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Association Between the Part D Coverage Gap and Adverse Health Outcomes

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Abstract

Background—Part D coverage gap entry is associated with a two-fold increased rate of drug discontinuation among beneficiaries now fully responsible for drug costs. Reduced adherence to drugs has been associated with adverse outcomes. We evaluated whether coverage gap entry is associated with risk of death or hospitalization for cardiovascular outcomes.

Design—Prospective cohort study. Beneficiaries entered the study upon reaching the coverage gap spending threshold and were observed until an event, reaching the threshold for catastrophic coverage, or year's end. Exposed patients were responsible for drug costs in the gap; unexposed patients received financial assistance. We matched 9,436 exposed patients to 9,436 unexposed patients based on propensity score (PS) or high-dimensional propensity score (hdPS).

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Conflict of interest:

Dr. Polinski is a consultant to Buccaneer Computer Systems and Service, Inc, a contractor for the Centers for Medicare and Medicaid Services. Within the past 5 years, Dr. Polinski's spouse was employed as an engineer by DePuy Orthopaedics, a subsidiary of Johnson & Johnson, and had Johnson & Johnson stock totaling < \$3100 in value. Dr. Shrank is a consultant to United Healthcare, which has a Part D business, but his consulting is unrelated. Dr. Shrank has received research funding from CVS Caremark, Aetna and Express Scripts, which also have Part D business. Dr. Glynn has worked on grants to the Brigham & Women's Hospital, his employer, from Astra Zeneca and Novartis related to the design, statistical monitoring, and analysis of clinical trials in the setting of cardiovascular drugs. Dr. Glynn also signed a consulting agreement to give a one-time Grand Rounds talk on comparative effectiveness research methods at Merck. At the time of the study, Mr. Roebuck was an employee of CVS Caremark. Dr. Schneeweiss is a paid member of the Scientific Advisory Board of HealthCore and a consultant to World Health Information Science Consultants, LLC. Dr. Schneeweiss is Principal Investigator of the Brigham and Women's Hospital DECIDE Center on Comparative Effectiveness Research funded by AHRQ and the DECIDE Methods Center. Dr. Schneeweiss received funding through investigator-initiated grants awarded to his employer, Brigham and Women's Hospital from Pfizer, Novartis, and Boehringer-Ingelheim. Opinions expressed here are only those of the authors and not necessarily those of the agencies.

Author contributions: Dr. Polinski was responsible for the conception and design, acquisition of data, analysis and interpretation of data, statistical analysis, drafting of the manuscript, and critical revision of the manuscript. Dr. Polinski had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Dr. Shrank participated in the design of the study, acquisition of data, analysis and interpretation of data, and critical revision of the manuscript. Drs. Huskamp and Glynn participated in the design of the study, analysis and interpretation of data, and critical revision of the manuscript. Mr. Roebuck participated in the acquisition of the data, analysis and interpretation of the data, and critical revision of the manuscript. Dr. Schneeweiss participated in the design of the study, analysis and interpretation of data, critical revision of the manuscript, and supervision.

Setting—Medicare Part D drug insurance.

Participants—303,978 Medicare beneficiaries aged 65+ in 2006 and 2007 with linked prescription and medical claims who enrolled in stand-alone Part D or retiree drug plans and reached the gap spending threshold.

Measurements—Rates of death and hospitalization for any of 5 cardiovascular outcomes, including acute coronary syndrome+revascularization (ACS), after reaching the coverage gap spending threshold were compared using Cox proportional hazards models.

Results—In PS-matched analyses, exposed beneficiaries had elevated but non-significant hazards of death (HR=1.25; 95% CI 0.98–1.59) and ACS (HR=1.16; 0.83–1.62) compared with unexposed patients. hdPS-matched analyses minimized residual confounding and confirmed results: death (HR=0.99; 0.78–1.24); ACS (HR=1.07; 0.81–1.41). Exposed beneficiaries were no more or less likely to experience other outcomes than were the unexposed.

Conclusions—During the short-term coverage gap period, having no financial assistance to pay for drugs was not associated with an increased risk of death or hospitalization for cardiovascular causes. However, long-term health consequences remain unclear.

