K, Heithoff K, Gatwood J. Value-based design and prescription drug utilization patterns among diabetes patients. *Am J Pharm Benefits*. 2013;5(3):113-120.

32. Kim YA, Loucks A, Yokoyama G, Lightwood J, Rascate K, Serxner SA. Evaluation of value-based insurance design with a large retail employer. *Am J Manag Care*. 2011;17(10):682-690.

33. Maciejewski ML, Farley JF, Parker J, Wansink D. Copayment reductions generate greater medication adherence in targeted patients. *Health Aff (Millwood)*. 2010;29(11):2002-2008.

34. Farley JF, Wansink D, Lindquist JH, Parker JC, Maciejewski ML. Medication adherence changes following value-based insurance design. *Am J Manag Care*. 2012;18(5):265-274.

35. Maciejewski ML, Wansink D, Lindquist JH, Parker JC, Farley JF. Value-based insurance design program in North Carolina increased medication adherence but was not cost neutral. *Health Aff (Millwood)*. 2014;33(2):300-308.

36. Nair KV, Miller K, Park J, Allen RR, Saseen JJ, Biddle V. Prescription co-pay reduction program for diabetic employees. *Popul Health Manag*. 2010;13(5):235-245.

37. Rodin HA, Heaton AH, Wilson AR, Garrett NA, Plocher DW. Plan designs that encourage the use of generic drugs over brand-name drugs: an analysis of a free generic benefit. *Am J Manag Care*. 2009;15(12):881-888.

38. Wertz D, Hou L, DeVries A, et al. Clinical and economic outcomes of the Cincinnati Pharmacy Coaching Program for diabetes and hypertension. *Manag Care*. 2012;21(3):44-54.

39. Zeng F, An JJ, Scully R, Barrington C, Patel BV, Nichol MB. The impact of value-based benefit design on adherence to diabetes medications: a propensity score-weighted difference in difference evaluation. *Value Health*. 2010;13(6):846-852.

40. Choudhry NK, Fischer MA, Smith BF, et al. Five features of value-based insurance design plans were associated with higher rates of medication adherence. *Health Aff (Millwood)*. 2014;33(3):493-501.

41. Barnett AG, van der Pols JC, Dobson AJ. Regression to the mean: what it is and how to deal with it. *Int J Epidemiol*. 2005;34(1):215-220.

42. Aschengrau A, Seage GR. *Essentials of Epidemiology in Public Health*. 3rd ed. Burlington, MA: Jones and Bartlett Learning; 2014.

43. Elliott DJ, Sonnad SS, Xu X, et al. Factors associated with employee participation in a value-based insurance design initiative. *Am J Pharm Benefits*. 2013;5(6):272-278.

44. Choudhry NK, Patrick AR, Antman EM, Avorn J, Shrank WH. Cost-effectiveness of providing full drug coverage to increase medication adherence in post-myocardial infarction Medicare beneficiaries. *Circulation*. 2008;117(10):1261-1268.

45. Davidoff A, Lopert R, Stuart B, Shaffer T, Lloyd JT, Shoemaker JS. Simulated value-based insurance design applied to statin use by Medicare beneficiaries with diabetes. *Value Health*. 2012;15(3):404-411.

