Published in final edited form as:
Health Aff (Millwood). 2009 ; 28(1): 215–225. doi:10.1377/hlthaff.28.1.215.

Distributing $800 Billion: An Early Assessment of the Medicare Part D Risk Adjustment Approach

John Hsu, MD, MBA, MSCE[1], **Jie Huang, PhD**[1], **Vicki Fung, PhD**[1], **Mary Price, MA**[1], **Richard Brand, PhD**[2], **Rita Hui, PharmD, MS**[3], **Bruce Fireman, MA**[1], **William Dow, PhD**[4], **John Bertko, F.S.A., M.A.A.A**[5], and **Joseph P. Newhouse, PhD**[6]

[1]Center for Health Policy Studies, and the Division of Research, Kaiser Permanente Medical Care Program

[2]Department of Epidemiology and Biostatistics, University of California, San Francisco

[3]Pharmacy Outcomes Research Group, Drug Information Services, Kaiser Permanente

[4]Division of Health Policy and Management, School of Public Health, University of California, Berkeley

[5]Brookings Institute Visiting Scholar; Adjunct Faculty RAND

[6]Department of Health Care Policy, Harvard Medical School; Department of Health Policy and Management, Harvard School of Public Health; Kennedy School of Government, Harvard University

Abstract

The viability and stability of the Medicare Part D prescription drug program depends on accurate risk adjusted payments. The current approach (RxHCC) uses diagnosis and demographic information to predict future drug costs. We evaluated the performance of multiple approaches for predicting 2006 Part D drug costs and plan liability. RxHCCs explain 12% of the variation in actual drug expenditures, overpredict costs for beneficiaries with low actual expenditures, and underpredict costs for beneficiaries with high actual expenditures. Combining RxHCCs with individual-level information on prior-year drug use substantially improves performance and decreases incentives for plans to select against bad risks.

Keywords

Medicare; Financing Health Care; Pharmaceuticals; Health Economics; Health Spending

Introduction

Starting in 2006, Medicare began offering an outpatient prescription drug benefit under the Part D program. Individual Medicare beneficiaries could sign up for benefits administered by private health plans offering either stand-alone drug benefits, i.e., Prescription Drug Plans (PDPs), or obtain prescription drugs through a Medicare Advantage program (MA-PD). In either case Medicare pays private plans a prospective payment for each Part D beneficiary adjusted for enrollee disease burden as determined by a risk-score. The goal of risk adjustment is to fairly compensate plans for the expected costs of their individual enrollees. Without

Corresponding author and reprint requests: John Hsu, MD, MBA, MSCE 2000 Broadway, 3rd Floor Oakland, CA 94612 Tel: 510-891-3601; Fax: 510-891-3606 Email: jhsu2000@gmail.com.

adequate risk adjustment there are strong financial incentives to select healthier, lower cost beneficiaries and avoid sicker, higher cost beneficiaries.[1]

Accurate risk adjustment improves the fairness of payments to plans and discourages deliberate selection of low-cost patients. Inaccurate risk adjustment threatens these goals as well as the long-term viability of the Part D program. Specifically, plans receiving inadequate payment for high-cost patients could restrict access to more expensive drugs through formulary changes or utilization management, increase patient cost-sharing, or exit the Part D market, thus leaving beneficiaries with fewer choices. As plans compete for beneficiaries each year, these perverse incentives could lead to escalating barriers to patients for obtaining expensive and newer drugs. Withdrawal from the market or changes in benefit or formulary design by plans over time could force some beneficiaries to change plans each year in the search for adequate coverage and potentially raise costs to both Medicare and beneficiaries.

Historically, the Medicare program has used a variety of approaches for adjusting payments to health plans. Originally Medicare used only basic demographics (i.e., age and sex), but now includes prior year diagnoses as well. Including this additional information has improved risk adjustment substantially. For example, the Centers for Medicare and Medicaid Services (CMS) hierarchical condition categories (CMSHCC) approach, which uses inpatient and outpatient diagnostic information, improved cost prediction by nearly two-fold compared with its predecessor, the Primary Inpatient Diagnostic Cost Groups, which used only inpatient information (11.2 versus 6.2 percent of the variation in medical costs explained, respectively); and represents an order of magnitude improvement over only demographic adjustment (1 percent).[2] The current Part D prescription drug hierarchical condition categories (RxHCC) risk adjustment approach uses inpatient and outpatient diagnosis data, but does not include any information on prescription drug use. In part this stems from the newness of the program; CMS did not have access to historical drug information on beneficiaries in 2006.[3]

In this study we examine the performance of the current Medicare Part D risk adjustment approach for predicting actual Part D drug expenditures and plan liability for Part D beneficiaries during the first year of the program, 2006. We compare this approach with other currently available risk adjustment approaches and with approaches that also incorporate information on individuals' prior prescription drug use.