Keywords

Medicare Part D; coverage gap; adverse health outcomes; cardiovascular disease; drug discontinuation

INTRODUCTION

Between 2.9–3.8 million (11–14%) Medicare Part D beneficiaries reach the Part D coverage gap period each year and are responsible for 100% of drug costs.^{1, 2} Beneficiaries enter the coverage gap following a period of initial coverage (\$2,250 in total drug spending in 2006) and remain in the coverage gap until out-of-pocket spending reaches a catastrophic coverage spending threshold (\$3,600 in 2006) when drug cost-sharing is dramatically reduced, or until year's end.³ While the 2010 Patient Protection and Affordable Care Act contains provisions that will gradually eliminate the coverage gap by 2020, there are no short-term solutions to eliminate beneficiaries' exposure⁴ and efforts to repeal these reforms are underway.^{5, 6} Recently, we documented 1.65-fold increased discontinuation rates and greater rates of poor adherence for both cardiovascular and all drugs among Medicare beneficiaries enrolled in stand-alone Part D plans who entered the Part D coverage gap and were responsible for 100% of their drug costs as compared to beneficiaries who received financial assistance during this time.⁷ Similar studies in the Medicare Advantage Part D population have produced analogous results.^{8–11} Other drug benefits with gaps in coverage (drug caps, high deductible health plans) have been associated with both increased drug discontinuation and subsequent increases in adverse health outcomes and death.^{12–15} To date, the effect of the Part D coverage gap on clinically relevant endpoints is unknown but urgently needed—closing the Part D gap might be expedited if adverse health effects were observed.

In this study, we examined the impact of entering the coverage gap on health outcomes in the same nationwide cohort of elderly Medicare beneficiaries in which we observed increased drug discontinuation during the gap.⁷ We hypothesized that beneficiaries who were responsible for 100% of drug costs during the gap would be more likely to experience adverse health events as a result of increased drug discontinuation and reduced drug adherence during this time.

METHODS

Study design and exposures

We conducted a prospective open cohort study in 2 cohorts of Medicare beneficiaries, one cohort eligible in 2005–2006 (*Early Part D Cohort*) and a second cohort eligible in 2006–2007 (*Established Part D Cohort*). Beneficiaries entered the study on the date when they reached the coverage gap spending threshold (\$2,250 in 2006; \$2,400 in 2007 in plan +beneficiary spending, Appendix Figure 1). *Exposed* beneficiaries were responsible for 100% of drug costs after reaching the coverage gap spending threshold (i.e., received no financial assistance) and *unexposed* otherwise. Beneficiaries enrolled in plans with generic drug coverage during the coverage gap were classified as *exposed*; these beneficiaries were removed in sensitivity analyses. In our dataset, no Part D plan offered both generic and branded drug coverage during the coverage gap. Beneficiaries were censored at the earliest date of an outcome, reaching the catastrophic coverage spending threshold (beneficiary out-of-pocket drug spending of \$3,600 in 2006; \$3,850 in 2007), or December 31.

Data source, study population

We studied fee-for-service Medicare beneficiaries aged ≥65 with prescription drug coverage through one of 129 stand-alone Part D plan or a retiree drug plan in 2006 or 2007 that was administered by Caremark, a pharmacy benefits manager. Caremark drug claims were linked to Medicare Parts A, B, and enrollment data to obtain demographic, diagnostic, and healthcare utilization information.

Beneficiaries had ≥1 Medicare claim in both the baseline and study years. Because Part D started in 2006, Early Part D Cohort (2005–2006) beneficiaries only had prescription claims available for 2006. For these beneficiaries, we required continuous Caremark eligibility and ≥1 prescription claim in 2006. Established Part D Cohort (2006–2007) beneficiaries had continuous Caremark eligibility and ≥1 prescription claim in 2006 and in 2007. To ensure we had some drug information for all beneficiaries, we restricted the cohorts to beneficiaries reaching the coverage gap spending threshold ≥60 days after drug plan enrollment in the study year. Additionally, we restricted our cohorts to those who did not enter a nursing home or hospice during the baseline year nor in the 2 month “trigger period” prior to reaching the coverage gap spending threshold, as these admissions would be indicative of worsening health and might confound the exposure-outcome relationship.

We used an algorithm⁷ that considered plan enrollment and plan and beneficiaries’ out-of-pocket spending to categorize beneficiaries into four benefit types (Appendix Table 1). Part D-enrolled beneficiaries who did not receive financial assistance to pay for drugs (*non-subsidy enrollees*) reached the coverage gap spending threshold and were subsequently responsible for 100% of their drug costs in the coverage gap. These beneficiaries were classified as *exposed*. The remaining three groups, *Part D full subsidy beneficiaries*, *Part D partial subsidy beneficiaries* and *retirees*, all received financial assistance after reaching the coverage gap spending threshold and were classified as *unexposed*. Full subsidy beneficiaries were enrolled in Part D plans with a coverage gap; however, their low incomes (<\$7,500 in 2006; <\$7,620 in 2007) limited their per-prescription cost-sharing to \$5 in 2006 or \$5.35 in 2007, even in the coverage gap period. Full subsidy beneficiaries are dually eligible for Medicare (usually based on age ≥65) and Medicaid (based on either low income or high medical costs relative to income (e.g., spend down)).¹⁶ Partial subsidy beneficiaries were enrolled in Part D plans with a coverage gap, but their incomes (\$7,500–\$11,500 in 2006; \$7,620–\$11,710 in 2007) limited cost-sharing to 15% for each prescription, even in the coverage gap period. The final unexposed beneficiaries were of *retirees* enrolled in retiree (non-Part D) drug plans. None of the retiree drug plans had a coverage gap design, so cost-

sharing for each prescription did not change when beneficiaries reached the coverage gap spending threshold. While the 3 beneficiary types in the unexposed group had different cost-sharing, none were responsible for 100% of drug costs after they reached the coverage gap spending threshold and thus provided an appropriate comparator group. To examine concerns that the unexposed group's heterogeneity might bias results through unmeasured selection (confounding) factors, we conducted sensitivity analyses in which the unexposed group was limited to retirees only.

