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### Authors

Williams, Jessica  
Steers, William N  
Ettner, Susan L  
[et al.](#)

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## Cost-related Nonadherence by Medication Type among Medicare Part D Beneficiaries with Diabetes

Jessica Williams, MA<sup>#</sup>, W. Neil Steers, PhD<sup>\*</sup>, Susan L. Ettner, PhD<sup>\*,#</sup>, Carol M. Mangione, MD, MSHS<sup>\*,#</sup>, and O. Kenrik Duru, MD, MSHS<sup>\*</sup>

<sup>\*</sup>David Geffen School of Medicine, University of California, Los Angeles, California.

<sup>#</sup>Department of Health Services, School of Public Health, University of California, Los Angeles, California.

### Abstract

**Background**—Despite the rollout of Medicare Part D, cost-related non-adherence (CRN) among older adults remains a problem.

**Objectives**—To examine the rate and correlates of self-reported CRN among a population of older persons with diabetes.

**Research Design**—Cross-sectional.

**Subjects**—1,264 Part D patients with diabetes, who entered the coverage gap in 2006.

**Measures**—Initial administrative medication lists were verified in computer-assisted telephone interviews, in which participants brought their medication bottles to the phone. Medications were classified into cardiometabolic (diabetes, hypertension, cholesterol-lowering), symptom relief, and “other.” Participants were asked if they had any cost-related non-adherence during 2006, and if so to which medication/s. We used the person-medication dyad as the unit of analysis, and tested a multivariate random effects logistic regression model to analyze the correlates of CRN.

**Results**—Approximately 16% of participants reported any CRN. CRN was more frequent for cholesterol-lowering medications [Relative risk 1.54, 95%CI 1.01-2.32] compared to medications taken for symptom relief. CRN was reported less frequently with increasing age above 75 years, compared to patients between 65 and 69. In addition, compared to those with incomes >\$40,000, CRN risk for those with incomes <\$25,000 was markedly higher [RR 3.05, 95%CI 1.99-4.65].

**Conclusions**—In summary, we found high rates of CRN among Medicare beneficiaries with diabetes, particularly those with lower incomes. We observed more frequent CRN for cholesterol-lowering medications as compared to medications for symptom relief. Efforts to ensure medication affordability for this population will be important in boosting adherence to key medications.

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Only about 50% of patients with chronic conditions routinely take their medicine as directed [1]. Diabetic patients’ nonadherence to medication is associated with adverse health outcomes, including increased hospitalization rates and higher mortality [2-6]. Patients

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Correspondence: Obidiugwu Kenrik Duru, MD, MSHS, Division of General Internal Medicine/Health Services Research, David Geffen School of Medicine, University of California, Los Angeles, 911 Broxton Avenue, Los Angeles, CA 90024. Telephone: (310) 794-8138. Fax: (310) 794-0723. kduru@mednet.ucla.edu.

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report many reasons for nonadherence such as forgetfulness, desire to avoid adverse medication side effects, and the relatively high costs of some medications [2]. Efforts to increase overall adherence often focus specifically on decreasing cost-related nonadherence because it is relatively common and can be addressed with policy-based approaches. Cost-related nonadherence (CRN) among older adults has been documented prior to the initiation of the Medicare Part D program and remains a significant problem, with recent published estimates of CRN ranging from 13% to 36% [7-10].

The existing research on CRN is somewhat limited, as the vast majority of papers examining CRN have used administrative data to calculate adherence, rather than direct patient report. Most of these papers have also used observed patient responses to cost sharing such as changes in copayment rates or prescription tiering strategies, to infer indirectly that nonadherence is associated with higher out of pocket costs [11-16]. Some authors have found that people are more likely to cut back on medications that they consider “less” necessary or medications for which an over-the-counter substitution is readily available [17-18]. However, while other studies have directly asked patients to report the types of medications they use less often due to cost (e.g., anti-hypertensives, cholesterol-lowering medications), research shows that many older patients do not in fact know the indication for all of their medications [19]. Few studies have reconciled administrative pharmacy data with actual medication bottles in the patient’s possession to determine rates of CRN among older adults.

Using data collected as part of the Translating Research into Action for Diabetes (TRIAD) Part D Study, the main objective of this analysis is to examine the overall rate of self-reported CRN among a population of older persons with diabetes who entered the Part D coverage gap in 2006. Data on CRN were obtained during telephone interviews in which patients were asked to bring all of their medication bottles to the phone, and self-report CRN for any medication they were currently taking.