Medicare Part D

Part D Benefits and Payments

The Part D program subsidizes private plans based on a standard defined benefit. In 2006 the standard benefit included a $250 deductible followed by 25% patient coinsurance up to $2,250 in total drug costs. There was no coverage between $2,250 in total drug costs and $3,600 in total out-of-pocket costs, meaning patients paid for the full cost of their drugs in this interval; above $3,600 in total out-of-pocket costs patients paid 5% coinsurance (catastrophic coverage period). All dollar amounts are updated each year (e.g., in 2007 the coverage gap and catastrophic coverage thresholds increased to $2,400 and $3,850, respectively).

Part D plans may offer benefits that are actuarially equivalent or better (i.e., “enhanced”) than the defined standard. In 2006, the standard benefit plans represented a small percentage of the plans offered (9% of PDPs and 7% of MA-PDs). A number of plans offered actuarially equivalent benefits (48% of PDPs and 29% of MA-PDs), which included variations from the defined standard such as a reduced or no deductible and use of tiered copayments instead of coinsurance before and after the coverage gap. Additionally, 43% of PDP and 64% of MA-PD plans had enhanced benefits; these plans generally included tiered copayment structures, no

deductible, and some plans offered supplemental benefits during the standard coverage gap (e.g., generic-only or generic and brand coverage).[4]

The Part D program provides a direct subsidy to plans in the form of a capitated payment for each member, which is adjusted for disease burden via the RxHCC score, and other factors including low income subsidy status and whether the beneficiary is institutionalized. Medicare also provides individual reinsurance to plans; the reinsurance subsidizes 80 percent of an individual's drug spending above the catastrophic coverage threshold ($3,600 in out-of-pocket costs in 2006).

Part D Risk Corridors from 2006-2011

To further mitigate risk to plans from unexpected costs during the initial program implementation years, Medicare established risk corridors, under which CMS shares plans' losses (or gains) above symmetric thresholds (e.g., ±2.5% in 2006-2007). Starting in 2008, plans assume more of the risk each year as the risk corridors widen; after 2011, plans assume all of the risk. In other words, the potential plan profits or losses have been limited during the first two years of the Part D program, and, if not offset by more accurate premium setting, now could increase with progressively less protection.

Current CMS Part D Risk Adjustment Approach: RxHCC Scores

The current Part D risk adjustment approach (RxHCC) is based on the Medicare Advantage CMS-HCC methodology and uses Part A (inpatient) and Part B (outpatient) diagnoses to predict drug expenditures. Under both approaches, ICD-9-CM diagnoses codes are classified into condition categories (CC), then further aggregated into hierarchical condition categories (HCC). The final RxHCC model adjusts for 84 hierarchical condition categories, as well as age, sex, and Medicare disability status. RxHCCs are scaled such that the average total risk score across the population of beneficiaries is 1.0. Thus, an individual with a total risk score greater than 1.0 is expected to have higher annual drug expenditure relative to the average beneficiary, and the direct subsidy payment for this individual is increased accordingly. The developers calibrated the RxHCC model using 2001-2002 inpatient and outpatient diagnoses from federal retirees with Medicare in the Federal Employee Health Benefit plan run by Blue Cross Blue Shield.[5] (For the disabled under 65 Medicare beneficiaries, Medicaid claims for the dually eligible were used for calibration.)

CMS calculates three scores per enrollee during the year: an initial score, a mid-year score, and a final score. Because health plans had until February 2007 to submit all Medicare claims for 2005 dates of service, CMS calculated a final score in 2007 for the 2006 payments. This score is used for final 2006 reconciliation payments.

Methods

Study Design and Rationale

Although Medicare's current risk adjustment approach for Part D uses individual-level diagnostic information from the prior year, it does not use any drug information. Individual plans, however, have these data and could use it to select groups of patients with lower costs or more favorable risk profiles, particularly if individuals' drug expenditures remain stable over time. The objective of this analysis is to examine the performance of the current risk adjustment approach, which creates incentives or disincentives for any such selection, and is not to assess the amount of selection in the current market.

Population and Sample

The study population included all persons who were adult members, age 65 years or older on January 1, 2006, who were individual subscribers to a single MA-PD program offered through an integrated delivery system. Because we wished to examine the predictive ability of prior drug spending, we focused on beneficiaries with 24 months of continuous membership: 12 months in 2005 in a Medicare Advantage program, followed by 12 months in 2006 in a MA-PD within the same health system. We excluded beneficiaries with the low income subsidy and beneficiaries with another source of insurance coverage within the health system because both faced different cost-sharing arrangements than individual MA-PD subscribers. Low income subsidy beneficiaries also differed greatly on sociodemographic characteristics compared with the overall population and an additional risk-adjustment multiplier is applied to this group.

