HSR Health Services Research

DOI: 10.1111/j.1475-6773.2011.01273.x
RESEARCH ARTICLE

The Impact of Medicare Part D on Out-of-Pocket Costs for Prescription Drugs, Medication Utilization, Health Resource Utilization, and Preference-Based Health Utility

Frank Xiaoqing Liu, G. Caleb Alexander, Stephanie Y. Crawford, A. Simon Pickard, Donald Hedeker, and Surrey M. Walton

Objectives. To quantify the impact of Medicare Part D eligibility on medication utilization, emergency department use, hospitalization, and preference-based health utility among civilian noninstitutionalized Medicare beneficiaries.

Study Design. Difference-in-differences analyses were used to estimate the effects of Part D eligibility on health outcomes by comparing a 12-month period before and after Part D implementation using the Medical Expenditure Panel Survey. Models adjusted for sociodemographic characteristics and health status and compared Medicare beneficiaries aged 65 and older with near elderly aged 55–63 years old.

Principal Findings. Five hundred and fifty-six elderly and 549 near elderly were included. After adjustment, Part D was associated with a U.S.$179.86 ($p = .034$) reduction in out-of-pocket costs and an increase of 2.05 prescriptions ($p = .081$) per patient year. The associations between Part D and emergency department use, hospitalizations, and preference-based health utility did not suggest cost offsets and were not statistically significant.

Conclusions. Although there was a substantial reduction in out-of-pocket costs and a moderate increase in medication utilization among Medicare beneficiaries during the first year after Part D, there was no evidence of improvement in emergency department use, hospitalizations, or preference-based health utility for those eligible for Part D during its first year of implementation.

Key Words. Medicare Part D, health care utilization, health outcomes, insurance, prescriptions

The implementation of Medicare Part D on January 1, 2006 provided a voluntary outpatient prescription drug benefit to 43 million Medicare beneficiaries for the first time since Medicare's inception (Doherty 2004). Following the implementation of Part D, Medicare's portion of national prescription drug

spending increased from 2 percent (2005) to 18 percent (2006) (Kaiser Family Foundation 2008). Around 50–60 percent of Medicare beneficiaries without prior prescription drug coverage had Part D drug coverage in 2006 (Levy and Weir 2009). The estimated federal cost of Part D from 2007 through 2016 is U.S.$768 billion dollars (Kaiser Family Foundation 2006).

Studies have found that Part D increased Medicare beneficiaries' prescription utilization and decreased their out-of-pocket costs (Lichtenberg and Sun 2007; Simoni-Wastila et al. 2008; Yin et al. 2008). However, it is less clear whether the program has led to reductions, or offsets, in nonprescription utilization of health care services. Khan, Kaestner, and Lin (2008) used data from the 1992–2000 Medicare Current Beneficiary Survey and found that prescription drug insurance did not appear to reduce beneficiary's hospitalizations. In contrast, Hsu et al. (2006) analyzed Medicare Part C claims data from Kaiser Permanente–Northern California and concluded that increases in medication coverage resulted in reduced hospitalizations and lower health care expenditures. Similarly, Zhang et al. (2009) analyzed claims data from a Medicare Advantage plan for a Pennsylvania insurer 2 years before and 2 years after the implementation of Part D and found that the increased spending on prescription drugs was offset by lower nondrug medical spending among groups with limited or no previous drug coverage.

We sought to study the overall policy impact of Part D on non-low-income Medicare beneficiaries using detailed health care utilization and expenditure data from a large, nationally representative sample of Medicare beneficiaries. This study hypothesized that Part D eligibility would be associated with an increase in Medicare beneficiaries' medication utilization and a reduction in their out-of-pocket costs for prescription drugs, emergency department use, and hospitalization rates (Gellad et al. 2006; Tjia and

---

Address correspondence to Frank Xiaoqing Liu, Ph.D., Global Health Economics, Baxter Healthcare Corporation, One Baxter Parkway, Deerfield, IL 60015; emails: xiaoqing_liu@baxter.com, uicfrank@gmail.com. G. Caleb Alexander, M.D., M.S., is with the Section of General Internal Medicine, Department of Medicine; Center for Health and the Social Sciences; MacLean Center for Clinical Medical Ethics; Department of Pharmacy Practice, University of Chicago, Chicago, IL. A. Simon Pickard, Ph.D., is with the Department of Pharmacy Practice and Center for Pharmacoeconomic Research, University of Illinois at Chicago, Chicago, IL. Stephanie Y. Crawford, Ph.D., is with the Department of Pharmacy Administration, University of Illinois at Chicago, Chicago, IL. Donald Hedeker, Ph.D., is with the Division of Epidemiology and Biostatistics, School of Public Health, University of Illinois at Chicago, Chicago, IL. Surrey M. Walton, Ph.D., is with the Department of Pharmacy Administration and Center for Pharmacoeconomic Research, University of Illinois at Chicago, Chicago, IL.

Schwartz 2006) as well as improvement in Medicare beneficiaries' overall health measured by preference-based health utility.

METHODS

Data

The data originated from Panel 10 of the Medical Expenditure Panel Survey (MEPS). The MEPS is cosponsored by the Agency for Healthcare Research and Quality (AHRQ) and the National Center for Health Statistics (NCHS) (Medical Expenditure Panel Survey 2008). MEPS provides annual estimates of health care utilization, cost, payment sources, health insurance coverage, health status, and sociodemographic characteristics for the U.S. civilian, noninstitutionalized population (Medical Expenditure Panel Survey 2008). The MEPS employs an overlapping panel design, with a new sample of households launched every calendar year to provide overlapping panels. Panels of each sample are interviewed through computer-assisted personal interviewing for a series of five rounds over 30 months (Cohen 2003).

We defined our cohort as noninstitutionalized people aged 65 and older on December 31, 2004, with data collected in all five rounds. In order to obtain a more homogenous sample and to avoid estimating the potential combined effect of other social welfare programs, we excluded individuals in TRICARE, Veteran Affairs (VA), recipients of state and other government subsidies, those reporting Medicaid benefits at any time, those with any annual income less than 125 percent of the federal poverty level, and those with cognitive limitations given that some of the data relied on self-report. In addition, individuals with inconsistent responses regarding their drug coverage, for example, reporting no Medicare coverage yet reporting Medicare payment for their prescription drugs, or with missing values in any of the variables used in the analyses were excluded.