Covariate assessment and propensity score matching

A beneficiary's characteristics influence Part D plan choice and cost-sharing obligations, and in turn, both patient and plan characteristics influence whether he will reach the coverage gap spending threshold and thus be responsible for all drug costs. To adjust for such 'confounding by health system use', a propensity score (PS) model assessed each beneficiary's likelihood of exposure after reaching the coverage gap during two time periods: the baseline year and a "trigger period," the 2 months prior to reaching the coverage gap spending threshold. Covariates assessed in both the baseline year and in the 2 month trigger period included diagnosis of dementia, cancer, COPD/emphysema, renal failure, end-stage renal disease, depression, HIV/AIDS, diabetes, atrial fibrillation (AF), hypercholesterolemia, hypertension, coronary artery disease, congestive heart failure (CHF), stroke, venous thromboembolism, myocardial infarction (MI), and/or acute coronary syndrome (ACS) with revascularization, Charlson comorbidity score,¹⁴ and number of office-based drug infusions, physician visits, and hospitalizations. Additional predictors included age, gender, race, region of the U.S., rural/urban residence, median household income from Census block data,¹⁷ time (in days) from plan enrollment to reaching the threshold, and total Medicare inpatient and outpatient spending in the baseline year. The number of unique drugs used,¹⁵ use of medications to prevent or treat MI/ACS/revascularization/CHF, stroke, and VTE, and total (plan + beneficiary) drug spending in the 2 months prior to cohort entry were added to the model. To explore the sensitivity of our results, we considered 2 alternative covariate assessment strategies: assessment in the 12 months; or 6 months prior to reaching the coverage gap spending threshold. Definitions and codes are in the Appendix. Each exposed beneficiary was PS- matched to one unexposed beneficiary using nearest neighbor matching.¹⁸

To further explore the sensitivity of our results to residual confounding, we secondly modeled a high-dimensional propensity score (hdPS). While the PS approach requires that candidate confounders be identified *a priori*, the hdPS approach identifies and selects large numbers of empirical covariates for adjustment based on their potential to causing bias. The hdPS' goal is to minimize residual confounding due to measured covariates (often proxies for unmeasured factors) that were not originally included in the PS.¹⁹ To implement the hdPS, we first identified 10 domains from which covariates might be selected: drug use; plan cost-sharing details; and inpatient, outpatient, ambulatory, and skilled nursing facility diagnoses and procedures. Due to the likelihood of rare outcomes, we assessed each variable's potential for confounding based solely on its association with exposure and screened candidate covariates so as to not include covariates that were potential instruments.^{19, 20} The first 400 of these empirically-identified covariates, together with all PS model covariates, were included in the final hdPS model.²¹ We then employed nearest neighbor 1:1 matching as before. To assess the discriminative ability of the PS and hdPS models, we calculated c statistics.

Drug discontinuations

To explore the plausibility of our hypothesis that reaching the coverage gap spending threshold led to increased drug discontinuation rates which in turn might result in adverse

health outcomes, we calculated the time to discontinuation of drugs to treat cardiovascular disease, diabetes, dementia, depression, and rheumatoid arthritis (drug list in Appendix). Drugs available upon reaching the coverage gap spending threshold were considered for discontinuation, defined as >30 days when no days' supply was available and no further fills were made during the coverage gap.⁷ If increased rates of drug discontinuation among the exposed began immediately after beneficiaries reached the coverage gap spending threshold, we might be confident that subsequent adverse health events might be associated with drug discontinuations and coverage gap exposure.

Outcomes

Our primary outcome was death from any cause. We then focused on cardiovascular-related outcomes, given the high prevalence of cardiovascular disease in the general population, the many drugs available to prevent and treat it, and the likelihood of events if drugs were indeed discontinued. We examined the number of emergency room visits and non-discretionary hospitalizations (hospitalizations within 24 hours of an emergency room visit) with a primary or secondary diagnosis of a cardiovascular condition. In both exposed and unexposed groups, we assessed rates of first hospitalization with a primary or secondary diagnosis code for ACS with revascularization; CHF; or AF and rates for two composite outcomes, death or hospitalization for MI or stroke; and hospitalization for MI or stroke. In sensitivity analyses, we defined hospitalization outcomes using the primary diagnosis code only and conducted separate analyses among beneficiaries who reached the coverage gap spending threshold before August (<236 days, the median time to reach the threshold) and August or after (≥ 236 days) to explore effect modification. Definitions and codes are in the Appendix.