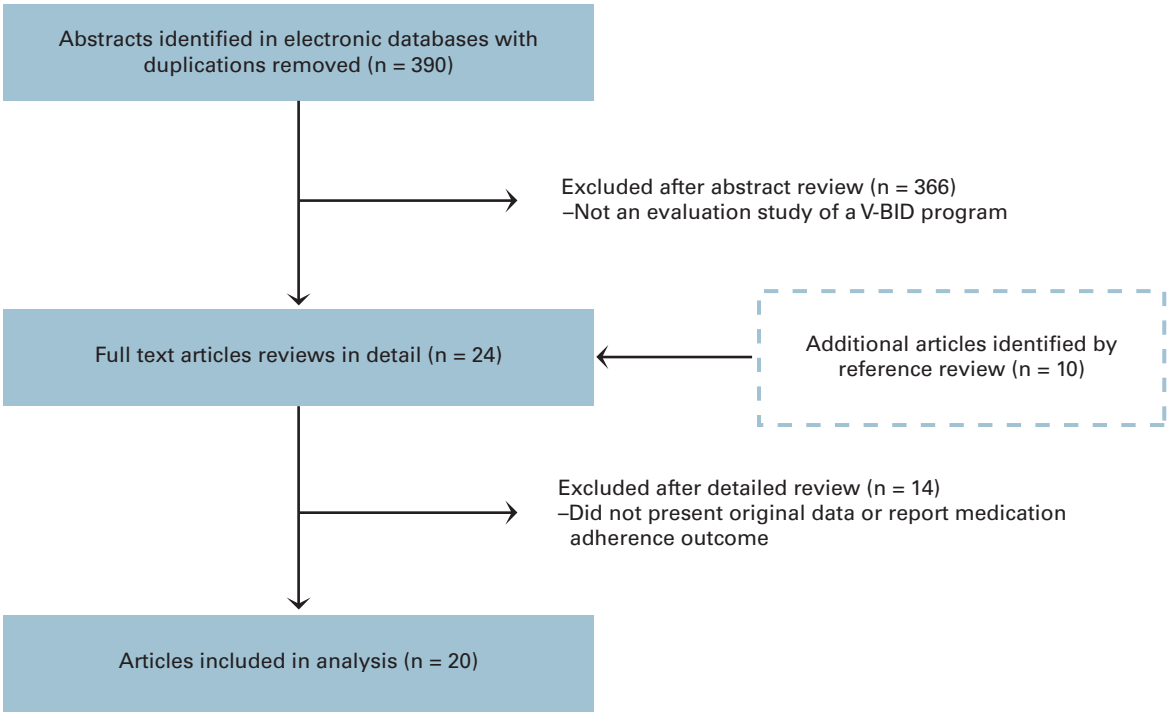
46. Rosen AB, Hamel MB, Weinstein MC, Cutler DM, Fendrick AM, Vijan S. Cost-effectiveness of full Medicare coverage of angiotensin-converting enzyme inhibitors for beneficiaries with diabetes. *Ann Intern Med*. 2005;143(2):89-99. ■

Take-Away Points

Many studies evaluating value-based insurance design (V-BID) programs suffer from a lack of clarity when describing the methods used or when reporting results, and much of the evidence comes from studies in which potential conflicts of interest exist.

- Authors should ensure that baseline and/or final adherence values are reported in addition to effect sizes, consistent terminology is used throughout a study, results are assessed for potential bias due to confounding factors, and due diligence has been performed to eliminate alternative explanations.
- Improving the quality and expanding the scope of the V-BID evidence base will serve to better inform healthcare system change.

Figure. Study Selection Flow Diagram



V-BID indicates value-based insurance design.

Table 1. Program Characteristics of Value-Based Insurance Design (V-BID) Evaluation Studies

Study Authors	Year VBID Implemented	Study Population	Study Firm or Sponsor	DM Program		
				Present	Type	Mandatory
Barron et al (2012)[21]	2005-2008	Beneficiaries in 1 northeastern state	Wellpoint	Yes	New	Yes
Barron et al (2012)[21]	2008	1 large employer	Wellpoint	No	—	—
Chang et al (2010)[22]	2007	3 CVS Caremark clients	CVS Caremark	No	—	—
Chernew et al (2008)[23]	2005	1 large employer	Marriott	Yes	Existing	No
Choudhry et al (2010)[24]	2007	1 large employer	Pitney Bowes	Yes	Existing	No
Choudhry et al (2011)[10]	2008-2010	Beneficiaries with Aetna insurance coverage	Aetna	No	—	—
Clark et al (2014)[25]	2010	1 large employer	Walgreens	Yes	New	Yes
Elliott et al (2013)[26]	2009	1 large employer	Christiana Care Health System	No	—	—
Frank et al (2012)[27]	2008	24 employer-sponsored managed care plans	Health Alliance	No	—	—
Kelly et al (2009)[28]	2005	1 large employer	Novartis	Yes	New	No
Gibson et al (2011)[29,a]	2005	1 large employer	Novartis	Yes	New	No
Gibson et al (2011)[30]	2006	1 large employer	Florida Health Care Coalition	Yes	New	No
Gibson et al (2013)[31,a]	2006	1 large employer	Florida Health Care Coalition	Yes	New	No
Kim et al (2011)[32]	2008	1 large employer	Not provided	Yes	New	Yes
Maciejewski et al (2010)[33]	2008	32,083 employer groups	BCBS of North Carolina	Yes	Existing	No
Farley et al (2012)[34,a]	2008	32,083 employer groups	BCBS of North Carolina	Yes	Existing	No
Maciejewski et al (2014)[35,a]	2008	32,083 employer groups	BCBS of North Carolina	Yes	Existing	No
Nair et al (2010)[36]	2006	1 large employer	State of Colorado	Yes	Existing	No
Rodin et al (2009)[37]	2007	44,155 beneficiaries in small employer groups	BCBS of Minnesota	No	—	—
Wertz et al (2012)[38]	2008	2 large employers	BCBS of Ohio	Yes	New	Yes
Zeng et al (2010)[39]	2007	1 large employer	Health Alliance	No	—	—