In 2006 the MA-PD benefits did not include a deductible, and beneficiaries had copayments ($10 generic and $40 brand) prior to the coverage gap. The benefits included a standard coverage gap that started after $2,250 in total drug costs and ended after $3,600 in cumulative out-of-pocket costs. After the coverage gap, during the catastrophic coverage period, beneficiaries had $3 generic and $10 brand copayments for the remainder of the year. In 2005, the year prior to the introduction of Part D, beneficiaries enrolled in the Medicare Advantage plan within this health system had $10 generic copayments and no brand drug coverage.

Outcome Variables

We examined the performance of various risk adjustment methods relative to two outcomes: total Part D drug expenditures and Part D plan liability in 2006. We used the 2006 Prescription Drug Event files, which each plan submits to CMS for payment purposes. The Prescription Drug Event files include detailed information on the drug dispensing events, including national drug codes (NDC), drug costs, patient payments, and low income subsidy amounts. To calculate total Part D drug costs in 2006 for each beneficiary, we summed the costs for all drugs dispensed in 2006.

To calculate plan liability in 2006 for each beneficiary, we summed the covered Part D plan paid amount for each drug dispensed in 2006 up to the catastrophic threshold ($3,600 in total out-of-pocket costs). In this study population, during the initial coverage period (i.e., prior to reaching the coverage gap), the plan liability equaled the gross drug cost less patient payments; during the coverage gap, the plan had no liability because patients paid the full cost of drugs dispensed. In the catastrophic coverage region, plan liability was 15% of gross drug cost; this accounted for 80% reinsurance from CMS and an approximate 5% patient payment.

Estimates of 2005 Drug Expenditures Applicable to the Part D Program

To estimate the 2005 drug expenditures applicable to the Part D program, we determined the drugs dispensed in 2005 that were covered in the 2006 Part D formulary, i.e., we applied a standardized formulary across the two years. To standardize costs in 2005 and 2006, we calculated the mean unit cost for each drug's National Drug Code (NDC) in 2006 using data from the 2006 Prescription Drug Event files. We then calculated total drug expenditures in 2005 for each member by multiplying the mean unit cost derived from 2006 Prescription Drug Event data by the dispensing quantity in 2005 for each drug. We used estimated 2005 drug costs as a risk adjustment measure, as described below.

Risk adjustment measures

We examined six categories of risk adjustment approaches in this study (note we report on only a subset of measures described below; please see the appendix for all measures):

1. Demographics (age and gender): We used six age groups: 65-69, 70-74, 75-79, 80-84, 85-89, and 90+ years old.
2. Medicare Part D risk adjuster (RxHCC): We examined the performance of the final RxHCC scores as calculated by CMS and reported to plans in Monthly Membership Reports.[6]
3. Medicare Part C/MA risk adjuster: We also examined various diagnosis and drug-based risk adjusters, which have been used to predict medical (inpatient and outpatient) costs.[7]
    a. CMS-HCC: summary scores based on inpatient and outpatient diagnoses in 2005 (prospective scores). These scores are currently used for Medicare Advantage (Parts A and B) risk adjustment.
    b. HCC: 184 Hierarchical Condition Categories based on inpatient and outpatient diagnosis in 2005. These are the individual condition categories that determine the CMS-HCC score (above); they include categories for which CMS makes no payment adjustment.
4. Drug use information
    a. RxGroups: 155 drug categories classified by therapeutic indication based on outpatient drug data in 2005. These drug categories are used to determine a summary score for a commercially available risk-adjustment approach.[8]
5. Drug expenditures:
    a. Cost 2005: 2005 drug costs
    b. Cost 2005 + Cost 2005^2: Because the relationship between prior and current year costs may not be strictly linear, we also examined a functional form that included a squared-term.
6. Medicare Part D risk adjuster (RxHCC) plus drug use or drug expenditure information: We examined the degree to which including this additional information with the RxHCC scores improved the accuracy of cost prediction.
    a. RxHCC with prior year drug use indicators (RxHCC + RxGroup)
    b. RxHCC with prior year drug expenditure data (RxHCC + Cost 2005 + Cost 2005^2)

Drug Expenditure Stability Over Time

The current Part D risk adjustment approach does not include information on prior year drug use. To examine the stability of drug expenditures over time, we divided beneficiaries into deciles based on their 2005 and 2006 Part D drug expenditures. For beneficiaries in each 2005 expenditure decile, we examined their distribution across 2006 expenditure deciles. We also calculated the Spearman correlation coefficient between 2005 and 2006 drug expenditures.