In this group of elderly Medicare beneficiaries with diabetes, we hypothesized that beneficiaries would be less likely to report CRN for their medications treating chronic conditions (diabetes, high blood pressure, or high cholesterol) than for their medications used primarily for symptom relief. We **simultaneously** investigated the possibility that CRN is associated with beneficiaries’ socio-demographic characteristics. In particular, we hypothesized that having higher income will make CRN less likely after controlling for other factors.

## Methods

### Study Design and Setting

TRIAD, a multicenter study of persons with diabetes cared for in managed care settings, has been described in detail elsewhere [20,21]. This analysis uses data from a TRIAD cross-sectional survey specifically examining the experiences of participants in 8 western states with Medicare Part D during 2006. The crude response rate for the survey was 58.1%. There were no differences between responders/non-responders in % female, out-of-pocket (OOP) quarterly costs, and number of meds prescribed, but responders were older than non-responders. The survey was administered between April and October 2007 to beneficiaries enrolled in one of two benefit designs within 1) a staff-model non profit Medicare Part D Advantage (MAPD) plan, 2) a network-model MAPD plan, or 3) a freestanding Prescription Drug Plan (PDP). Some beneficiaries in the PDP or network-model MAPD plans had coverage for generic but not brand name drugs while they were in the coverage gap (from \$2,250 in total drug costs to \$3,600 in out-of-pocket drug costs), while others had no coverage while in the gap—leaving them to pay for their medications entirely out-of-pocket.

Beneficiaries in the staff-model MAPD plan had the standard plan with no drug coverage in the gap.

The survey was administered by CATI to beneficiaries who entered the coverage gap in 2006. The interviewers began with a pre-populated list of medications for each beneficiary, drawn from administrative pharmacy claims data. Before asking about CRN, interviewers asked participants to bring their prescription medications to the phone in order to record adherence for medications not present in the pharmacy claims, and to verify the accuracy of the claims-based medication list. If the patient reported that they had discontinued one of the medications on the administrative list, they were not asked any additional questions about the medication. After interviewers verified which medications patients were taking, they asked whether the participant had any CRN to *any* of their medications during 2006. If participants answered “yes” to this question, interviewers followed up by asking which specific medications participants took less of because of cost. The institutional review board at the University of California-Los Angeles approved the protocol for this study.

### Participants

The TRIAD survey randomly sampled beneficiaries who were 65 years or older by January 1, 2005, and who had total drug costs exceeding the \$2,250 gap threshold by October 1, 2006. Beneficiaries had to be continuously enrolled in an MAPD plan from January 1, 2005 until December 31, 2006 or newly enrolled in a PDP plan between November 15, 2005 and March 1, 2006 and continuously enrolled until December 31, 2006 to be eligible for the sample. We excluded Medicare beneficiaries who had a low-income subsidy (because these patients had no coverage gap), those who had full prescription drug coverage in the gap, and those who could not provide informed consent.

### Variables

The dependent variable was whether the patient had any CRN for the medication in the patient-medication dyad. As in previous studies, CRN was defined to include any of the following self-reported behaviors specifically attributed to costs: delayed or stopped refills, skipped doses or otherwise used less medication than prescribed [22]. To understand the patterns of CRN in the study sample, we developed categories of medications based on chronic conditions of the participants. We focused mainly on medications to treat diabetes, hypertension, or high cholesterol because of the importance of medication adherence for treatment of these conditions among diabetes patients. We grouped medications together that are largely prescribed for symptom control, including those for pain, cough, allergies, insomnia, upset stomach, dermatitis, urinary incontinence, erectile dysfunction, itching and muscle cramps (see Appendix, hereafter “symptom relief medications”). These symptom relief medications may improve a patient’s quality of life but would not be necessarily detrimental to health if not taken. Many of these medications are prescribed on an “as needed” basis, for the patient to determine the dosing schedule based on individual symptoms. CRN for these medications implies that patients took less than they felt they needed, because of cost. All medications not otherwise classified were grouped together as “other.”

The main predictors of interest were indicators for the type of medication, specifically diabetes, hypertension, cholesterol-lowering, symptom relief, and other. Our multivariate analysis also included comorbidity count, out-of-pocket costs in the first quarter of 2006, **age, an indicator for gender**, race/ethnicity (white non-Hispanic, Hispanic, African American, Asian/Pacific Islander, and all other), educational attainment (less than high school, high school graduate, some college, and college graduate or higher), annual income

(less than \$25K, \$25-40K, and greater than \$40K), and indicators for the **participant's plan type and** whether the participant had any coverage for prescription medications in the gap.