BCBS indicates Blue Cross Blue Shield; DM, disease management.
[a]Additional analysis of program previously described in literature.
New DM programs were implemented concurrently with V-BID or members were required to newly enroll in a DM program. Existing DM programs were in place for eligible beneficiaries prior to V-BID implementation.

Table 2. Study Characteristics of Value-Based Insurance Design (V-BID) Evaluation Studies

Study Authors	Intervention Sample Size[a]	Control Sample Size[a]	Targeted Drug Classes	Pre-period	Follow-up Period
Barron et al (2012)[21]	237	237	Antidiabetics	1 year	1 year
Barron et al (2012)[21]	715	497	Antidiabetics	6 months	1 year
Chang et al (2010)[22]	20,173	190,889	Antidiabetics	1 year	1 year
Chernew et al (2008)[23]	37,867	70,259	Antidiabetics, antihypertensives, statins, inhaled corticosteroids	1 year	1 year
Choudhry et al (2010)[24]	2830	49,801	Statins, clopidogrel	1 year	1 year
Choudhry et al (2011)[10]	2845	3010	Antihypertensives, statins	n/a[b]	≥3 months
Clark et al (2014)[25]	2298	2298	Antidiabetics, antihyperlipidemics	18 months	18 months
Elliott et al (2013)[26]	188	—	Antidiabetics	n/a[b]	1 year
Frank et al (2012)[27]	14,976	19,119	Statins	1 year	1 year
Kelly et al (2009)[28]	9624	—	Antidiabetics, antihypertensives, asthma medications	1 year	3 years
Gibson et al (2011)[29]	25,065	25,065	Antidiabetics, antihypertensives, asthma medications	1 year	3 years
Gibson et al (2011)[30]	1876	328	Antidiabetics	1 year	3 years
Gibson et al (2013)[31]	1876	1876	Antidiabetics	1 year	3 years
Kim et al (2011)[32]	1276	1276	Antidiabetics, antihypertensives, statins, inhaled corticosteroids	1 year	1 year
Maciejewski et al (2010)[33]	47,040[c]	83,070[c]	Antidiabetics, antihypertensives, antihyperlipidemics	1 year	1 year
Farley et al (2012)[34]	51,416[c]	51,416[c]	Antidiabetics, antihypertensives, antihyperlipidemics	1 year	2 years
Maciejewski et al (2014)[35]	22,470	22,470	Antihypertensives	1 year	2 years
Nair et al (2010)[36]	589	—	Antidiabetics	1 year	2 years
Rodin et al (2009)[37]	2401	5375	Antidiabetics, statins	2 years	2 years
Wertz et al (2012)[38]	607	557	Antidiabetics, antihypertensives, antihyperlipidemics	1 year	1 year
Zeng et al (2010)[39]	71	639	Antidiabetics	1 year	2 years

MPR indicates medication possession ratio; PDC, proportion of days covered.
[a]Sample sizes shown are the final analytical sample sizes after matching (when applicable).
[b]No pre-period data used in study.
[c]Overall analytical sample sizes not provided; calculated by the author as the sum of the sample sizes in each group before matching (Maciejewski et al 2010) or after matching (Farley et al 2012); beneficiaries using multiple medication classes may have been counted more than once.