Model Development and Evaluation

We used information in Year 1 (2005) to predict expenditures in Year 2 (2006) to follow the prospective risk adjustment approach used by Medicare; Medicare uses diagnoses from the prior year in the CMS-HCC adjustment scheme for Part C and the RxHCC adjustment approach for Part D. We used ordinary least squares (OLS) regression with Part D-covered drug expenditure as the dependent variable and the risk adjusters in 2005 (described above) as independent variables. To compare the predictive accuracy of the different risk adjustment methods, we report the adjusted R^2, and mean absolute prediction error (MAPE) for all models.

The R^2 represents the percentage of total variation in the outcome explained by the model (larger values correspond with greater accuracy), the adjusted R^2 is a similar measure that accounts for the number of terms in the model; the MAPE represents the mean absolute value of the difference between actual observed expenditures and the expenditures predicted by the model (smaller values correspond with greater accuracy).

To examine the performance of different risk adjustment approaches across beneficiaries with different levels of drug expenditures, we examined the performance of three primary risk adjustment models (RxHCC; RxHCC+RxGroups; RxHCC+Cost 2005+Cost 2005^2) in more detail. We computed the mean observed expenditure in 2006 and mean predicted expenditure in 2006 for 20 subgroups of patients defined by observed expenditures in 2006 (5-percentile groups); for each of the three risk adjustment models, we plotted the mean observed and predicted values against each other. The 45-degree line represents equality between predicted and observed expenditures: values above the 45-degree line indicate that predicted expenditures exceeded observed expenditures for the group; values below the 45-degree line indicate that predicted expenditures were lower than the actual expenditures. The shorter the distance from a point to the 45-degree line, the closer the mean predicted and actual expenditure for the group using a given risk adjustment approach. We performed this evaluation for both Part D drug expenditures and plan liability.[9]

Results

Exhibit 1 displays the individual characteristics of all 139,462 Medicare Advantage beneficiaries in our study. Although we excluded beneficiaries with the low income subsidy, 17% of the study beneficiaries lived in a low socio-economic status neighborhood as defined by census block group measures. Many beneficiaries also had a diagnosed chronic condition as of 2005, e.g., 60% with hypertension, 19% with diabetes, and 15% with coronary artery disease.

Stability of Drug Expenditures over Time

To illustrate the distribution of expenditures from two consecutive years, Exhibit 2 displays the percentage of beneficiaries whose 2006 Part D drug expenditures fall into each decile of drug expenditures, by their level of total 2005 drug expenditures in deciles. The Spearman correlation coefficient between the two years is 0.83, indicating a strong correlation between a given individuals' drug costs in 2005 and 2006. Overall, 88% of beneficiaries had 2006 expenditures that were within two deciles of their 2005 expenditures: 36% of beneficiaries were in the same decile in both years; 37% had one decile difference; and 15% had two deciles difference between the two years.

Risk Adjustment Measures - Part D Drug Expenditures and Plan Liability

Exhibit 3 displays the performance of six categories of risk adjustment approaches in predicting actual 2006 Part D drug expenditures and plan liability. While these measures are correlated (see appendix), their performance varies substantially. Specifically, the final 2006 RxHCC score accounts for 12% of the variation in all Part D expenditures in 2006 and 19% in Part D plan liability.

Approaches that included more detailed information on prior year diagnoses or classes of drug use performed considerably better than summary scores: for example, the CMS-HCC score accounts for 10% of the variation in drug expenditures, while including separate indicators for each of the 184 hierarchical condition categories, which are used to calculate the summary score, accounts for 17%. Approaches that include information on prior year drug use or costs perform markedly better than the current Medicare risk adjustment approaches for Part D

(RxHCC score) and Medicare Advantage (CMS-HCC score), which are based solely on diagnoses. For example, using 155 outpatient drug category indicators accounts for 29% of the variation in drug expenditures and 38% in plan liability; and using actual 2005 drug expenditures accounts for 39% of the variation in 2006 drug expenditures and 33% in plan liability. Allowing for nonlinearity by adding a squared term for 2005 costs further improves performance such that 42% of the variation in both 2006 drug expenditures and plan liability is accounted for.

Combining the current Part D RxHCC risk adjustment approach with prior year drug data accounts for a modest amount of additional variability in 2006 expenditures as compared with the approaches described above. Specifically, combining the RxHCC with 2005 expenditures and a term for costs-squared accounts for 43% of the variation in 2006 drug expenditures and 46% of the plan liability.