Race/ethnicity, education, and income were taken from the participant survey. The summed, non-weighted comorbidity count included the following self-reported chronic conditions: congestive heart failure, chronic obstructive pulmonary disease, depression, non-skin cancer, history of myocardial infarction, narrowing of arteries, angina, hypertension, hyperlipidemia, stroke, chronic bronchitis, asthma, bleeding ulcer, and osteoporosis. Finally, out-of-pocket medication costs in the first quarter of 2006 and whether the participant had any prescription medication coverage **during the gap** were obtained from prescription claims.

## Statistical Methods

Some individuals were missing key data components and we handled these missing values in **two** ways. A few individuals reported that they had some CRN in 2006 but could not identify the specific medications of which they took less. Because we could not determine the bias introduced by these individuals, we excluded them from the analysis. As is common in survey data, some individuals were missing annual income information. These values were filled in with the median values from the beneficiaries' Census block from the 2000 Census. We calculated unadjusted percentages of CRN, as well as basic demographic and clinical characteristics, at the individual level (Table 1).

**However, our** unit of analysis **for multivariate models** was the person-medication dyad (Table 2). In other words, if an individual was taking two different **medications**, a diuretic (e.g. hydrochlorothiazide) and a beta-blocker (e.g. metoprolol), each **medication** counted as a separate observation—yielding two **separate** observations for that individual within the analysis. There were five possible types of person-medication dyads in the analysis, corresponding to the medication classifications we used: diabetes, hypertension, cholesterol-lowering, symptom relief, and other.

We used multivariate logistic regression to analyze the determinants of CRN. The dependent variable was equal to 1 if the individual reported CRN for that **medication** during 2006 and equal to 0 if they did not. Given that our unit of analysis was the person-medication dyad, we used a hierarchical model with individual random intercepts to control for clustering of medications within individuals [23]. We included several covariates in model as well as indicators for the type of **medication** class. We calculated relative risks when the coefficient estimates were statistically significant, for ease of interpretation, and simulated their associated 95% confidence intervals using multiple draws from a multivariate normal distribution of the parameter's RR [24-26]. We used SAS version 9.1.2 for the analyses (SAS Inc., Cary, NC).

## Results

### The initial sample size was 1,502 CATI participants

Sixty-one participants reported CRN in 2006, but could not identify which medications they took less **than prescribed**. We dropped these participants from the analysis sample. Income values were backfilled for 181 individuals in the sample. An additional 78 were excluded due to missing data on at least one covariate. The survey included 99 participants who were believed to have entered the gap in 2006 at the time the sample was drawn, but were later found to have not in fact crossed the cost threshold for gap entry; these participants were therefore excluded. The final analytic sample **included 1,264 participants, taking a total of 11,991 medications**. About 87% of medications reported as being “currently taken”

matched those on the pre-populated administrative list, with the remaining 13% of medications reported additionally by participants.

Approximately 16% of individuals in the analytic sample reported CRN to at least one medication. Among participants in the analytic sample, about 5% of participants taking diabetes medications reported CRN to at least one of their diabetes medications (Table 1). Slightly higher rates of CRN to condition-specific medications were observed for the cholesterol-lowering (6%) and hypertension (6%) medication groups. Seven percent of participants reported CRN to at least one of their symptom relief medications and 11% of participants reported CRN to at least one medication not otherwise classified. Thirty-eight percent of the patients in the sample reported taking at least one medication from each of the 5 categories. The majority of the participants were white (74%) and the mean age was 74.7 years (standard deviation 5.6). **Slightly more than 40%** of the participants reported income of at least \$40,000 a year and just over half reported having at least some college education. The mean comorbidity count was 4.9 (SD 2.3), and mean out-of-pocket medication cost in the first quarter of 2006 was \$350 (SD=\$260).