Table 3. Effects of Value-Based Insurance Design (VBID) on Medication Adherence

		Baseline Adherence		Effect Size (%)		
Study Authors	**Drug Class**	**Treatment**	**Control**	**1 Year**	**2 Years**	**3 Years**
Barron et al (2012)[21]	All antidiabetics	76%[a]	68%[a]	–3.0		
Barron et al (2012)[21]	All antidiabetics	64%[a]	59%[a]	–1.0		
Chang et al (2010)[22]	Insulin	52.8%[a,b]	63.5%[a,b]	**9.9**[a]		
	Oral antidiabetics	53.8%[a,b]	67.6%[a,b]	**5.0**[a]		
	All antidiabetics	n/a	n/a	**7.2**[a]		
Chernew et al (2008)[23]	ACE inhibitors/ARBs	68.4%	(unspecified)	**2.6**[a]		
	Beta-blockers	68.3%	(unspecified)	**3.0**[a]		
	Antidiabetics	69.5%	(unspecified)	**4.0**[a]		
	Statins	53.0%	(unspecified)	**3.4**[a]		
	Inhaled steroids	31.6%	(unspecified)	1.9		
Choudhry et al (2010)[24]	Statins	n/a	n/a	**3.1**[a]		
	Clopidogrel	n/a	n/a	**4.2**[a]		
Choudhry et al (2011)[10]	ACE inhibitors/ARBs	n/a	n/a	**5.6**[a,c]		
	Beta-blockers	n/a	n/a	**4.4**[a,c]		
	Statins	n/a	n/a	**6.2**[a,c]		
	Overall	n/a	n/a	**5.4**[a,c]		
Clark et al (2014)[25]	Antidiabetics	81.8%	81.9%		**8.9**[a,d]	
	Antihyperlipidemics	77.7%	77.6%		**7.4**[a,d]	
Elliott et al (2013)[26]	Oral antidiabetics	68.6%[e]	(None)	**9.2**[a]		
	Insulin	76.3%[e]	(None)	1.9		
Frank et al (2012)[27]	Statins	77.6%	(unspecified)	**2.7**[a]		
Kelly et al (2009)[28]	Asthma	41%	(None)	8.0	10.0	9.0
	Antihypertensives	64%	(None)	8.0	11.0	9.0
	Antidiabetics	67%	(None)	1.0	6.0	4.0
Gibson et al (2011)[29]	Asthma	n/a	n/a	0.0	0.1	0.3
	Antidiabetics	n/a	n/a	**–0.2**[a]	–0.2	–0.1
	Cardiovascular	n/a	n/a	**0.7**[a]	**1.4**[a]	**2.0**[a]
	Overall	n/a	n/a	**0.5**[a]	**1.1**[a]	**1.8**[a]
Gibson et al (2011)[30]	All antidiabetics	38.2%[a]	33.8%[a]	1.5	2.5	3.6
	Insulin	9.7%	8.0%	0.1	0.4	0.8
	Oral antidiabetics	32.2%	28.5%	2.4	3.3	4.1
	All antidiabetics with DM	45.3%[a]	43.0%[a]	**3.7**[a]	**5.1**[a]	**6.5**[a]
	Insulin with DM	10.0%	9.9%	1.0	**1.8**[a]	**2.7**[a]
	Oral antidiabetics with DM	39.1%[a]	36.9%[a]	**3.7**[a]	**4.8**[a]	**5.8**[a]
Gibson et al (2013)[31]	Insulin	10%	n/a	**1.0**[a]	**1.8**[a]	**2.7**[a]
	Brand name oral antidiabetics	19.6%	n/a	**1.9**[a]	**3.3**[a]	**4.7**[a]
	Generic oral antidiabetics	28.2%	n/a	**4.3**[a]	**4.6**[a]	**5.1**[a]
Kim et al (2011)[32]	Oral hypoglycemics with NC	80%	75%	10.1		
	Insulin with NC	64%	58%	3.6		
	ACE inhibitor/ARB with NC	81%	77%	3.4		
	Beta-blockers with NC	84%	75%	0.5		
	Statins with NC	79%	74%	7.5		
	Inhaled steroids with NC	40%	44%	22.6		
	Oral hypoglycemics with HEM	74%	75%	8.6		
	Insulin with HEM	65%	60%	5.4		
	ACE inhibitor/ARB with HEM	81%	77%	1.6		
	Beta-blockers with HEM	76%	77%	3.5		
	Statins with HEM	74%	72%	5.3		
	Inhaled steroids with HEM	48%	52%	–2.0		

(continued)