Comparison of Actual and Predicted 2006 Part D Prescription Drug Expenditures

Exhibits 4 and 5 compare actual drug expenditures in 2006 and predicted 2006 expenditures based on three risk adjustment approaches: 1) RxHCC alone; 2) RxHCC combined with prior year drug category data; and 3) RxHCC combined with prior year drug expenditure data. At low levels of actual expenditures, predicted expenditures are larger than actual expenditures for all three approaches (which implies that Medicare would over-pay plans for these beneficiaries), and at high levels of actual expenditures, the predicted expenditures are less than actual expenditures (i.e., under-payment). Predicted expenditures under the RxHCC approach, however, differ most from actual expenditures compared with the two other approaches that combine the RxHCC with prior year drug use or cost information. Thus, incorporating prior year drug data compared with the RxHCCs alone would reduce the potential profit from favorable selection.

Discussion

This study examined the accuracy of the current Medicare Part D risk adjustment approach in predicting 2006 Part D drug expenditures and plan liability. Accurate risk adjustment is important for providing fair payments to health plans and discouraging deliberate selection of patients with more favorable risk profiles. The results from this study suggest that incorporating information on prior drug use and/or costs into the risk adjustment approach would substantially improve the accuracy of payments to Part D plans.

In a cohort of Medicare Advantage beneficiaries continuously enrolled in 2005 and 2006, expenditures for Part D-covered drugs were relatively stable during consecutive years. Not surprisingly, the performance of the current Part D risk adjustment approach is improved by using prior year drug information in addition to using only diagnoses and demographic information to predict future drug costs. Including information on whether patients had specific types of drug use (i.e., any use of a drug within a therapeutic class) improves prediction substantially over the current Part D risk adjustment approach: in the case of predicting total Part D drug expenditures in 2006, the percent of variation explained increased from 12% to 29%. Including drug cost information further improves prediction, e.g., increasing the percent of variation explained to 39%. Better accounting for the curvilinear relationship between prior year and current year expenditures by including a quadratic term further improves the performance of cost-based risk-adjustment measures. Specifically it decreases the level of overprediction at low expenditure levels and underprediction at high expenditure levels. In short, approaches that combine prior year diagnosis and drug information, and allow for curvilinear expenditure relationships perform the best among the approaches we examined in predicting future year expenditures, with 43% and 46% of variation in all drug expenditures and plan liability, respectively, explained. The existing Part D risk adjustment approach, of

course, could not use drug information in 2006 because prior drug information was not available to CMS before the introduction of the drug benefit.

Policy Implications

Part D drug information is now available for beneficiaries who enrolled in Part D in 2006 through the Prescription Drug Event files and would permit development of a revised system for future payments. Both of these approaches should be operationally feasible, and have precedents in the Medicare hospital payment program where the Diagnosis-Related Group (DRG) system depends in part on procedures performed.

Risk adjustment approaches cannot and need not perfectly predict costs because some costs will be unpredictable and plans cannot select based on unpredictable variation.[10] Drug expenditures, however, tend to be stable from year-to-year, and are more predictable than other types of medical costs. Ignoring past spending when making payments thus results in preventable misallocation of dollars, and creates strong incentives for selection. At this point in time, plans have detailed information on enrollees' drug use and expenditures, and so can predict future costs substantially better than CMS does in its current risk adjustment score. Inadequate risk adjustment offers plans an incentive to select the most profitable beneficiaries through strategies that limit enrollment of beneficiaries with certain types of conditions, cost-profiles, or drug use.[11] These strategies include subtle adjustments of formularies or to drug prices, or policies that restrict patient access to more expensive medications, such as prior authorization or fail-first requirements.

Importantly, as the risk corridors start to widen in 2008 and eventually disappear, the incentives for favorable selection increase. Additional work is needed to examine such potential strategies, especially relative to plan bids, and the implications for spending under Parts A and B of the Medicare program.

Balancing Concerns about Divergent and Perverse Incentives

Traditionally, the Medicare program has not used payment adjustments based on prior utilization because of concerns that this creates perverse incentives for overuse (i.e., generating higher costs in the current year leads to higher payments next year). Use of standardized or reference costs for each of the Part D therapeutic classes rather than actual past costs would decrease this perverse incentive to the degree it exists, albeit potentially at the expense of increasing incentives to select favorable risks.[12] How the Part D market might respond to these competing incentives is unknown.

In addition to the divergent incentives for adverse selection and for overuse, approaches that exclude drug use information also create perverse incentives for underuse (e.g., stinting on delivery of necessary medications). This is particularly relevant for stand-alone PDP plans, which do not bear any inpatient or outpatient costs incurred as a result of under-treatment with prescription drugs. Incorporating information on drug use into the risk adjustment scheme would decrease such incentives.