An ideal control group for these analyses would be a group of individuals covered by Medicare but without access to Part D. However, no such group exists. Several studies assessing the impact of Medicare Part D have used a near-elderly cohort as the control group because of their similarity to Medicare beneficiaries (Ketcham and Simon 2008; Yin et al. 2008; Zhang et al. 2008; Engelhardt and Gruber 2010). Similar to these studies, we restricted our control group to non-Medicare individuals 55 years and 63 years of age on December 31, 2004. We excluded individuals aged 64 in 2005 because we wanted to avoid those with partial eligibility to Part D in 2006 and excluded those under 55 to help avoid the variation in medicines used by women for reproduction and contraception (Grootendorst, O'Brien, and Anderson 1997).

Analysis

Five primary dependent variables were examined: out-of-pocket costs, medication utilization, emergency department use, hospitalizations, and preference-based health utility. Out-of-pocket costs were defined as direct payment for prescription drugs by patients during the calendar year in 2005 and 2006. All dollar amounts were adjusted to 2006 dollars based on the Consumer Price Index (CPI) (Medical Expenditure Panel Survey 2009). Medication utilization was measured by the number of prescription refills per person during a year. Emergency department use was measured by the annual number of emergency department use for raw difference-in-differences analysis and dichotomously defined as the absence or presence of one or more emergency department admissions during each calendar year for multivariate analysis, since very few noninstitutionalized individuals had such use during a given year. Similarly, hospitalization was measured by the annual number of hospitalizations in the unadjusted analysis and coded dichotomously for the multivariate analysis. Finally, we examined the impact of Medicare Part D on health using Brazier et al.'s SF-6D algorithm to generate societal preference-weighted summary scores derived from the items on the SF-12 survey included in the MEPS in 2005 and 2006 (Brazier and Roberts 2004). We used the SF-6D algorithm because the body of literature that supports the validity and interpretability of the SF-6D is more substantial than that for other algorithms available for the SF-12/SF-36 (Pickard et al. 2005). The scores are scaled such that 0 represents death or a state equivalent to death and 1.0 represents perfect health (Brazier and Roberts 2004; Fleishman 2005).

In addition to the five outcome variables described above, we examined several available intermediate outcomes, including drug coverage, drug costs paid by Medicare, drug costs paid by private insurance, and total drug costs, as well as total hospitalization costs and total emergency department use costs to assess whether there were cost offsets of Part D.

We used a difference-in-differences (DD) model to estimate the impact of Part D on each outcome (Athey and Imbens 2006). This approach is valid only under a restrictive assumption that changes in the outcomes of both groups would have followed similar trends over time in the absence of the intervention (Bertrand, Duflo, and Mullainathan 2004). Although such an assumption cannot be definitively tested, we extracted similar study and control groups from MEPS Panel 9 data to examine whether there were parallel trends in each outcome between those groups during the years prior to Part D implementation (Card and Shore-Sheppard 2004; Lichtenberg and Sun 2007).

Further, we examined whether there were parallel trends between analogous groups using MEPS Panel 8.

Independent two-group *t*-tests were conducted for continuous variables and χ^2-tests for categorical variables to compare the treatment and control groups at baseline in terms of age, gender, race, education, marital status, census region, metropolitan statistical area, annual household income, Instrumental Activities of Daily Living and Activities of Daily Living, physical functioning, number of chronic diseases, body mass index, and smoking status. We conducted unadjusted difference-in-differences analyses, and then examined difference-in-differences effects after adjusting for individuals' sociodemographic characteristics and health status.

A multivariate difference-in-differences model can be written as follows:

$$Outc_{it} = \beta_0 + \beta_1 MPD + \beta_2 Year + \beta_3 (MPD \times Year) + X'_{it}\alpha + \varepsilon_{it}$$

where $Outc_{it}$ is the major outcome of interest, *MPD* is a dummy variable for treatment and control group, and β_1 captures potential differences between the treatment and control group. The dummy variable *Year* represents 2006, and β_2 captures the change in outcomes of interest in the absence of Medicare Part D (time trend). The coefficient β_3 is the parameter of interest. β_3 measures the effect of the intervention on the treatment group (i.e., difference-in-differences). X is a matrix of covariates, including sociodemographic characteristics and health status.

Specifically for the multivariate analysis, we selected a generalized linear model with Gamma distribution and log link for out-of-pocket costs based on its coefficient of Kurtosis and heteroscedasticity (Manning and Mullahy 2001; Deb, Manning, and Norton 2008). For examining medication utilization, we used a generalized linear model with a negative binomial distribution and log link based on the characteristics of data dispersion ($\alpha = 0.9855$; 95 percent CI, 0.8837–1.0990). For emergency department use and hospitalization, we used multivariate logistic regression. We then computed the adjusted difference-in-differences of out-of-pocket costs and medication utilization and the interaction effects for the logistic model on emergency department use and hospitalizations according to the appropriate functional forms (Norton, Wang, and Ai 2004; Deb et al. 2008). Analysis of covariance was used to model preference-based health utility. All analyses accounted for MEPS' complex sampling design and applied sample weights accordingly (Machlin, Yu, and Zodet 2005). Data were analyzed with *SAS* version 9.1.3 (SAS Inc., Cary, NC,

U.S.A.) in the descriptive analyses and *Stata* 10 (Stata Corp., College Station, TX, U.S.A.) in the adjusted analyses.

Potential "offset" effects of lower coverage for prescription drugs resulting in increased hospitalization among people with a chronic disease have been reported (Chandra, Gruber, and McKnight 2007). Based on those findings, we repeated the raw difference-in-differences analyses among subpopulations with one or more of the chronic diseases[1] measured in the MEPS 2005 questionnaire (diabetes, asthma, emphysema, high blood pressure, high cholesterol, coronary heart disease, angina, myocardial infarction, stroke, joint pain, and arthritis) as a sensitivity analysis to examine whether increased coverage for prescription drugs resulted in a reduction of hospitalization among people with chronic diseases.