In the multivariate analysis, there were 11,991 person-medication dyads. Reports of CRN were more frequent for cholesterol-lowering medications [Relative risk 1.54, 95% CI 1.01-2.32] and “other” medications [RR 1.40, 95% CI 1.00-1.95] as compared to medications taken for symptom relief (Table 2, for odds ratios from the logistic regression see Table, Supplemental Digital Content 1). Reports of CRN were also more frequent for cholesterol-lowering medications compared to diabetes medications (RR 1.03, 95% CI 1.54-2.30) and for cholesterol-lowering medications compared to hypertension medications (RR 1.13, 95% CI 1.63-2.37) (data not shown). Compared to ages 65-69, older age categories were associated with lower risk of CRN. CRN was less than half as likely for someone aged 75-79 years (RR=0.46, 95% CI 0.28-0.76), or 80-84 years (RR=0.42, 95% CI 0.23-0.79), and one-third as likely for those aged 85 years or older (RR=0.30, 95% CI 0.11-0.79). In addition, CRN risk for those with annual incomes under \$25K per year (RR=3.05, 95% CI=1.99-4.65) was three times the risk of those earning at least \$40K per year. Furthermore, CRN risk for high school **graduates** (RR=0.45, 95% CI 0.27-0.77) was about half the CRN risk for **individuals with at least 4 years of** college, although no other significant differences were seen for other education categories.

## Discussion

Using a technique of medication reconciliation to combine administrative data records with real-time assessment including medication bottles on hand, we found a 16% prevalence of cost-related nonadherence to any medication in 2006, among a sample of Medicare beneficiaries. These numbers are similar to other **CRN estimates (11.5% to 14.3%)** obtained using alternate methods **and data from the nationally representative** Medicare Current Beneficiaries' Survey [27,28]. The specific key findings in our report are the associations between increased CRN and cholesterol-lowering medication (relative to symptom relief medication), between decreased CRN and advancing age, and between increased CRN and annual income below \$25,000 (relative to income of \$40,000 or more). Although we found a statistically significant coefficient for one of the education categories, there was no pattern in the results.

The finding of greater CRN for cholesterol-lowering medications is particularly noteworthy **and did not match our hypothesis**. Previous studies have found reduced adherence to statins over time, with the greatest decline occurring in the first six months among elderly patients with chronic conditions [29,30]. Based on data from clinical trials such as the Heart Protection Study, patients with diabetes or who had a prior myocardial infarction or stroke

have approximately a 20-25% reduction in risk for a cardiovascular event with good adherence to cholesterol-lowering medications [31]. Therefore, finding ways to minimize CRN, especially in the context of the high-risk population in this study, should reduce the rate of these complications. In fact, the Accountable Care Act of 2010 (**ACA**) proposes to eliminate the coverage gap by 2020. However, that does not mean that the trend of increased cost shifting to patients will necessarily decrease across the marketplace.

In fact, many health insurers are now offering drug benefit packages that place increased cost-sharing burdens on patients. These include high-deductible health plan (HDHPs), employer offerings of which have increased 16% since 2006 [32]. The HDHPs have similar aspects to the Part D coverage gap. Specifically, patients in HDHPs bear the full cost of prescriptions until they reach an out-of-pocket threshold. Our results may indicate that patients in these types of plans could also be at increased risk of CRN to essential medications when faced with cost pressures.

Our finding of lower CRN with advancing age up to 85 years and older is consistent with several prior studies before the Medicare Part D benefit was enacted [8, 33]. Our finding of an approximately 3-fold CRN for low-income patients is also consistent with earlier work prior to Part D **with diabetic patients** [34]. Low-income Medicare beneficiaries that do not automatically receive the low-income Part D subsidy as a result of ongoing Medicaid enrollment are eligible to apply for this subsidy, if they meet pre-specified income and asset cutoffs (in 2006, individual income less than \$14,700 per year) [35]. While low-income subsidy (LIS) beneficiaries were excluded from our sample because they did not face the coverage gap, these beneficiaries may still face cost pressures from co-payments. Still, our findings suggest that increasing enrollment of eligible patients into the LIS program and/or liberalizing the income and asset thresholds may reduce CRN among vulnerable low-income patients by reducing the amount they have to pay for prescriptions.

There are many other possible strategies for reducing CRN, several of which can be pursued by physicians such as 1) prescribing generic medications whenever possible, 2) pursuing the use of less expensive therapeutic substitutions and 3) talking to patients about nonadherence. One possible approach would be to review the medication list, prioritize what is essential, and consider discontinuing medications that may be less effective or may not be needed. This would have the double benefit of reducing costs as well as reducing possible complications related to polypharmacy, which is extremely common in our sample. Although the evidence on the effectiveness of medication therapy management programs has been mixed, these programs have the potential to increase medication adherence and additional studies in this area would be beneficial [36-38].