Limitations

In this study, we used information from a single integrated delivery system in a single region of the country. Actual expenditures and risk adjuster performance in other plans will vary by prescribing practice patterns, patient cost-sharing structures, drug formularies, pharmacy management, and contracts with drug suppliers including any rebates. For example, the health system that provided data for this study historically has had a higher level of generic drug use compared with use across the general U.S. population. Although these differences could affect the relative performance of the alternative risk adjustment approaches in other settings, they

are unlikely to affect the overall study finding that incorporating information on past drug use substantially improves risk adjustment.

Moreover, CMS could use drug information from all plans when refining the risk adjustment approach. This study was also limited to beneficiaries who were continuously enrolled over 24-months through 2005 and 2006, and these beneficiaries may have different cost profiles. Our findings were similar, however, in sensitivity analyses that included subjects who died (3.2%) during 2006.

Conclusion

The current Part D risk adjustment score, which only accounts for diagnostic and demographic information, predicts around one eighth of the variation in actual drug expenditures and plan liability. Combining this approach with individual level prescription drug information from the prior year could substantially improve performance of the risk adjuster. Such improvements would diminish incentives to select beneficiaries with favorable risk profiles, mitigate incentives for underuse, and improve the fairness of payments among plans.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding Source

The National Institute on Aging, the Agency for Healthcare Research and Quality (R01 AG029316, R01 HS013902), and the Alfred P. Sloan Foundation provided funding for the study.

Notes

1. Cutler DM, Reber S. Paying for Health Insurance: the Tradeoff Between Competition and Adverse Selection. Quarterly Journal of Economics May;1998 :433–466.Huskamp HA, et al. The Medicare Prescription Drug Benefit: How Will the Game Be Played? Health Affairs March;2000 :8–23. [PubMed: 10718018]Newhouse JP, et al. Risk Adjustment and Medicare: Taking a Closer Look. Health Affairs September;1997 :26–43. [PubMed: 9314674]Newhouse JP. Risk Adjustment: Where Are We Now? Inquiry 1998:122–131. [PubMed: 9719781]Pauly MV, Zeng Y. Adverse Selection and the Challenges to Stand-Alone Prescription Drug Insurance. Front Health Policy Research 2004:55–74.
2. Iezzoni LI, et al. Paying More Fairly for Medicare Capitated Care. New England Journal of Medicine December 24;1998 :1933–1938. [PubMed: 9862953]Pope GC, et al. Risk Adjustment of Medicare Capitation Payments Using the CMS-HCC Model. Health Care Financing Review 2004:119–141. [PubMed: 15493448]
3. Robst J, et al. Diagnosis-Based Risk Adjustment for Medicare Prescription Drug Plan Payments. Health Care Financing Review 2007:15–30. [PubMed: 17722748]
4. Medicare Payment Advisory Commission. Report to the Congress: Increasing the Value of Medicare. 2006
5. Robst J, et al. Diagnosis-Based Risk Adjustment.
6. Ibid
7. Pope GC, et al. Risk Adjustment of Medicare Capitation Payments Using the CMS-HCC Model. Health Care Financ.Rev 2004:119–141. [PubMed: 15493448]
8. Please see http://www.DxCG.com for more information about this commercially available measure
9. We also classified all individuals into five-percentile groups based on predicted expenditures from each of the three models and calculated the mean predicted and observed expenditures, the mean prediction error (MPE), and the predictive ratio (PR) for each 5-percentile group (these results are

available in the appendix). The MPE is the mean of predicted expenditure minus observed expenditure for each 5-percentile group. The PR is the predicted expenditure divided by the observed expenditure

10. Ellis RP, McGuire TG. Predictability and Predictiveness in Health Care Spending. Journal of Health Economics January;2007 :25–48. [PubMed: 16908083]
11. Luft HS, Dudley RA. Assessing Risk-Adjustment Approaches Under Non-Random Selection. Inquiry 2004:203–217. [PubMed: 15449434]Shen Y, Ellis RP. How Profitable Is Risk Selection? A Comparison of Four Risk Adjustment Models. Health Economics March;2002 :165–174. [PubMed: 11921314]
12. Newhouse, JP. Pricing the Priceless: A Health Care Conundrum. The MIT Press; Cambridge: 2002.