Statistical analysis

We cross-tabulated beneficiaries' characteristics at baseline by benefit group before and after matching. We produced Kaplan-Meier curves for time to discontinuation of drugs and calculated discontinuation risk for the exposed and unexposed at the median and interquartile range times spent in the coverage gap period. Each individual drug was assessed for potential discontinuation, so analyses were at the drug level. For both PS- and hdPS-matched cohorts, we used Cox proportional hazards models to estimate hazard ratios for death and each cardiovascular outcome. Poisson models for emergency room visits and non-discretionary hospitalizations used generalized estimating equation methods²² to account for repeated events among individuals and a scale parameter to account for overdispersion.²³ After testing for effect measure modification by cohort using Wald's tests and finding none, we conducted pooled cohort analyses that accounted for the correlation between beneficiaries present in both cohorts by using robust standard errors.²³ The Human Subjects Committee at Brigham and Women's Hospital approved this study. Data use agreements were in place with all data providers.

RESULTS

Among all 303,978 beneficiaries who reached the coverage gap in 2006 or 2007, 94,220 (31%) were enrolled in Part D plans while the remainder were enrolled in non-Part D retiree plans. Among enrollees in Part D plans, 9,436 (10%) received no financial assistance to pay for drugs during the coverage gap (Table 1). At least 79% had hypertension, and 35% had coronary artery disease. In the Early Part D cohort, 38% of non-subsidy enrollees had diabetes compared to 50% of full subsidy beneficiaries. Among retirees, 35% had coronary artery disease compared to 40% of non-subsidy enrollees. In the 2 months prior to cohort entry in 2006, non-subsidy beneficiaries used an average of 6 drugs, whereas partial subsidy beneficiaries used an average of 7 and full subsidy beneficiaries an average of 8. All

beneficiaries reached the gap spending threshold late in the year. Non-enrollees reached the threshold last, after 229–240 days (~8 months).

The PS model had a c statistic of 0.72. Of the 9,436 exposed beneficiaries, 9,383 (99%) could be PS-matched. The hdPS model had an improved c statistic of 0.91; still, nearly all exposed patients, 9210 (98%), could be hdPS-matched. After PS-matching, measured covariate distributions were largely balanced between the exposed and unexposed groups (Table 2), and residual differences were minimal: for example, unexposed matched beneficiaries had \$123 more Medicare Parts A and B spending in the baseline year than did exposed beneficiaries. hdPS-matched results were similar (data not shown).

Kaplan-Meier curves demonstrated the almost immediate difference in drug discontinuation rates after coverage gap entry (Figure 1). Beneficiaries spent a median 95 days (IQR: 49, 145) in the coverage gap, with exposed beneficiaries having discontinued 10.1% (IQR: 4.8%, 13.5%) of drugs by day 95, whereas unexposed had discontinued 6.1% (IQR: 2.8%, 8.8%).

In the PS-matched pooled cohort, the exposed death rate was 25% greater than that of the unexposed, 5 versus 4 deaths/100 person-years (Table 3). Among the exposed, 73% of deaths occurred outside the hospital, whereas among the unexposed, 74% of deaths occurred outside the hospital. Exposed patients were 20% more likely to have hospitalizations for MI or stroke or to die than were the unexposed. In the hdPS-matched pooled cohort, differences in event rates for this outcome disappeared. Similarly, in the hdPS-matched cohort, the exposed death rate was no greater than that of the unexposed and exposed patients were no more likely to die outside of a hospital setting than were unexposed patients (73% versus 68%, $p=0.31$).

In PS-matched analyses, exposed beneficiaries had elevated but non-significant increased hazards of death (HR=1.25, 95% CI, 0.98–1.59) (Table 4). Hazard ratios were nearly identical when location of death was considered: out-of-hospital death (HR=1.25, 0.94–1.65). Exposed beneficiaries were 28% more likely to die or have a hospitalization for MI or stroke (1.02–1.60) but no more or less likely than unexposed beneficiaries to have increased rates of non-discretionary hospitalizations (hospitalizations occurring within 24 hours of an emergency room visit, HR=0.65, 0.41–1.03) or emergency room visits (HR=0.87, 0.74–1.02) with cardiovascular diagnoses. In hdPS-matched analyses, the hazard of all cause death remained non-significant (HR=0.99, 0.78–1.24) as did the hazard of out-of-hospital death (HR=1.07, 0.81–1.41). In contrast to PS-matched results, in the hdPS-matched analysis, exposed beneficiaries were no more or less likely to die or have a hospitalization for MI or stroke (HR=1.04, 0.84–1.30). None of the analyses showed effect modification by pre-August versus August and after arrival to the spending threshold.