There were several limitations to our study. We did not have prescription drug claims for the entire sample population so we could not use prescription fills as a comparison to the self-reported CRN data. We also had a portion of the sample, about 4%, who reported CRN in general but who could not report which medications were affected. Our measure of overall medication cost burden was drawn from the first quarter of the 2006 study year, so there is a possibility of reverse causality if CRN very early in the year led to lower medication costs. We also do not know how participants specifically chose the medications to cut back on—a much more detailed survey would be needed to answer this particular question. Our sample was not geographically representative of all Medicare beneficiaries with diabetes, and differed somewhat in terms of national demographic characteristics, including relatively more Latinos and fewer African Americans [39]. Our sample also had a slightly higher annual income than the overall Medicare population [40]. Because our sample may have had fewer financial constraints given their higher average income, it is possible that the degree of CRN was lower than it would be for diabetic Medicare beneficiaries overall.

Furthermore, our sample was limited to patients who entered the coverage gap, which represent the highest-spending Medicare beneficiaries. However, rates of gap entry among older adults with chronic conditions are generally high, and prior analyses indicate that among Medicare beneficiaries, 35% with dementia, 23% with coronary artery disease, and 22% with congestive heart failure entered the coverage gap in 2006 [41]. The results of our study are salient to the millions of patients with chronic conditions such as these who enter the coverage gap; these patients represent a substantial segment of the Medicare population and have disproportionate policy impact.

In summary, using an approach that combined administrative medication data with real-time telephone assessments based on actual patient medication bottles, we found a high rate of cost-related nonadherence among a population of Medicare beneficiaries with diabetes. In addition, we observed more frequent CRN for cholesterol-lowering medications as compared to medications for symptom relief or for hypertension or diabetes control. Medicare beneficiaries with diabetes are at high risk of CRN, particularly of non-adherence to statin medications that have been proven to reduce the risk of future events.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## APPENDIX: Medications prescribed for symptom relief

### Pain relievers

Acetaminophen/codeine

Butalbital/acetaminophen/caffeine

Carisopr/asa

Diclofenac

Dicyclomine

Hydrocodone/acetaminophen

Hydrocodone/ibuprofen

Endocet

Etodolac

Fentanyl

Flexeril

Gabapentin

Glucosamine

Hydromorphone

Hyoscyamine

Ibuprofen



Imipramine  
Indomethacin  
Midrin  
Ketoprofen  
Ketorolac  
Lidocaine  
Pregabalin  
Meloxicam  
Methocarbamol  
Morphine  
Nabumetone  
Naprosyn  
Nortryptiline  
Orphenadrine  
Oxycodone  
Oxycodone/acetaminophen  
Piroxicam  
Propoxyphene  
Propoxyphene/acetaminophen  
Ropinirole  
Salsalate  
Sulindac  
Tramadol  
Tegaserod

### **Cough medications**

Benzonatate  
Guafenesin/codeine  
Guafenesin/phenylephrine  
Promethazine/codeine