RESULTS

Sample and Baseline Characteristics

The dataset included 1681 individuals in MEPS Panel 10 aged 65 and older as of January 1, 2005. Of these, 1125 were excluded due to aforementioned eligibility criteria (844 were excluded for military or institutional status or because of their low annual family income, being in Medicaid or TRICARE, or without Medicare coverage, and 281 for other criteria, such as those with cognitive problems, directly inconsistent reporting, or missing values), leaving 556 for the final analysis, representing a population of over 13.6 million Medicare beneficiaries. Similarly, of the 1271 individuals initially selected as controls, 549 remained after all inclusion and exclusion criteria were applied (532 excluded for military or institutional status or because of their low annual family income, or being in Medicaid, TRICARE, or Medicare, and 190 because of other criteria), representing over 13.4 million near elderly.[2] Note also that some of the main sample had missing values for preference-based health utility score. Hence, the sample sizes in those analyses were 491 and 484 for elderly and near elderly, respectively.

Table 1 examines the demographic and health related characteristics of the two groups. Overall, the average age was 73.51 years for Medicare beneficiaries and 59.19 years for the control group. Medicare beneficiaries tended to have less education (31.65 percent versus 43.19 percent with at least some college, $p < .0001$), lower incomes (15.98 percent versus 7.39 percent with low income, $p < .0001$), lower obesity rates (22.94 percent versus 29.13 percent, $p = .037$), lower current smoking rates (10.02 percent versus 14.46 percent, $p = .038$), a higher percentage with physical function limitation (26.69 percent

Table 1: Comparison of Baseline Characteristics of the Study Group and the Control Group

Individual Characteristics	*Variable Description*	*Elderly (N = 556)*		*Near Elderly (N = 549)*	
		Mean	*SE*	*Mean*	*SE*
Age (mean)***		73.51	0.33	59.19	0.12
Sex (proportion)					
	Male	0.4649	0.0168	0.4894	0.0186
Ethnicity (proportion)*					
	White	0.9199	0.0110	0.8754	0.0130
	Black	0.0383	0.0060	0.0653	0.0083
	Other	0.0418	0.0097	0.0592	0.0095
Education (proportion)***					
	Less than high school	0.1903	0.0170	0.1069	0.0160
	High school diploma	0.4932	0.0216	0.4612	0.0244
	College and plus	0.3165	0.0205	0.4319	0.0229
Family income (proportion)***					
	Low income	0.1598	0.0175	0.0739	0.0114
	Middle income	0.3248	0.0274	0.2801	0.0216
	High income	0.5153	0.0272	0.6460	0.0235
Region (proportion)					
	Northeast	0.2044	0.0168	0.2217	0.0223
	Midwest	0.2373	0.0213	0.2491	0.0221
	South	0.3423	0.0275	0.3411	0.0228
	West	0.2159	0.0272	0.1881	0.0160
MSA (proportion)					
	Metropolitan	0.8292	0.0194	0.8351	0.0227
Body mass index (BMI) (proportion)*					
	Normal or under weight	0.3464	0.0179	0.2922	0.0195
	Over weight	0.4242	0.0178	0.4166	0.0214
	Obesity	0.2294	0.0179	0.2913	0.0200
Smoke (proportion)*					
	Currently smoking	0.1002	0.0139	0.1446	0.0176
Marriage (proportion)*					
	Married	0.6817	0.0222	0.7430	0.0203
Activities of daily living+instrumental activities of daily living (ADL_IADL) (proportion)**					
	Yes	0.0298	0.0065	0.0076	0.0040
Physical function limitation (proportion)***					
	Yes	0.2669	0.0198	0.1077	0.0152
Number of chronic disease (NCD) (proportion)***					
	No chronic diseases	0.1087	0.0163	0.1947	0.0167
	1 or 2 chronic diseases	0.3640	0.0182	0.4688	0.0207
	$\geq$ 3 chronic diseases	0.5273	0.0199	0.3365	0.0208
Prescription drug coverage (proportion)***					
	No	0.4998	0.0260	0.1452	0.0155
Weighted population		13,606,613		13,451,661	

Notes. Elderly: Medicare beneficiaries, 65 years or older, excluding those under Medicaid and those with government subsidies as well as those with inconsistent report on drug coverage.

Near elderly: The corresponding respondents with age between 55 and 63 in 2005.

*$p < .05$; **$p < .01$; ***$p < .001$.

Source: MEPS Panel 10 longitudinal data file, 2005–2006.

versus 10.77 percent, $p<.0001$) and were more likely to have greater than three chronic illnesses (52.73 percent versus 33.65 percent, $p<.0001$) . There were small differences in race, and no statistically significant differences between treatment and control groups with regard to gender or region.

The mix of prescription drug coverage was different between the elderly and near elderly. There were 14.52 percent of the near elderly without prescription coverage any time in 2005 and 2006 versus 49.98 percent of the elderly. Using MEPS Panel 8 and Panel 9, we found similar results in percent without prescription drug coverage for near elderly versus elderly: 11.52 percent versus 49.95 percent in Panel 8 and 11.47 percent versus 48.08 percent in Panel 9.

There were no large or statistically significant differences between the treatment and control groups with regard to trends in the primary outcomes of interest in the Panel 9 data before Part D (Table 2). For example, a test of parallelism of the trends in out-of-pocket costs for prescription drugs between elderly and near elderly showed that the interaction coefficient of time (from 2004 to 2005) and being elderly was -29.56 (SE = 69.10, $t=-0.43$, $p=.6692$). After controlling for observed covariates, the adjusted p-value was .9110. Similarly, no significant differences were observed with regard to the other outcomes examined, including prescription drug use, emergency department use, hospitalization, and preference-based utility score in Panel 9.