The separate sensitivity analyses which 1) excluded exposed beneficiaries with generic drug coverage during the coverage gap period, 2) limited the unexposed group to retirees only (excluded low-income beneficiaries with full or partial subsidies), 3) explored alternate covariate assessment periods, or 4) used only the primary diagnosis code for cardiovascular outcomes all produced analogous results.

DISCUSSION

In this study of health outcomes among beneficiaries who reached the Part D coverage gap spending threshold, we found that having no financial assistance to pay for drugs in the coverage gap was not associated with an elevated risk for death or hospitalization for cardiovascular outcomes during the 3 month median length coverage gap. Although exposure was associated with a 28% (2–61%) increased risk of the composite outcome death

or hospitalization for MI or stroke during the gap in the main analysis, this effect became clinically meaningless in sensitivity analyses with finer control for measured confounders (HR=1.04, 0.84–1.30). Our findings of no increased risk of adverse health outcomes are the first to use linked medical and pharmacy claims to explore the clinical consequences of increased drug discontinuation and decreased drug adherence during the coverage gap.

Drug discontinuation and reduced adherence are associated with poor clinical outcomes,^{24–28} and our results are inconsistent with studies that have examined the impact of drug benefit restrictions and poor medication adherence on health outcomes in other settings.^{13, 14, 24, 26, 27, 29} For example, increased prescription cost-sharing for Canadian elderly was associated with a 9% decrease in essential drug use and a 7% increased rate of adverse events, including death.¹⁴ The fact that we did not observe an increase in unintended health outcomes despite the documented increase in drug discontinuation during the coverage gap is likely due to several factors. While most prior studies that showed adverse health effects had follow-up of >1 year,^{8, 12–14, 24, 26, 27, 29, 30} beneficiaries in our study reached the coverage gap relatively late in the year (median 236 days (~8 months)) and spent only a median 95 days in the gap period before they regained drug coverage at the beginning of the next calendar year. For the average beneficiary, the length of time spent in the coverage gap may be too short to experience any meaningful unintended health outcome.^{26, 27} This observation highlights the peculiar structure of the coverage gap: in contrast to other drug cost-sharing policies, the gap is a temporary, often brief period after which one regains insurance at the beginning of the next year. While it is possible to study adverse outcomes after beneficiaries exit the coverage gap and regain drug insurance, it is then more difficult to attribute that adverse event to coverage gap exposure. Secondly, on the absolute scale, coverage gap exposure was associated with the additional discontinuation of 15 drugs per 100 person-years,⁷ a relatively small effect in absolute terms; combined with the brief length of the gap period, we may not be able to observe sufficient numbers of events. Finally, our results may differ due to the characteristics of patients included in our sample. Patients were eligible for our study because they repeatedly filled prescriptions whose aggregate costs brought them to the coverage gap spending threshold. Persistence with medications is associated with other healthy behaviors that reduce the likelihood of adverse outcomes.³¹ At present, the long-term impact of the coverage gap on health outcomes remains unclear and merits further scrutiny.

Given the non-randomized design of our study, we cannot rule out the possibility of unmeasured confounding or residual confounding that would support alternate explanations. However, we did employ multiple approaches to reduce confounding, including restriction of the population to those with no nursing home or hospice admissions, PS-matching and hdPS-matching. In particular, the hdPS approach allows for extensive adjustment for covariates that may be confounders themselves and are often proxies for or correlated with unmeasured confounders, thus reducing residual confounding and minimizing the impact of unmeasured confounding.¹⁹ Compared to the PS model's c-statistic of 0.72, the hdPS model c-statistic was 0.91, indicating better discriminative ability of this model and improved balance of measured covariates between groups. The advantages of the hdPS as a sensitivity analysis were most apparent in examining the hazard ratio for death or hospitalization for MI or stroke. Whereas the PS-matched result was marginally significant, HR=1.28 (1.02–1.60), the hdPS-matched result reduced residual confounding and showed non-significant differences between exposed and unexposed beneficiaries, HR=1.04 (0.84–1.30). Our study has robust external validity, as we examined the heterogeneous experiences of beneficiaries in 129 stand-alone Part D plans who reflect the larger population of Part D enrollees, 66% of whom were enrolled in stand-alone plans in 2010.²⁷ In our study, 62% of beneficiaries were women, comparable to the 60% female stand-alone plan population and 52% of beneficiaries were aged 65–74, comparable to the 49% in the larger stand-alone

population.³² Our study population was less racially diverse: 8.4% African American compared with 12% in the larger population.