HC-tussive syrup

### **Allergy medications**

Azelastine nasal spray

Diphenhydramine

Fexofenadine

Fluticasone nasal spray

Mometasone

Ipratropium nasal spray

Loratadine

Meclizine

Triamcinolone nasal spray

Cortisporin otic

Prochlorperazine

Rhinocort nasal spray

Cetirizine

### **Insomnia medications**

Amitriptyline

Eszopiclone

Zaleplon

Zolpidem

### **Anxiety medications**

Alprazolam

Diazepam

Flurazepam

Lorazepam

Oxazepam

Temazepam

### **Dyspepsia/upset stomach medications**

Carafate

Famotidine

Metoclopramide

Ranitidine

### **Dermatitis medications**

Betamethasone cream

Econazole nitrate cream

Fluocinonide

Hydrocortisone

Metronidazole gel

Mupirocin

Pimecrolimus

Tretinoin

Triamcinolone

### **Urinary incontinence medications**

Oxybutynin

Phenazopyridine

Solifenacin

Tolterodine

### **Constipation medications**

Docusate sodium

Senna

### **Diarrhea medications**

Diphenoxylate/atropine

### **Erectile dysfunction medications**

Alprostadil

Vardenafil

Sildenafil

## Pruritis/itching relief medications

Hydroxyzine

Doxepin

## Hair loss medications

Propecia

## Medications to relieve muscle cramping

Quinine

## Medications for nausea

Anzemet

## References

1. DiMatteo MD, Giordani PJ, Lepper HS, et al. Patient adherence and medical treatment outcomes: a meta-analysis. *Med Care*. 2002; 40:794–811. [PubMed: 12218770]
2. Ho PM, Rumsfeld JM, Masoudi FA, et al. Effect of medication nonadherence on hospitalization and mortality among patients with diabetes mellitus. *Arch Intern Med*. 2006; 17:1836–1841. [PubMed: 17000939]
3. Pladevall M, Williams LK, Potts LA, et al. Clinical outcomes and adherence to medications measured by claims data in patients with diabetes. *Diabetes Care*. 2004; 27:2800–2805. [PubMed: 15562188]
4. Sokol MC, McGuigan KA, Verbrugge RR, et al. Impact of medication adherence on hospitalization risk and healthcare cost. *Med Care*. 2005; 43:521–530. [PubMed: 15908846]
5. Lau DT, Nau DP. Oral antihyperglycemic medication nonadherence and subsequent hospitalization among individuals with Type 2 Diabetes. *Diabetes Care*. 2004; 27:2149–2153. [PubMed: 15333476]
6. Piette JD, Wagner TH, Potter MB, et al. Health insurance status, cost-related medication underuse, and outcomes among diabetes patients in three systems of care. *Med Care*. 2004; 42:102–109. [PubMed: 14734946]
7. Piette JD, Heisler M, Wagner TH. Cost-related medication underuse among chronically ill adults: the treatments people forgo, how often, and who is at risk. *Am J Publ Health*. 2004; 94:1782–1787.
8. 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; 166:1829–1835. [PubMed: 17000938]
9. Madden JM, Graves JA, Zhang F, et al. Cost-related medication nonadherence and Ssending on basic needs following implementation of Medicare Part D. *JAMA*. 2008; 299:1922–1928. [PubMed: 18430911]
10. Gellad W, Haas J, Safran D. Race/ethnicity and nonadherence to prescription medications among seniors: Results of a national study. *J Gen Intern Med*. 2007; 22:1572–1578. [PubMed: 17882499]
11. Landsman PB, Yu W, Liu X, et al. Impact of 3-tier pharmacy benefit design and increased consumer cost-sharing on drug utilization. *Am J Manag Care*. 2005; 11:621–628. [PubMed: 16232003]
12. Chernen M, Gibson TB, Yu-Isenberg K, et al. Effects of increased patient cost sharing on socioeconomic disparities in health care. *J Gen Intern Med*. 2008; 23:1131–1136. [PubMed: 18443882]