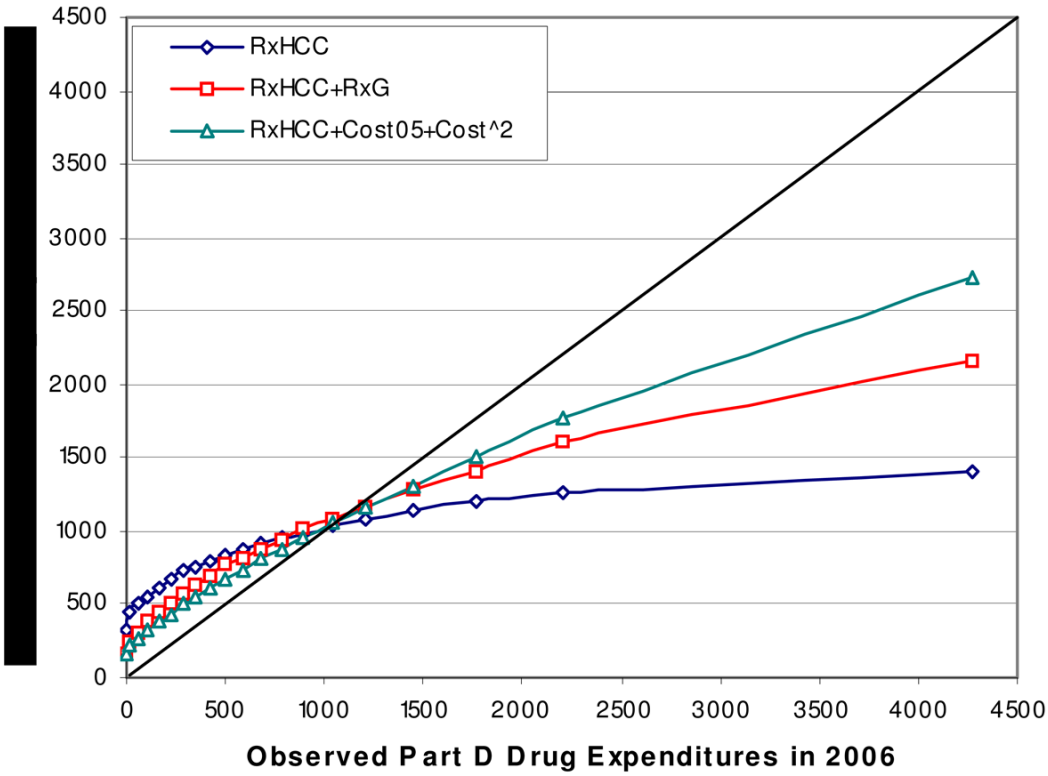

Exhibit 4. Comparison of Predicted Versus Observed Part D Drug Expenditures, by 5% Groups Based on Observed Expenditures

Source: Authors' analysis

Exhibit 4 displays the predicted versus observed expenditures using three risk adjustment approaches, by the level of actual 2006 Part D drug expenditures (20 levels with each representing 5% of the total population). The three approaches are 1) RxHCC alone; 2) RxHCC combined with prior year drug category data; and 3) RxHCC combined with prior year drug expenditure data. The third approach uses 2005 drug expenditures and includes a term for costs^2. Data points above the diagonal line indicate that predicted expenditures were higher than actual expenditures for the group (over-payment); points below the diagonal indicate that predicted expenditures were lower than the actual expenditures (under-payment).