Our results suggest no increased risk of death or hospitalization for other cardiovascular outcomes during the short-term coverage gap period, despite evidence of increased rates of drug discontinuation and reduced drug adherence among those fully exposed to drug costs during that time. These apparent null findings could be explained by the short follow-up period that reflects the Part D coverage gap's peculiar structure, the small absolute effect of coverage gap exposure on drug discontinuation, and the small number of observed events. In contrast to the larger body of research evidence describing the deleterious effects of restricting drug insurance benefits on health outcomes, we find that the coverage gap might on average be just short enough to avoid short-term negative health outcomes. However, it remains unclear whether Part D coverage gap-related lapses in financial assistance to pay for drugs affect health outcomes in the long-term. Any drug cost-sharing policy which reduces essential medication use is problematic, and present knowledge deficits regarding the gap's long-term effects should be considered as Part D beneficiaries' financial responsibilities in the coverage gap change under the Affordable Care Act's incremental reforms.⁴

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Survival function estimates: drug discontinuation since reaching the coverage gap spending threshold

Baseline characteristics of all 303,978 Medicare beneficiaries who reached the coverage gap spending threshold in 2006 or 2007.

Table 1

	Early Part D cohort, 2006 N = 169,516				Established Part D cohort, 2007 N = 134,462			
	Unexposed (no gap in financial assistance)		Exposed		Unexposed (no gap in financial assistance)		Exposed	
	Full subsidy beneficiaries	Partial subsidy beneficiaries	Retirees	Non-subsidy enrollees	Full subsidy beneficiaries	Partial subsidy beneficiaries	Retirees	Non-subsidy enrollees
% or mean ± SD unless otherwise noted								
N (%)	41,556 (25)	5,048 (3)	117,361 (69)	5,551 (3)	32,569 (24)	5611 (4)	92,397 (69)	3885 (3)
Female gender	77	67	57	62	76	65	57	64
Age as of January 1 of the baseline year								
65 – 74	50	53	55	53	51	52	52	51
75 – 84	36	37	38	38	35	36	39	37
85+	15	11	7	10	14	12	8	11
Race								
White	67	91	93	97	68	92	94	96
Black	21	6	5	2	20	6	4	3
Other	12	3	1	1	12	3	1	1
Region								
Northeast	34	41	21	47	31	64	24	26
Central	28	22	26	18	29	14	26	20
South	32	30	42	26	33	17	41	44
West	6	7	10	8	8	6	11	10
Urban residence	68	75	72	81	66	85	72	69
Median household income in zip code of residence (\$)	37871 ± 15,981	46,566 ± 19,505	44,649 ± 18464	51,648 ± 21,820	38,407 ± 15,858	53,202 ± 22,335	44,624 ± 18,948	45,266 ± 18,503
Charlson comorbidity score *	3 ± 2	2 ± 2	2 ± 2	2 ± 2	3 ± 2	3 ± 2	2 ± 2	2 ± 2
Number of physician visits *	8 ± 8	11 ± 8	10 ± 8	12 ± 8	8 ± 8	12 ± 9	10 ± 8	11 ± 8
Number of hospitalizations *	0.5 ± 1	0.5 ± 0.9	0.4 ± 0.8	0.5 ± 0.9	0.5 ± 1.0	0.5 ± 0.9	0.4 ± 0.8	0.4 ± 0.8
Number of office-based drug infusions *	1 ± 6	1 ± 8	1 ± 7	2 ± 8	1 ± 6	2 ± 9	1 ± 7	2 ± 8

	Early Part D cohort, 2006 N = 169,516				Established Part D cohort, 2007 N = 134,462			
	Unexposed (no gap in financial assistance)			Exposed	Unexposed (no gap in financial assistance)			Exposed
	Full subsidy beneficiaries	Partial subsidy beneficiaries	Retirees	Non- subsidy enrollees	Full subsidy beneficiaries	Partial subsidy beneficiaries	Retirees	Non- subsidy enrollees
	% or mean ± SD unless otherwise noted							
Number of unique medications ^{**}	8 ± 4	7 ± 4	6 ± 4	6 ± 3	8 ± 4	6 ± 3	6 ± 4	6 ± 3
Total Medicare Parts A, B spending in the baseline year (\$) [median, interquartile range (IQR)]	3,478 [1,511, 8,880]	3,743 [1,664, 9,454]	2,964 [1266, 7423]	4,075 [1868, 9954]	3,526 [1,557, 8,762]	4,515 [2125, 10862]	3,099 [1,310, 7,802]	3,524 [1,624, 9,025]
Total out-of-pocket drug spending ^{**} (\$) [median, IQR]	17 [7, 27]	109 [42, 192]	73 [20, 154]	144 [96, 201]	18 [8, 30]	124 [66, 195]	76 [21, 160]	157 [100, 225]
Total plan drug spending ^{**} (\$) [median, IQR]	611 [409,918]	441 [266,676]	412 [207,682]	387 [256,550]	642 [429,961]	421 [258,652]	428 [208,714]	351 [220,517]
Time (in days) to reach the coverage gap spending threshold [†]	200 ± 79	217 ± 78	207 ± 79	229 ± 67	198 ± 79	223 ± 78	208 ± 79	240 ± 70
Diagnosis of diabetes [*]	50	43	35	38	51	44	37	36
Diagnosis of atrial fibrillation [*]	3	5	4	5	3	5	4	5
Diagnosis of congestive heart failure [*]	32	26	19	22	31	26	18	21
Diagnosis of hypercholesterolemia / hyperlipidemia [*]	38	50	46	54	39	57	45	48
Diagnosis of coronary artery disease [*]	36	40	35	40	35	43	36	37
Diagnosis of hypertension [*]	85	85	79	84	86	86	80	82
Diagnosis of stroke [*]	14	11	8	10	13	11	7	10
Diagnosis of myocardial infarction [*]	1	2	1	2	1	2	1	2