Table 3. Effects of Value-Based Insurance Design (V-BID) on Medication Adherence *(continued)*

		Baseline Adherence		Effect Size (%)		
Study Authors	**Drug Class**	**Treatment**	**Control**	**1 Year**	**2 Years**	**3 Years**
Maciejewski et al (2010)[33]	ACE inhibitors	81-84%	81-84%	**3.1**[a]		
	ARBs[f]	77-80%	77-80%	0.0		
	Beta-blockers	81-84%	81-84%	**2.7**[a]		
	Metformin	75-76%	75-76%	**3.7**[a]		
	Calcium channel blockers	81-84%	81-84%	**1.3**[a]		
	Cholesterol absorption inhibitors[f]	77-80%	77-80%	–0.8		
	Statins	74-75%	74-75%	**2.6**[a]		
	Diuretics	77-80%	77-80%	**3.4**[a]		
Farley et al (2012)[34]	ACE inhibitors	75-83%	(unspecified)	**2.5**[a]	**4.8**[a]	
	ARBs[f]	75-83%	(unspecified)	**0.9**[a]	–0.2	
	Beta-blockers	75-83%	(unspecified)	**2.2**[a]	**4.3**[a]	
	Metformin	75-83%	(unspecified)	**3.2**[a]	**5.0**[a]	
	Calcium channel blockers	75-83%	(unspecified)	**0.9**[a]	**2.0**[a]	
	Cholesterol absorption inhibitors[f]	75-83%	(unspecified)	0.3	0.4	
	Statins	75-83%	(unspecified)	**1.4**[a]	**2.3**[a]	
	Diuretics	75-83%	(unspecified)	**2.8**[a]	**4.5**[a]	
Maciejewski et al (2014)[35]	Antihypertensives - hypertension	78.2%	78.3%	**2.2**[a,g]	**3.4**[a,g]	
	Antihypertensives - hypertension & hyperlipidemia	78.3%	78.4%	**1.6**[a,g]	**3.0**[a,g]	
	Antihypertensives - hypertension & CAD	77.4%	76.5%	2.0[g]	2.7[g]	
Nair et al (2010)[36]	Oral antidiabetics	72.2%	(None)	1.8	–0.7	
	Insulin	56.1%	(None)	**5.3**[a]	**6.4**[a]	
	Overall	70.8%	(None)	2.3	0.9	
Rodin et al (2009)[37]	Statins	n/a	n/a	**4.9**[a]		
	Sulfonylureas	n/a	n/a	0.6		
	Metformin	n/a	n/a	2.3		
	Thiazolidinediones	n/a	n/a	–1.9		
	Insulin	n/a	n/a	–0.6		
Wertz et al (2012)[38]	Antihypertensives with DCP	85%	85%	6		
	Antidiabetics with DCP	78%	74%	6		
	Statins with DCP	71%	70%	3		
	Antihyperlipidemics with DCP	76%	76%	5		
	Antihypertensives with HHCP	82%	86%	9		
	Antidiabetics with HHCP	68%	64%	14		
	Statins with HHCP	76%	73%	1		
	Antihyperlipidemics with HHCP	77%	77%	3		
Zeng et al (2010)[39]	Antidiabetics	88%	88%	2.0		

ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; CAD, coronary artery disease; DCP, diabetes coaching program; DM, disease management; HEM, health education mailing; HHCP, heart-healthy coaching program; n/a, baseline values not provided; NC, nurse counseling.
[a] $P < .05$. Bolded values indicate the effect sizes that were statistically significant at $P < .05$.
[b] Baseline adherence reported as proportion with >80% adherence.
[c] After minimum of 3 months.
[d] After 18 months.
[e] Self-reported as number of days of missed medications in the previous week.
[f] No difference in co-payments between intervention and control groups.
[g] Control group results not reported; effect size reflects adherence change in treatment group.
Effect size calculated as adherence change in treatment group minus adherence change in control group.