13. Motheral BR, Henderson R. The effect of a copay increase on pharmaceutical utilization, expenditures, and treatment continuation. *Am J Manag Care*. 1999; 5:1383–1394. [PubMed: 10662412]
14. Goldman DP, Joyce GF, Zheng Y. Prescription drug cost sharing: associations with medication and medical utilization and spending and health. *JAMA*. 2007; 298:61–69. [PubMed: 17609491]
15. Johnson RE, Goodman MJ, Hornbrook MC, et al. The impact of increasing patient prescription drug cost sharing on therapeutic classes of drugs received and on the health status of elderly HMO members. *Health Serv Res*. 1997; 32:103–122. [PubMed: 9108807]
16. Curtis JR, Xi J, Westfall JO, et al. Improving the prediction of medication compliance: the example of bisphosphonates for osteoporosis. *Med Care*. 2009; 47:334–341. [PubMed: 19194337]
17. Goldman DP, Joyce GR, Escarce JJ, et al. Pharmacy benefits and the use of drugs by the chronically ill. *JAMA*. 2004; 291:2344–2350. [PubMed: 15150206]
18. Fairman KA, Motheral BR, Henderson RR. Retrospective, long-term follow-up study of the effect of a three-tier prescription drug copayment system on pharmaceutical and other medical utilization and costs. *Clin Ther*. 2003; 25:3147–3161. [PubMed: 14749153]
19. Persell SD, Heiman HL, Weingart SN, et al. Understanding of drug indications by ambulatory care patients. *Am J Health Syst Pharm*. 2004; 61:2523–2527. [PubMed: 15595226]
20. Duru OK, Mangione CM, Hsu J, et al. Generic-only drug coverage in the Medicare Part D gap and effect on medication cost-cutting behaviors for patients with diabetes mellitus: The Translating Research into Action for Diabetes Study. *J Am Geriatr Soc*. 2010; 58:822–828. [PubMed: 20406312]
21. TRIAD study group. The Translating Research into Action for Diabetes (TRIAD) study: A multicenter study of diabetes in managed care. *Diabetes Care*. 2002; 25:386–389. [PubMed: 11815515]
22. Tseng CW, Brook RH, Keeler E, et al. Cost-lowering strategies used by medicare beneficiaries who exceed drug benefit caps and have a gap in drug coverage. *JAMA*. 2004; 292:952–960. [PubMed: 15328327]
23. Snijders, TAB.; Bosker, RJ. *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling*. Second Edition. Sage Publications; London: 2011.
24. Cummings P. The relevant merits of risk ratios and odds ratios. *Arch Pediatr Adolesc Med*. 2009; 163(5):438–445. [PubMed: 19414690]
25. King G, Tomz M, Wittenberg J. Making the most of statistical analyses: improving interpretation and presentation. *American Journal of Political Science*. 2000; 44(2):341–355.
26. Train, KE. *Discrete Choice Methods with Simulation*. Cambridge University Press; Cambridge, UK: 2003.
27. Kennedy JJ, Maciejewski M, Liu D, et al. Cost-related nonadherence in the Medicare program: the impact of Part D. *Med Care*. 2011; 49:522–526. [PubMed: 21430574]
28. Madden JM, Graves AJ, Ross-Degnan D, et al. Cost-related medication nonadherence after implementation of Medicare Part D, 2006-2007. *JAMA*. 2009; 302:1755–56. [PubMed: 19861666]
29. Benner JS, Glynn RJ, Mogun H, et al. Long-term persistence in use of statin therapy in elderly patients. *JAMA*. 2002; 288:455–461. [PubMed: 12132975]
30. Jackevicius CA, Mamdani M, Tu JV. Adherence with statin therapy in elderly patients with and without acute coronary syndromes. *JAMA*. 2002; 288:462–467. [PubMed: 12132976]
31. 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. [PubMed: 12114036]
32. [Accessed May 14, 2012] Kaiser/HRET Survey of Employer Sponsored Health Benefits, 2005-2011. Available at:<http://ehbs.kff.org/?page=charts&id=2&sn=23&ch=2161>
33. Klein D, Turvey C, Wallace R. Elders who delay medication because of cost: health insurance, demographic, health, and financial correlates. *Gerontologist*. 2004; 44:779–787. [PubMed: 15611214]
34. Piette JD, Wagner TH, Potter MB, et al. Health insurance status, cost-related medication underuse, and outcomes among diabetes patients in three systems of care. *Med Care*. 2004; 42:102–109. [PubMed: 14734946]

35. Kaiser Family Foundation. [Accessed on December 21, 2011] Fact Sheet: Low-income assistance under the Medicare Drug Benefit. May. 2006 Available at: [www.allhealth.org/.../Lowincomemedicareassistance-305.pdf](http://www.allhealth.org/.../Lowincomemedicareassistance-305.pdf)
36. Lau DT, Briesacher BA, Touchette DR, et al. Medicare Part D and quality of prescription medication use in older adults. *Drugs Aging*. 2011; 28:797–807. [PubMed: 21970307]
37. Moczygmba LR, Barner JC, Lawson KA, et al. Impact of telephone medication therapy management on medication and health-related problems, medication adherence, and Medicare Part D drug costs: A 6-month follow up. *The American Journal of Geriatr Pharmacother*. 2011; 9:328–338.
38. Pellegrino AN, Martin MT, Tilton JJ, et al. Medication therapy management services: definitions and outcomes. *Drugs*. 2009; 69:393–406. [PubMed: 19323584]
39. Bambauer KZ, Safran DG, Ross-Degnan D, et al. Depression and cost-related medication nonadherence in Medicare beneficiaries. *Arch Gen Psychiatr*. 2007; 64:602–608. [PubMed: 17485612]
40. Federal Interagency Forum on Aging-Related Statistics. Older Americans update 2006: key indicators of well-being. U.S. Government Printing Office; Washington, DC: May. 2006 Available at: [http://www.agingstats.gov/agingstatsdotnet/Main\\_Site/Data/Data\\_2006.aspx](http://www.agingstats.gov/agingstatsdotnet/Main_Site/Data/Data_2006.aspx) [Accessed on March 30, 2012]
41. Ettner SL, Steers WN, Duru OK, et al. Entering and exiting the Medicare Part D coverage gap: role of comorbidities and demographics. *J Gen Intern Med*. 2010; 25:568–74. [PubMed: 20217267]