Using MEPS Panel 8, 2 years before Part D, we also found that the trends of the two groups were not significantly different in the aforementioned outcomes of interest with the exception of the health utility score (DD = 0.0084, $t=-3.93$, $p<.0001$; after adjustment, $t=-1.35$, $p=.1768$), though the difference there was small. In Panel 8, both out-of-pocket costs (DD = 116.64, SE = 61.33, $t=1.90$, $p=.0580$) and prescription refills (DD = 1.79, SE = 0.98, $t=1.84$, $p=.0671$) had some marginally significant evidence of increase from 2003 to 2004 for the elderly compared with the nonelderly.[3] However, the out-of-pocket costs and medication utilization differences were not significant in multivariate models ($t=1.56$, $p=0.12$ for out-of-pocket costs and $t=1.13$, $p=.262$ for medication utilization). In addition, the change in out-of-pocket costs from 2003 to 2004 was in the opposite direction of our main findings in Panel 10 regarding the impact of Part D. Overall, the data supported that the control group was appropriate for use in adjusting for secular time trends.

Observed and Adjusted Difference-in-Differences

Table 3 depicts the unadjusted difference-in-differences results for the primary and intermediate outcomes of interest. On average, Medicare beneficiaries'

Table 2: Observed Difference-in-Differences in Primary and Secondary Outcomes of Interest before the Implementation of Medicare Part D

Outcome Variables	*2004*	*2005*	*Differences*	*DD*	*t-Value*	*p-Value*
Out-of-pocket costs for prescription drugs						
Elderly	954.49	904.87	− 49.61	− 29.56	− 0.43	.6692
Near elderly	466.26	446.21	− 20.05			
Number of prescription refills						
Elderly	23.60	22.59	− 1.01	− 0.52	− 0.55	.5861
Near elderly	15.95	15.46	− 0.49			
Number of emergency department use						
Elderly	0.2075	0.1764	− 0.0311	− 0.0452	− 1.04	.2982
Near elderly	0.1235	0.1376	0.0141			
Number of hospitalization						
Elderly	0.1696	0.1809	0.0113	− 0.0223	− 0.69	.4895
Near elderly	0.0599	0.0935	0.0335			
Preference-based health utility score						
Elderly	0.7718	0.7779	0.0061	0.0086	1.49	.1377
Near elderly	0.8086	0.8062	− 0.0024			
Prescription drug costs paid by Medicare						
Elderly	156.92	167.98	11.06	11.06	0.61	.5435
Near elderly	0.00	0.00	0.00			
Prescription drug costs paid by private insurance						
Elderly	480.54	356.70	− 123.83	− 75.09	− 1.05	.2957
Near elderly	792.25	743.51	− 48.75			
Total prescription drug costs						
Elderly	1677.96	1549.49	− 128.47	− 62.83	− 0.65	.5187
Near elderly	1275.83	1210.19	− 65.64			

Notes. Elderly: Medicare beneficiaries, 65 years or older, excluding those under Medicaid and those with government subsidies as well as those with insistent report on drug coverage ($N = 518$ with 455 for utility score values).

Near elderly: the corresponding respondents with age between 55 and 63 in 2004 ($N = 584$, with 514 for utility score values).

Source: MEPS Panel 9 longitudinal data file, 2004–2005.

out-of-pocket costs decreased by U.S.$255.45, from U.S.$854.33 in 2005 to U.S.$598.88 in 2006. This decrease was significantly larger than the decrease of U.S.$26.40 for the near elderly over the same period ($p < .001$). The annual costs for prescription drugs paid by private insurance also decreased significantly more (U.S.$351.57 more) per elderly person than per near elderly ($p < .001$). However, Medicare payments for its beneficiaries' prescription drugs, which are zero by definition for the control group, increased significantly by U.S.$704 from 2005 to 2006 ($t = 8.75$, $p < .001$). The number of prescription refills for the elderly increased by 1.89 prescriptions per patient year from 2005 to 2006 compared with a 0.70 prescription per patient year

Table 3: Observed Difference-in-Differences in the Primary and Secondary Outcomes of Interest during the Implementation of Medicare Part D

Outcome Variable	*2005*	*2006*	*Differences*	*DD*	*t-Value*	*p-Value*
Out-of-pocket costs for prescription drugs						
Elderly	854.33	598.88	−255.45	−229.05	−4.49	<.0001
Near elderly	461.43	435.03	−26.40			
Number of prescription refills						
Elderly	21.98	23.88	1.89	1.19	1.51	.1311
Near elderly	15.43	16.13	0.70			
Number of emergency department use						
Elderly	0.1706	0.1941	0.0235	0.0522	1.57	.1181
Near elderly	0.1302	0.1015	−0.0287			
Number of hospitalization						
Elderly	0.1407	0.1574	0.0167	0.0257	1.15	.2531
Near elderly	0.0887	0.0797	−0.0091			
Preference-based health utility score						
Elderly	0.7798	0.7798	−0.0001	0.0008	−1.18	.2378
Near elderly	0.8043	0.8034	−0.0009			
Prescription drug costs paid by Medicare						
Elderly	127.47	831.48	704.00	704.00	8.75	<.0001
Near elderly	0.00	0.00	0.00			
Prescription drug costs paid by private insurance						
Elderly	446.88	146.75	−300.13	−351.57	−5.49	<.0001
Near elderly	656.90	708.34	51.44			
Total prescription drug costs						
Elderly	1520.17	1621.10	100.92	84.76	0.90	.3704
Near elderly	1130.56	1146.72	16.16			
Total emergency department use costs						
Elderly	82.86	90.97	8.11	4.25	0.13	.8954
Near elderly	93.22	97.08	3.86			
Total hospitalization costs						
Elderly	1723.43	1659.18	−64.25	−184.34	−0.34	.7369
Near elderly	1125.75	1245.84	120.09			
Has usual third-party payer	Round 1	Round 2	Round 3	Round 4	Round 5	
Elderly	39.89%	43.71%	48.78%	65.01%	65.61%	
Near elderly	40.68%	47.45%	47.88%	54.41%	56.21%	
Prescription drugs paid by Medicare (%)						
Elderly	4.25%	3.74%	6.50%	17.40%	19.32%	
Near elderly	0.00%	0.00%	0.00%	0.00%	0.00%	

Elderly: Medicare beneficiaries, 65 years or older, excluding those under Medicaid and those with government subsidies as well as those with inconsistent report on drug coverage ($N = 556$, with 491 for utility score values).

Near elderly: the corresponding respondents with age between 55 and 63 in 2005 ($N = 549$, with 484 for utility score values).