Table 3a. Significant Effects of Value-Based Insurance Design (V-BID) on Medication Adherence

		Baseline Adherence		Effect Size (%)		
Study Authors	**Drug Class**	**Treatment**	**Control**	**1 Year**	**2 Years**	**3 Years**
Chang et al (2010)[22]	Insulin	52.8%[a,b]	63.5%[a,b]	**9.9**[a]		
	Oral antidiabetics	53.8%[a,b]	67.6%[a,b]	**5.0**[a]		
	All antidiabetics	n/a	n/a	**7.2**[a]		
Chernew et al (2008)[23]	ACE inhibitors/ARBs	68.4%	(unspecified)	**2.6**[a]		
	Beta-blockers	68.3%	(unspecified)	**3.0**[a]		
	Antidiabetics	69.5%	(unspecified)	**4.0**[a]		
	Statins	53.0%	(unspecified)	**3.4**[a]		
Choudhry et al (2010)[24]	Statins	n/a	n/a	**3.1**[a]		
	Clopidogrel	n/a	n/a	**4.2**[a]		
Choudhry et al (2011)[10]	ACE inhibitors/ARBs	n/a	n/a	**5.6**[a,c]		
	Beta-blockers	n/a	n/a	**4.4**[a,c]		
	Statins	n/a	n/a	**6.2**[a,c]		
	Overall	n/a	n/a	**5.4**[a,c]		
Clark et al (2014)[25]	Antidiabetics	81.8%	81.9%		**8.9**[a,d]	
	Antihyperlipidemics	77.7%	77.6%		**7.4**[a,d]	
Elliott et al (2013)[26]	Oral antidiabetics	68.6%[e]	(None)	**9.2**[a]		
Frank et al (2012)[27]	Statins	77.6%	(unspecified)	**2.7**[a]		
	Antidiabetics	n/a	n/a	**–0.2**[a]	–0.2	–0.1
	Cardiovascular	n/a	n/a	**0.7**[a]	**1.4**[a]	**2.0**[a]
	Overall	n/a	n/a	**0.5**[a]	**1.1**[a]	**1.8**[a]
	All antidiabetics with DM	45.3%[a]	43.0%[a]	**3.7**[a]	**5.1**[a]	**6.5**[a]
	Insulin with DM	10.0%	9.9%	1.0	**1.8**[a]	**2.7**[a]
	Oral antidiabetics with DM	39.1%[a]	36.9%[a]	**3.7**[a]	**4.8**[a]	**5.8**[a]
Gibson et al (2013)[31]	Insulin	10%	n/a	**1.0**[a]	**1.8**[a]	**2.7**[a]
	Brand name oral antidiabetics	19.6%	n/a	**1.9**[a]	**3.3**[a]	**4.7**[a]
	Generic oral antidiabetics	28.2%	n/a	**4.3**[a]	**4.6**[a]	**5.1**[a]
Maciejewski et al (2010)[33]	ACE inhibitors	81-84%	81-84%	**3.1**[a]		
	Beta-blockers	81-84%	81-84%	**2.7**[a]		
	Metformin	75-76%	75-76%	**3.7**[a]		
	Calcium channel blockers	81-84%	81-84%	**1.3**[a]		
	Statins	74-75%	74-75%	**2.6**[a]		
	Diuretics	77-80%	77-80%	**3.4**[a]		
Farley et al (2012)[34]	ACE inhibitors	75-83%	(unspecified)	**2.5**[a]	**4.8**[a]	
	ARBs[f]	75-83%	(unspecified)	**0.9**[a]	–0.2	
	Beta-blockers	75-83%	(unspecified)	**2.2**[a]	**4.3**[a]	
	Metformin	75-83%	(unspecified)	**3.2**[a]	**5.0**[a]	
	Calcium channel blockers	75-83%	(unspecified)	**0.9**[a]	**2.0**[a]	
	Statins	75-83%	(unspecified)	**1.4**[a]	**2.3**[a]	
	Diuretics	75-83%	(unspecified)	**2.8**[a]	**4.5**[a]	
Maciejewski et al (2014)[35]	Antihypertensives - hypertension	78.2%	78.3%	**2.2**[a,g]	**3.4**[a,g]	
	Antihypertensives - hypertension & hyperlipidemia	78.3%	78.4%	**1.6**[a,g]	**3.0**[a,g]	
Nair et al (2010)[36]	Insulin	56.1%	(None)	**5.3**[a]	**6.4**[a]	
Rodin et al (2009)[37]	Statins	n/a	n/a	**4.9**[a]		

ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; DM, disease management; n/a, baseline values were not provided.
[a] $P < .05$. Bolded values indicate the effect sizes that were statistically significant at $P < .05$.
[b] Baseline adherence reported as proportion with >80% adherence.
[c] After minimum of 3 months.
[d] After 18 months.
[e] Self-reported as number of days of missed medications in the previous week.
[f] No difference in co-payments between intervention and control groups.
[g] Control group results not reported; effect size reflects adherence change in treatment group.
Effect size is calculated as adherence change in treatment group minus adherence change in control group.