^{*} Assessed in the baseline year, 2005 for the Early Part D cohort, 2006 for the Established Part D cohort;

^{**} Assessed in the 2 months prior to cohort entry;

[†] Assessed in the study year.

Table 2

Selected baseline characteristics* of multivariate propensity score 1:1 matched beneficiaries in the Early Part D cohort, 2006 and the Established Part D cohort, 2007.

	2006 Early Part D cohort N = 11,032			2007 Established Part D cohort N = 7,734		
	Exposed (No financial assistance in coverage gap) N = 5,516	Unexposed (Financial assistance in coverage gap) N = 5,516	Delta	Exposed (No financial assistance in coverage gap) N = 3,867	Unexposed (Financial assistance in coverage gap) N = 3,867	Delta
	% or mean ± SD					
Female gender	63	63	0%	64	64	0%
Age	75 ± 7	75 ± 7	0 years	75 ± 7	75 ± 7	0 years
65 – 74	53	54	+1%	51	53	+2%
75 – 84	38	36	–2%	37	37	0%
85+	10	10	0%	11	11	0%
Race						
White	97	97	0%	96	96	0%
Black	2	2	0%	3	3	0%
Other	1	1	0%	1	1	0%
Region						
Northeast	47	47	0%	26	27	+1%
Midwest	18	19	+1%	20	20	0%
South	26	26	0%	44	43	0%
West	8	8	0%	10	10	–1%
Urban residence	80	80	0%	70	70	0%
Median household income	51,504 ± 21,565	51,292 ± 22,147	–\$212	45,521 ± 18,956	45,235 ± 18,478	–\$286
Time to reach the doughnut hole spending threshold, in days	229 ± 67	228 ± 81	–1 days	240 ± 78	240 ± 71	0 days
Total Medicare Parts A and B spending in 2005 (\$)	9,362 ± 14,099	9,485 ± 15,630	+\$123	8,346 ± 12,731	8,021 ± 13,429	–\$325
Total spending on drugs in the 2 months prior to reaching the doughnut hole spending threshold (\$)	584 ± 331	593 ± 429	+\$9	568 ± 342	556 ± 401	–\$16
Charlson comorbidity score	2 ± 2	2 ± 2	0 points	2 ± 2	2 ± 2	0 points

	2006 Early Part D cohort N = 11,032			2007 Established Part D cohort N = 7,734		
	Exposed (No financial assistance in coverage gap) N = 5,516	Unexposed (Financial assistance in coverage gap) N = 5,516	Delta	Exposed (No financial assistance in coverage gap) N = 3,867	Unexposed (Financial assistance in coverage gap) N = 3,867	Delta
	% or mean ± SD					
Number of unique drugs in the 2 months prior to reaching the doughnut hole spending threshold	6 ± 3	6 ± 4	0 drugs	6 ± 3	6 ± 4	0 drugs
Number of physician visits	12 ± 8	12 ± 10	0 visits	11 ± 8	11 ± 9	0 visits
Number of hospitalizations	0.4 ± .9	0.4 ± .9	0 hosp.	0.4 ± 0.9	0.4 ± 0.9	0 hosp.
Number of office-based drug infusions	2 ± 8	2 ± 10	0 infus.	2 ± 8	1 ± 7	-1 infus.
Diagnosis of diabetes	38	38	0%	36	35	-1%
Diagnosis of stroke	10	10	0%	10	10	0%
Diagnosis of MI	2	2	0%	2	2	0%
Diagnosis of acute coronary syndrome with revascularization	5	5	0%	4	4	0%
Diagnosis of venous thromboembolism	4	4	0%	3	3	0%
Diagnosis of atrial fibrillation	5	5	0%	5	4	-1%
Diagnosis of hyperlipidemia	55	55	0%	49	50	+1%
Diagnosis of congestive heart failure	23	22	-1%	21	19	-2%
Diagnosis of coronary artery disease	40	40	0%	37	36	-1%
Diagnosis of hypertension	84	84	0%	83	83	0%

* Unless otherwise noted, presented covariates are assessed in the baseline year.