Source: MEPS Panel 10 longitudinal data file, 2005–2006.

increase among the near elderly over the same time period for a net relative increase of 1.19 prescriptions. Overall the chance of hospitalization increased on average by 0.0167 per patient year among the elderly, while it decreased by 0.0091 per patient year in the near elderly. However, the difference in the trends was not significant ($p = .2531$).

Results of a difference-in-differences analysis in MEPS Panel 10 participants with one or more chronic diseases were similar to those reported in Table 3.[4] For example, on average, Medicare beneficiaries' out-of-pocket costs decreased U.S.$281.91 over the period examined, from U.S.$938.85 (2005) to U.S.$656.94 (2006). This decrease was significantly larger than the decrease of U.S.$35.24 for the near elderly over the same period ($p < 0.0001$). There were no results that would suggest a cost offset in hospitalizations or emergency department use.

Table 4 depicts the adjusted difference-in-differences results.[5] After adjustment for sociodemographic characteristics (e.g., age and education) and health status (e.g., physical functioning), Part D was associated with an estimated U.S.$179.86 reduction in out-of-pocket costs for prescription drugs ($p = .034$) and an estimated 2.05 increase in the number of prescriptions per year ($p = .081$) between 2005 and 2006 for Medicare beneficiaries relative to the near-elderly control group. There were nonsignificant impacts seen for Part D on emergency department use (0.037 change in annual visits, $p = .565$) and hospitalization (0.0362 change in annual hospitalizations, $p = .479$). Finally, there was a small and nonstatistically significant change in Medicare beneficiaries' preference-based health utility due to Part D after adjustment for potentially confounding covariates and time trends (– 0.0106 change in utility, $p = .143$).

Discussion

In this analysis of the Medical Expenditure Panel Survey, we found that Part D eligibility was associated with substantial reductions of out-of-pocket costs for prescription drugs and a modest increase of medication utilization. However, there were no statistically significant effects found for the drug benefit on individuals' emergency department use, hospitalization rate, or preference-based health utility during the first year of Part D implementation. Overall, there was no evidence from the analyses suggesting a cost offset related to Part D. These findings are important because of the scope of Part D, as well as the uncertainty as to whether documented changes in medication utilization and

Table 4: Adjusted Effect of Medicare Part D on Out-of-Pocket Costs, Number of Prescription Refills, Emergency Department Use, Hospitalization, and Preference-Based Utility Score among Overall Medicare Beneficiaries

	Regression Coefficients	*Adjusted Difference-in-Differences Effects*	*Standard Error*	*p-Value**
Out-of-pocket costs for prescription drugs	− 0.2189	− 179.86	4.22	.034
Number of prescription refills	0.1000	2.05	0.0432	.081
Emergency department use	1.15	0.0377	0.0277	.565
Hospitalization	1.19	0.0362	0.0265	.479
Preference-based utility score	− 0.0106	− 0.0106	0.0072	.143

Notes. The adjusted difference-in-differences were the interaction effects of changing group (elderly or near elderly) and year (2005 or 2006) within the nonlinear models for out-of-pocket costs, number of prescription refills, emergency department use, and hospitalization.

For the complete regression results, please see supporting information Appendix SA5. We controlled for being elderly, year, family income, body mass index, chronic disease status, region, metropolitan status, ethnicity, education level, marriage, current smoking status, physical function, activities of daily living, and instrumental activities of daily living.

**p*-values refer to the multiple regression coefficient's *p*-value.

Source: MEPS Panel 10 data file, 2005–2006; sample sizes were the same as in Table 3.

out-of-pocket costs have led to measurable changes in Medicare beneficiaries' nonprescription health care utilization or outcomes.

In an attempt to focus our analysis on patients more likely to be affected by improved coverage, we examined the impact of Part D eligibility on patients who reported one or more chronic diseases. Results of this analysis were consistent with the main results, which is likely because 89.13 percent of Medicare beneficiaries and 80.53 percent of the control group in our data reported having one or more chronic diseases.

The size of our estimates of reductions in out-of-pocket costs (21 percent [adjusted] reduction in out-of-pocket costs from a level U.S.$854.33 in 2005) and increases in medication utilization (9.33 percent increase from 21.98 prescription refills in 2005) were consistent with prior studies (Lichtenberg and Sun 2007; Yin et al. 2008; Joyce et al. 2009; Schneeweiss et al. 2009). Using data from a large retail pharmacy chain, Lichtenberg and Sun (2007) found that out-of-pocket costs for prescription drugs among the elderly decreased 18.4 percent and their days of therapy increased 12.8 percent from 2005 to 2006. Yin et al. (2008), using an alternative analytic approach with a more refined sampling method and more restricted control group, estimated a 13.1 percent reduction in out-of-pocket costs and a 5.9 percent increase in pill-days. Using a large dataset from a prescription transaction manager, Ketcham and Simon (2008) found a 17.2 percent decrease in elderly patients' out-of-pocket

costs and a 8.1 percent increase in number of days supply of prescription drugs. Among seniors without previous prescription drug coverage, Schneeweiss et al. (2009)used pharmacy chain data and time series design and found a 37–58 percent decrease in user costs for prescription drugs and a 11–37 percent increase in drug use, although they did not include a concurrent control group and only examined four essential medication classes in their analysis.

In contrast, we did not find any significant impact of Medicare Part D on total expenditures for prescription drugs, hospitalization, or emergency department use. Compared with the average increase in costs for prescription drugs by Medicare, the decrease in Medicare beneficiaries' out-of-pocket costs was small. Our findings support the study results by Engelhardt and Gruber that found Part D substantially transferred payment for prescription drugs from the private sector to the public sector (Engelhardt and Gruber 2010).

There are several reasons that may account for our finding that Part D was not associated with any reduction in hospitalization or emergency department use. First, the MEPS Panel 10 database was not released until January 2009 and included a limited follow-up period following Part D, which is especially important to consider since many individuals did not enroll until several months following Part D implementation. Improved prescription drug access may not manifest immediately in some of the health outcomes that were examined (e.g., hospitalization rates). Second, despite the substantial reductions in out-of-pocket costs, estimated increases in prescription drug utilization were much smaller (Yin et al. 2008). Our data suggested an increase of 2.05 prescriptions per patient year. These modest increases in utilization were projected by economists even before Part D implementation because both poor and wealthy Medicare beneficiaries already had prescription drug access, albeit through different methods of financing (Pauly 2004). Third, not only were the increases in prescription drug utilization modest, they may not have accrued for individuals or therapies that are likely to result in reductions, or offsets, in nonmedication health services use.