**Table 1**

Descriptive Statistics for the Analytic Sample (n=1,264 individuals) Mean

Characteristic	Mean (Standard Deviation) or Percent
<b>Independent Variable Description</b>	
Taking at least one diabetes medication (n=1,184)	94%
Taking at least one hypertension medication (n=1,169)	92%
Taking at least one cholesterol medication (n=969)	77%
Taking at least one symptom relief medication (n=746)	59%
Taking at least one other medication (n=1,125)	89%
<b>Dependent Variable Description</b>	
% reporting CRN to any diabetes medication (64 of 1,184)	5%
% reporting CRN to any hypertension medication (75 of 1,169)	6%
% reporting CRN to any cholesterol medication (59 of 969)	6%
% reporting CRN to any symptom relief medication (50 of 746)	7%
% reporting CRN to any other medication (120 of 1,125)	11%
<b>Health, Costs and Benefit Design</b>	
Mean comorbidity count	4.9 (2.3)
Mean out-of-pocket costs (Q1 2006)	\$350 (\$260)
Type of Plan/Gap Coverage combination	
Integrated delivery system MAPD/no gap coverage (n=354)	28%
For-profit MAPD/no gap coverage (n=440)	35%
For-profit MAPD/generic-only gap coverage (n=176)	14%
For profit PDP/no gap coverage (n=117)	9%
For-profit PDP/generic-only gap coverage (n=177)	14%
<b>Demographics</b>	
Mean age, in years (SD)	74.7 (5.6)
Female, % (n=712)	56%
Race or ethnicity, %	
White (n=937)	74%
Latino (n=210)	17%
African American (n=52)	4%
Asian or Pacific Islander (n=24)	2%
All other (n=41)	3%
Education, %	
Less than high school (n=239)	19%
High school graduate (n=372)	30%
Some college (n=384)	30%
At least four years college (n=269)	21%
Median annual income	
< \$25,000 (n=452)	36%
\$25,000-\$39,999 (n=298)	23%

Characteristic

Mean  
(Standard  
Deviation)  
or Percent



**Table 2**

Results of Multivariate Analyses (n=11,991 person-medication dyads)

Independent Variable	Relative Risk	95% Confidence Interval	
Type of Person-Medication Dyad (Symptomatic is reference)			
Diabetes medication	1.00	0.68	1.48
Hypertension medication	0.94	0.66	1.36
Cholesterol medication	<b>1.54</b>	<b>1.01</b>	<b>2.32</b>
Other medication	<b>1.40</b>	<b>1.00</b>	<b>1.95</b>
Comorbidity count	1.20	0.96	1.51
Out-of-pocket costs (Q1 2006)	0.93	0.79	1.10
Benefit Design			
Type of Plan/Gap Coverage combination (ref: for-profit MAPD/generic-only coverage)			
Integrated system MAPD/no gap coverage	0.80	0.43	1.50
For-profit MAPD/no gap coverage	1.19	0.68	2.13
For profit PDP/no gap coverage	1.21	0.59	2.52
For-profit PDP/generic-only coverage	1.19	0.60	2.37
Demographics			
Age (ref: 65-69 years)			
70-74	0.75	0.47	1.19
75-79	<b>0.46</b>	<b>0.28</b>	<b>0.76</b>
80-84	<b>0.42</b>	<b>0.23</b>	<b>0.79</b>
85+	<b>0.30</b>	<b>0.11</b>	<b>0.79</b>
Female	1.18	0.81	1.71
Race or ethnicity (ref: white)			
Latino	1.16	0.69	1.93
Asian or Pacific Islander	2.85	0.94	8.03
African American	0.90	0.36	2.20
All other	2.11	0.94	4.65
Education (ref: at least 4 years of college)			
Less than high school	0.63	0.35	1.13
High school graduate	<b>0.45</b>	<b>0.27</b>	<b>0.77</b>
Some college	0.80	0.49	1.30
Annual income (ref: $\geq$ 40,000)			
< 25,000	<b>3.05</b>	<b>1.99</b>	<b>4.65</b>
25,000-39,999	1.46	0.89	2.38

Notes: 1) Of the 11,991 dyads in the analysis, 544 (4.5%) included CRN (this is lower than the individual-level CRN value since most participants were on multiple medications).

2) Joint significance tests for the drug class, age, income, and education categories were statistically significant at the 5% level, whereas joint significance tests for the race/ethnicity and plan/gap coverage categories were not.