Table 3b. Nonsignificant Effects of Value-Based Insurance Design (V-BID) on Medication Adherence

		Baseline Adherence		Effect Size (%)		
Study Authors	**Drug Class**	**Treatment**	**Control**	**1 year**	**2 years**	**3 years**
Barron et al (2012)[21]	All antidiabetics	76%[a]	68%[a]	–3.0		
Barron et al (2012)[21]	All antidiabetics	64%[a]	59%[a]	–1.0		
Chernew et al (2008)[23]	Inhaled steroids	31.6%	(unspecified)	1.9		
Elliott et al (2013)[26]	Insulin	76.3%[b]	(None)	1.9		
Kelly et al (2009)[28]	Asthma	41%	(None)	8.0	10.0	9.0
	Antihypertensives	64%	(None)	8.0	11.0	9.0
	Antidiabetics	67%	(None)	1.0	6.0	4.0
Gibson et al (2011)[29]	Asthma	n/a	n/a	0.0	0.1	0.3
	Antidiabetics	n/a	n/a	**–0.2**[a]	–0.2	–0.1
Gibson et al (2011)[30]	All antidiabetics	38.2%[a]	33.8%[a]	1.5	2.5	3.6
	Insulin	9.7%	8.0%	0.1	0.4	0.8
	Oral antidiabetics	32.2%	28.5%	2.4	3.3	4.1
	Insulin with DM	10.0%	9.9%	1.0	**1.8**[a]	**2.7**[a]
Kim et al (2011)[32]	Oral hypoglycemics with NC	80%	75%	10.1		
	Insulin with NC	64%	58%	3.6		
	ACE inhibitor/ARB with NC	81%	77%	3.4		
	Beta-blockers with NC	84%	75%	0.5		
	Statins with NC	79%	74%	7.5		
	Inhaled steroids with NC	40%	44%	22.6		
	Oral hypoglycemics with HEM	74%	75%	8.6		
	Insulin with HEM	65%	60%	5.4		
	ACE inhibitor/ARB with HEM	81%	77%	1.6		
	Beta-blockers with HEM	76%	77%	3.5		
	Statins with HEM	74%	72%	5.3		
	Inhaled steroids with HEM	48%	52%	–2		
Maciejewski et al (2014)[35]	Antihypertensives - Hypertension & CAD	77.4%	76.5%	2.0[c]	2.7[c]	
Nair et al (2010)[36]	Oral antidiabetics	72.2%	(None)	1.8	–0.7	
	Overall	70.8%	(None)	2.3	0.9	
Rodin et al (2009)[37]	Sulfonylureas	n/a	n/a	0.6		
	Metformin	n/a	n/a	2.3		
	Thiazolidinediones	n/a	n/a	–1.9		
	Insulin	n/a	n/a	–0.6		
Wertz et al (2012)[38]	Antihypertensives with DCP	85%	85%	6		
	Antidiabetics with DCP	78%	74%	6		
	Statins with DCP	71%	70%	3		
	Antihyperlipidemics with DCP	76%	76%	5		
	Antihypertensives with HHCP	82%	86%	9		
	Antidiabetics with HHCP	68%	64%	14		
	Statins with HHCP	76%	73%	1		
	Antihyperlipidemics with HHCP	77%	77%	3		
Zeng et al (2010)[39]	Antidiabetics	88%	88%	2.0		

ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; CAD, coronary artery disease; DCP, diabetes coaching program; DM, disease management; HEM, health education mailing; HHCP, heart-healthy coaching program; n/a, baseline values were not provided; NC, nurse counseling.
[a] $P < .05$. Bolded values indicate the effect sizes that were statistically significant at $P < .05$.
[b] Self-reported as number of days of missed medications in the previous week.
[c] Control group results not reported; effect size reflects adherence change in treatment group.
Effect size is calculated as adherence change in treatment group minus adherence change in control group.