We also explored changes in total hospitalization cost and total cost for emergency department use using the same data and did not find any cost offsets with those variables. Our findings are consistent with others, using alternative methods and data sources, also suggesting that Part D eligibility would not lead to substantial reductions in hospitalizations or other cost offsets (Briesacher et al. 2005; Khan et al. 2008). Using Medicare Current Beneficiary Survey (MCBS) from the years 2000 to 2007, Kaestner and Khan (2010) found a 70 percent increase in prescription drug use among Medicare beneficiaries without pre-Part D prescription drug coverage. However, they found little

evidence that Medicare Part D was significantly associated with a reduction in emergency department use, hospitalization, or with an increase in their health status.

Our findings raise important questions for future research. One set of questions relates to whether Part D has led to significant offsets among particular subsets of Medicare beneficiaries, such as those with particular types of insurance coverage or eligible for medication therapy management services (MTM). For example, one recent quasi-experimental study of individual diabetics found that MTM was associated with better clinical outcomes and greater cost reduction, suggesting that such interventions could lead to improvements in individuals' health outcomes (Fox et al. 2009). However, patients to whom Medicare-eligible MTM services apply (i.e., those with complex medication regimens, multiple chronic conditions, and high drug expenses) may represent a small proportion of newly covered recipients of drug coverage who were previously not insured, and they may have been insufficiently represented in our analyses. Evaluation of the impact of Part D on dual eligible beneficiaries' health care utilization and outcomes is also important. Dual eligible beneficiares accounted for roughly 29 percent of the current Medicare participants who enrolled in Medicare Part D (Frank and Newhouse 2008), and they are a highly vulnerable population with low incomes and high rates of chronic disease. Although the transition to Part D was characterized by considerable concern regarding the program's impact on the dually eligible (Crowley, Ashner, and Elam 2005; Levinson 2006; Smith et al. 2006; Donohue and Frank 2007; West et al. 2007) and contingency plans were developed (Smith et al. 2006), there is evidence that Part D did not have any statistically significant impact on their prescription utilization or expenditures (Basu, Yin, and Alexander 2010).

Our analysis has several limitations. First, despite advantages of using the near-elderly group to control for secular variations, we acknowledge challenges to this strategy. The near elderly differ from other populations in terms of proportions in the active labor workforce and health care coverage levels (Powell-Griner, Bolen, and Bland 1999). It is not possible to know with certainty whether the elderly and near elderly would have experienced similar trends in out-of-pocket costs, emergency department use, and hospitalization if Medicare Part D had not been implemented, which would imply a bias in the results. Of particular concern was that the mix of prescription drug coverage in the control group was different from the mix in the Medicare-eligible study group. We found that less than 15 percent in the control group had no prescription drug insurance compared to almost 50 percent in the Medicare

beneficiary group based on the Panel 10 data. Using Panel 9 data with the same inclusion and exclusion criteria, 11.47 percent of the control group did not have any prescription drug insurance versus 48.08 percent of the elderly. In addition, the MEPS data did not provide information regarding whether Medicare beneficiaries changed Medicare Advantage plans from 2005 to 2006. Differences in the coverage mix or in the Medicare Advantage plans could have biased the results by introducing differences across time between the treatment and control groups. However, none of the relevant outcomes between the study and control groups from Panel 9 displayed changes that were significantly different. Looking further, the Panel 8 results were consistent as well except possibly for the marginally significant findings in out-of-pocket costs and medication utilization. Here any suggested bias regarding out-of-pocket costs would imply that our findings were too small. With respect to prescriptions, the Panel 8 results could imply that the finding may be too large, though again this difference in trend was not significant in multivariate models and was not seen in Panel 9. Overall, we do not believe the observed differences in coverage and other characteristics precluded our use of the near elderly as the control group.

Second, as discussed above, we examined a limited follow-up period after Part D implementation. Third, we transformed the number of emergency department use and hospitalizations into dummy variables and may have thereby lost information on the effects of Part D. It is possible, for example, that Part D did reduce use of emergency department and hospitalization among users of these services, but that it did not affect the proportion of Medicare beneficiaries with at least some use.

Fourth, since we did not have utility weights for the SF-6D based upon the preferences of the U.S. general population, we used weights obtained from the United Kingdom. It is unclear if having a set of U.S. weights would have made a difference on the impact of the drug benefit on preference-based health utilities scores (Johnson et al. 2005). Further, the SF-6D has theoretical merit compared with other utility algorithms available for the SF-12, including being based on standard gamble utilities, and it provides directly elicited preferences rather than scores mapped from another indirect health utility measure like the EQ-5D or HUI (Health Utilities Index) (Pickard et al. 2005).

Fifth, we excluded dually eligible beneficiaries and those with Medicaid, and thus our results may not generalize to this population, though it is noteworthy that prior work suggests no change in their prescription drug access due to Part D (Basu et al. 2010).

CONCLUSION

In the first year following Part D implementation, we found that despite a substantial reduction in out-of-pocket costs for prescription drugs and a modest increase in the number prescription refills, there was no discernible impact of Part D on emergency department use, hospitalizations, or preference-based health utility that would suggest a cost offset. Further work is needed to characterize whether such reductions, or offsets, may potentially be realized over the longer term or present in other populations, and if so, in what contexts.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: This work is based upon a thesis in partial fulfillment of the requirements for the doctoral degree at the Graduate College of the University of Illinois at Chicago and supported by the Agency for Healthcare Research and Quality (K08 HS15699-01A1, Alexander), and the Robert Wood Johnson Physician Faculty Scholars Program (Alexander).

The funding sources had no role in study design or conduct; collection, management, analysis, or interpretation of the data; nor preparation, review, or final manuscript approval.