Table 3

Number and rates of health services utilization and cardiovascular outcome events in the coverage gap period among beneficiaries who received no financial assistance (exposed) compared with beneficiaries who received financial assistance (unexposed) in the multivariate PS-1:1 matched and hdPS-1:1 pooled cohorts.

	1:1 PS matched pooled cohort N=18,766		1:1 hdPS matched pooled cohort N=18,420	
	Exposed N=9,383	Unexposed N=9,383	Exposed N=9,210	Unexposed N=9,210
	<i>N (rate per 100 person-years) * unless otherwise noted</i>			
Death from any cause	135 (5)	122 (4)	135 (5)	149 (5)
Died outside of hospital, N(%)	99 (73)	90 (74)	99 (73)	101 (68)
Hospitalization with a primary or secondary diagnosis of:				
Myocardial infarction ^b , stroke, ^c or death	158 (6)	156 (5)	157 (6)	179 (6)
Myocardial infarction ^{b c}	60 (2)	74 (2)	59 (2)	81 (3)
Acute Coronary Syndrome (ACS) ^d with revascularization ^e	66 (2)	70 (2)	65 (2)	68 (2)
Congestive heart failure ^b	145 (5)	188 (6)	143 (5)	201 (7)
Atrial fibrillation ^b	114 (4)	138 (4)	113 (4)	134 (4)
Health service use				
Number of non-discretionary hospitalizations ^a with a primary or secondary cardiovascular diagnosis ^b	28 (1)	48 (1)	28 (1)	46 (1)
Number of emergency room visits with a primary or secondary cardiovascular diagnosis ^b	386 (13)	493 (15)	377 (13)	491 (16)

^a A non-discretionary hospitalization is defined as a hospital admission that occurs within 24 hours after an emergency room visit.

^b For specific codes, please see the Appendix.

^c The stroke definition includes inpatient codes for ischemic and hemorrhagic stroke excluding transient ischemic attack. For specific codes, please see the Appendix.

^d The definition for acute coronary syndrome includes inpatient codes for myocardial infarction or angina. For specific codes, please see the Appendix.

^e Revascularization included any of the following procedures during the same hospital stay as the ACS diagnosis: percutaneous transluminal coronary angioplasty (PTCA), coronary artery bypass grafting (CABG), placement of a stent, systemic or intracoronary thrombolysis, and angiography. For specific codes, please see the Appendix.

* Person-years were calculated between the date a beneficiary reached the coverage gap spending threshold and the date of first outcome, date he/she reached the end of the study year or date he/she reached the catastrophic coverage spending threshold, whichever was earliest.

Table 4

Hazard ratios of adverse health events in the coverage gap, comparing beneficiaries who received no financial assistance (exposed) with beneficiaries who received financial assistance (unexposed) in the coverage gap.

	1:1 PS-matched pooled cohort N=18,766	1:1 hdPS-matched pooled cohort N=18,420
Death from any cause	1.25 (0.98 – 1.59)	0.99 (0.78 – 1.24)
Died outside of hospital	1.25 (0.94 – 1.65)	1.07 (0.81 – 1.41)
Hospitalization 1° or 2° diagnosis of:		
ACS with revascularization	1.16 (0.83 – 1.62)	1.07 (0.76 – 1.50)
Congestive heart failure	0.95 (0.76 – 1.18)	0.82 (0.66 – 1.03)
Atrial fibrillation	0.91 (0.71 – 1.16)	0.91 (0.71 – 1.17)
Death or hospitalization for MI or stroke	1.28 (1.02 – 1.60)	1.04 (0.84 – 1.30)
Hospitalization for MI or stroke	1.01 (0.72 – 1.42)	0.86 (0.62 – 1.20)
Health service use		
Number of non-discretionary hospitalizations with a cardiovascular diagnosis	0.65 (0.41 – 1.03)	0.66 (0.41 – 1.07)
Number of emergency room visits with a cardiovascular diagnosis	0.87 (0.74 – 1.02)	0.84 (0.72 – 0.98)

* Health services outcomes are modeled using Poisson regression models with a scale parameter to account for overdispersion. Cardiovascular hospitalization outcomes and death are modeled using Cox proportional hazards models.

^a A non-discretionary hospitalization is defined as a hospital admission that occurs within 24 hours after an emergency room visit.

^b For specific codes, please see the appendix.

^c The stroke definition includes inpatient codes for ischemic and hemorrhagic stroke excluding transient ischemic attack. For specific codes, please see the appendix.

^d The definition for acute coronary syndrome includes inpatient codes for myocardial infarction or angina. For specific codes, please see the Appendix.

^e Revascularization included any of the following procedures during the same hospital stay as the ACS diagnosis: percutaneous transluminal coronary angioplasty (PTCA), coronary artery bypass grafting (CABG), placement of a stent, systemic or intracoronary thrombolysis, and angiography. For specific codes, please see the Appendix