The authors gratefully acknowledge James W. Shaw, Ph.D., Pharm.D., M.P.H., for assistance with survey data analysis; Willard Manning, Ph.D., for assistance in modeling out-of-pocket costs and comments on a previous manuscript draft; and the reviewers of HSR for their comments on earlier drafts.

A previous version of this paper was presented at the International Society for Pharmacoeconomics and Outcomes Research, 15th Annual International Meeting, Atlanta, GA, May 18, 2010.

Disclosure: None.

Disclaimer: None.

NOTES

1. We also examined the impact of Medicare Part D on outcomes among patients reporting ambulatory care sensitive conditions, including asthma, chronic obstructive pulmonary disease, and congestive heart failure, which need timely and appropriate primary care, and those reporting specific chronic diseases like

diabetes or arthritis. Unfortunately, small sample sizes limited our ability to rigorously assess Part D impact among these subjects.
2. For more detail, please see supporting information Appendix SA2.
3. For more detail, please see supporting information Appendix SA3.
4. For more detailed results, please see supporting information Appendix SA4.
5. For the complete set of regression results, please see supporting information Appendix SA5.

REFERENCES

Athey, S., and G. W. Imbens. 2006. "Identification and Inference in Nonlinear Difference-in-Differences Models." *Econometrica* 74 (2): 431–97.

Basu, A., W. Yin, and G. C. Alexander. 2010. "Impact of Medicare Part D on Medicare 2013; Medicaid Dual-Eligible Beneficiaries' Prescription Utilization and Expenditures." *Health Services Research* 45 (1): 133–51.

Bertrand, M., E. Duflo, and S. Mullainathan. 2004. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119 (1): 249–75.

Brazier, J. E., and J. Roberts. 2004. "The Estimation of a Preference-Based Measure of Health from the SF-12." *Medical Care* 42: 851–59.

Briesacher, B. A., B. Stuart, X. Ren, J. A. Doshi, and M. V. Wrobel. 2005. "Medicare Beneficiaries and the Impact of Gaining Prescription Drug Coverage on Inpatient and Physician Spending." *Health Services Research* 40 (5, part 1): 1279–96.

Card, D., and L. D. Shore-Sheppard. 2004. "Using Discontinuous Eligibility Rules to Identify the Effects of the Federal Medicaid Expansions on Low-Income Children." *Review of Economics and Statistics* 86 (3): 752–66.

Chandra, A., J. Gruber, and R. McKnight. 2007. "Patient Cost-Sharing, Hospitalization Offsets, and the Design of Optimal Health Insurance for the Elderly" [accessed on December 28, 2007]. Available at http://www.nber.org/tmp/73688-w12972.pdf

Cohen, S. B. 2003. "Design Strategies and Innovations in the Medical Expenditure Panel Survey." *Medical Care* 41 (7, suppl): III-5–12.

Crowley, J. S., D. Ashner, and L. Elam. 2005. "State Medicaid Outpatient Prescription Drug Policies: Findings from a National Survey, 2005 Update" [accessed on April 7, 2005]. Available at http://www.kff.org/medicaid/upload/State-Medicaid-Outpatient-Prescription-Drug-Policies-Findings-from-a-National-Survey-2005-Update-report.pdf

Deb, P., W. Manning, and E. Norton. 2008. "Preconference Course: Modeling Health Care Costs and Counts" [accessed on August 16, 2008]. Available at http://harrisschool.uchicago.edu/faculty/articles/ASHE2008_Minicourse_Cost_Use_slides_refs.pdf

Doherty, R. B. 2004. "Assessing the New Medicare Prescription Drug Law." *Annals of Internal Medicine* 141 (5): 391–5.

Donohue, J. M., and R. G. Frank. 2007. "Estimating Medicare Part D's Impact on Medication Access among Dually Eligible Beneficiaries with Mental Disorders." *Psychiatric Services* 58 (10): 1285–91.

Engelhardt, G. V., and J. Gruber. 2010. "Medicare Part D and the Financial Protection of the Elderly" [accessed on February 17, 2011]. Available at http://www.indiana.edu/~econdept/workshops/Spring_2011_Papers/EngelhardtMedicare-PartD.pdf

Fleishman, J. A. 2005. "Methodology Report #15: Demographic and Clinical Variations in Health Status" [accessed on June 2, 2005]. Available at http://www.meps.ahrq.gov/data_files/publications/mr15/mr15.shtml

Fox, D., L. D. Ried, G. E. Kaein, W. Myers, and K. Foli. 2009. "A Medication Therapy Management Program's Impact on Low-Density Lipoprotein Cholesterol Goal Attainment in Medicare Part D Patients with Diabetes." *Journal of American Pharmacists Association* 49 (2): 192–9.

Frank, R. G., and J. P. Newhouse. 2008. "Should Drug Prices Be Negotiated under Part D of Medicare? And If So, How?" *Health Affairs* 27 (1): 33–43.

Gellad, W. F., H. A. Huskamp, K. A. Phillips, and J. S. Haas. 2006. "How the New Medicare Drug Benefit Could Affect Vulnerable Populations." *Health Affairs* 25 (1): 248–55.

Grootendorst, P. V., B. J. O'Brien, and G. M. Anderson. 1997. "On Becoming 65 in Ontario: Effects of Drug Plan Eligibility on Use of Prescription Medicines." *Medical Care* 35 (4): 386–98.

Hsu, J., M. Price, J. Huang, R. Brand, V. Fung, R. Hui, B. Fireman, J. P. Newhouse, and J. V. Selby. 2006. "Unintended Consequences of Caps on Medicare Drug Benefits." *New England Journal of Medicine* 354 (22): 2349–59.

Johnson, J. A., N. Luo, J. W. Shaw, P. Kind, and S. J. Coons. 2005. "Valuations of EQ-5D Health States: Are the United States and United Kingdom Different?" *Medical Care* 43 (3): 221–8.

Joyce, G. F., D. P. Goldman, W. B. Vogt, E. Sun, and A. B. Jena. 2009. "Medicare Part D after 2 Years." *American Journal of Managed Care* 15 (8): 536–44.

Kaestner, R., and N. Khan. 2010. "Medicare Part D and Its Effect on the Use of Prescription Drugs, Use of Other Health Care Services and Health of the Elderly" [accessed on December 28, 2010]. Available at http://www.nber.org/tmp/56791-w16011.pdf

Kaiser Family Foundation. 2006. "The Medicare Prescription Drug Benefit" [accessed on October 31, 2006]. Available at http://www.kff.org/medicare/upload/7044-04.pdf

Kaiser Family Foundation 2008. "Medicare Spending and Financing: Fact Sheet" [accessed on October 9, 2008]. Available at http://www.kff.org/medicare/upload/7305_03.pdf

Ketcham, J. D., and K. I. Simon. 2008. "Medicare Part D's Effects on Elderly Patients' Drug Costs and Utilization." *American Journal of Managed Care* 14 (11): SP14–SP22.

Khan, N., R. Kaestner, and S.-J. Lin. 2008. "Effect of Prescription Drug Coverage on Health of the Elderly." *Health Services Research* 43 (5, part 1): 1576–97.

Levinson, D. R. 2006. "Dual Eligibles' Transition: Part D Formularies' Inclusion of Commonly Used Drugs" [accessed on August 24, 2006]. Available at http://oig.hhs.gov/oei/reports/oei-05-06-00090.pdf

Levy, H., and D. R. Weir. 2009. "Take-Up of Medicare Part D: Results from the Health and Retirement Study." *Journal of Gerontology: Social Sciences* 65B (4): 492–501.

Lichtenberg, F. R., and S. X. Sun. 2007. "The Impact of Medicare Part D on Prescription Drug Use by the Elderly." *Health Affairs* 26 (6): 1735–44.

Machlin, S., W. Yu, and M. Zodet. 2005. "Computing Standard Errors for MEPS Estimates" [accessed on March 9, 2005]. Available at http://www.meps.ahrq.gov/survey_comp/standard_errors.jsp

Manning, W. G., and J. Mullahy. 2001. "Estimating Log Models: To Transform or Not to Transform?" *Journal of Health Economics* 20 (4): 461–94.

Medical Expenditure Panel Survey. 2008. "Survey Components" [accessed on December 16, 2008]. Available at http://www.meps.ahrq.gov/mepsweb/

Medical Expenditure Panel Survey. 2009 "Using Appropriate Price Indices for Expenditure Comparisons" [accessed on March 24, 2009]. Available at http://207.188.212.220/mepsweb/about_meps/Price_Index.shtml

Norton, E., H. Wang, and C. Ai. 2004. "Computing Interaction Effects and Standard Errors in Logit and Probit Models." *Stata Journal* 4 (2): 154–67.

Pauly, M. V. 2004. "Medicare Drug Coverage and Moral Hazard." *Health Affairs* 23 (1): 113–22.

Pickard, A. S., Z. Wang, S. Walton, and T. Lee. 2005. "Are Decisions Using Cost-Utility Analyses Robust to Choice of SF-36/SF-12 Preference-Based Algorithm?" *Health and Quality of Life Outcomes* 3 (1): 11 (online pages 1–9). Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC555748/pdf/1477-7525-3-11.pdf.

Powell-Griner, E., J. Bolen, and S. Bland. 1999. "Health Care Coverage and Use of Preventive Services among the Near Elderly in the United States." *American Journal of Public Health* 89 (6): 882–6.

Schneeweiss, S., A. R. Patrick, A. Pedan, L. Varasteh, R. Levin, N. Liu, and W. H. Shrank. 2009. "The Effect of Medicare Part D Coverage on Drug Use and Cost Sharing among Seniors without Prior Drug Benefits." *Health Affairs* 28 (2): w305–16.

Simoni-Wastila, L., I. H. Zuckerman, T. Shaffer, C. M. Blanchette, and B. Stuart. 2008. "Drug Use Patterns in Severely Mentally Ill Medicare Beneficiaries: Impact of Discontinuities in Drug Coverage." *Health Services Research* 43 (2): 496–514.

Smith, V., K. Gifford, S. Kramer, and L. Elam. 2006. "The Transition of Dual Eligibles to Medicare Part D Prescription Drug Coverage: State Action during Implementation. Results from a 50-State Snapshot" [accessed on September 6, 2006]. Available at http://www.kff.org/medicaid/upload/7467.pdf

Tjia, J., and J. S. Schwartz. 2006. "Will the Medicare Prescription Drug Benefit Eliminate cost Barriers for Older Adults with Diabetes Mellitus?" *Journal of the American Geriatrics Society* 54 (4): 606–12.

West, J. C., J. E. Wilk, I. L. Muszynski, M. Rubio-Stipec, C. L. Alter, W. E. Narrow, and D. A. Regier. 2007. "Medication Access and Continuity: The Experiences of

Dual-Eligible Psychiatric Patients during the First 4 Months of the Medicare Prescription Drug Benefit." *American Journal of Psychiatry* 164 (5): 789–96.

Yin, W., A. Basu, J. X. Zhang, A. Rabbani, D. O. Meltzer, and G. C. Alexander. 2008. "The Effect of the Medicare Part D Prescription Benefit on Drug Utilization and Expenditures." *Annals of Internal Medicine* 148 (3): 169–77.

Zhang, J. X., W. Yin, S. X. Sun, and G. C. Alexander. 2008. "The Impact of the Medicare Part D Prescription Benefit on Generic Drug Use." *Journal of General Internal Medicine* 23 (10): 1673–8.

Zhang, Y., J. M. Donohue, J. R. Lave, G. O'Donnell, and J. P. Newhouse. 2009. "The Effect of Medicare Part D on Drug and Medical Spending." *New England Journal of Medicine* 361 (1): 52–61.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix SA2: Patient Selection Flow Chart.

Appendix SA3: Observed Difference-in-Differences in the Primary and Secondary Outcomes of Interest among MEPS Panel 8 Participants (Two Years Prior to the Implementation of Part D).

Appendix SA4: Observed Difference-in-Differences in the Primary and Secondary Outcomes of Interest among MEPS Panel 10 Participants with Chronic Diseases.

Appendix SA5: Adjusted Effects of Medicare Part D on Out-of-Pocket Costs, Medication Utilization, Emergency Department Use, Hospitalization, and Preference-Based Utility Score among Overall Medicare Beneficiaries.