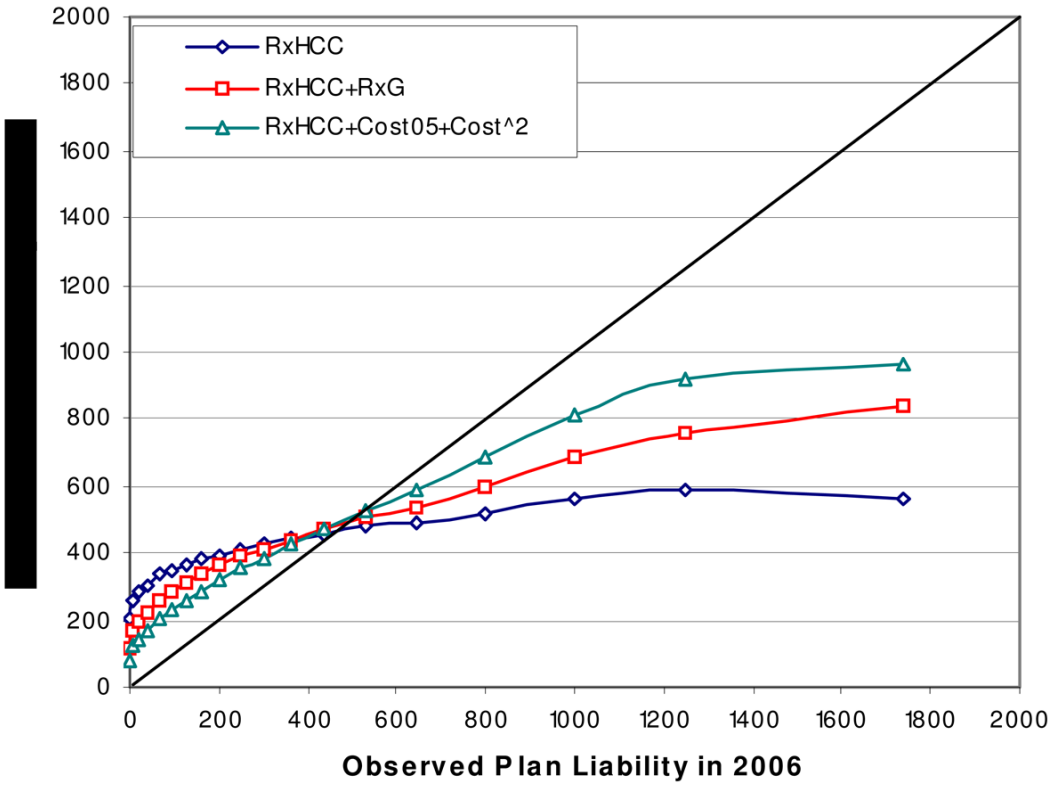

Exhibit 5. Comparison of Predicted Versus Observed Plan Liability, by 5% Groups Based on Observed Plan Liability

Source: Authors' analysis

Exhibit 5 displays the predicted versus observed plan liability using three risk adjustment approaches, by the level of actual 2006 Plan liability (20 levels with each representing 5% of the total population). The three approaches are 1) RxHCC alone; 2) RxHCC combined with prior year drug category data; and 3) RxHCC combined with prior year drug expenditure data. The third approach uses 2005 drug expenditures and includes a term for costs^2. Data points above the diagonal line indicate that predicted expenditures were higher than actual expenditures for the group (over-payment); points below the diagonal indicate that predicted expenditures were lower than the actual expenditures (under-payment).

Exhibit 1

Beneficiary Characteristics

Characteristics		N	%
Total		139,462	100.00
Age group	65-69	36,763	26.36
	70-74	38,143	27.35
	75-79	30,163	21.63
	80-84	20,260	14.53
	85-89	9,884	7.09
	90+	4,249	3.05
Gender	Female	82,053	58.84
Race/ethnicity	White	94,187	67.54
	Black	3,438	2.47
	Hispanic	9,970	7.15
	Asian	10,232	7.34
	Other	3,490	2.50
	Unknown	18,145	13.01
Neighborhood SES	Non-low	107,301	76.94
	Low	24,121	17.30
	Unknown	8,040	5.77
Chronic disease	Asthma	14,578	10.45
	Diabetes	25,828	18.52
	Hypertension	83,129	59.61
	Coronary Artery Disease	21,587	15.48
	Heart failure	9,275	6.65

Source: Author's analysis

Neighborhood SES defined using 2000 US Census data and home address geocodes. Chronic disease status defined as inclusion in health system chronic disease registries as of the 4^{th} quarter of 2005.

Exhibit 2

Distribution of Drug Expenditures in 2005 and 2006 for Individual Beneficiaries

Decile in 2005 Drug Expenditures	Decile in 2006 Part D Drug expenditure (row %)										
	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	Total
Decile 1	63.3	19.8	7	3.3	1.9	1.3	1.3	0.8	0.7	0.6	100
Decile 2	23	40	17.8	8	4.1	2.6	1.5	1.2	1	0.8	100
Decile 3	7	23.1	32.3	17.1	8.4	4.6	2.9	2.1	1.5	1	100
Decile 4	2.8	9.3	22.9	27.6	17.3	8	5.2	3.5	2.1	1.3	100
Decile 5	1.4	4.2	10.5	22.2	25.2	16.9	9.2	5.2	3.1	2	100
Decile 6	0.8	1.8	5	11.9	22.4	24.7	16.5	9.1	5.2	2.6	100
Decile 7	0.5	1	2.4	5.5	12.5	23.2	25.3	16.9	8.4	4.3	100
Decile 8	0.3	0.5	1.2	2.7	5.5	12.7	23.9	28.3	17.8	7.2	100
Decile 9	0.3	0.3	0.6	1	2	4.8	11.4	26.1	35.5	17.9	100
Decile 10	0.3	0.3	0.4	0.6	0.7	1.3	2.6	6.8	24.7	62.2	100

Source: Authors' analyses

This exhibit displays the percentage of beneficiaries in each decile of drug expenditures in 2005 who were in each decile of drug expenditures in 2006. Decile 1 refers to the lowest 10% of expenditures during the year; and Decile 10 refers to the highest 10% of expenditures. The mean expenditure in Decile 1 in 2005 was $6 (SD=10); the mean expenditure in Decile 10 in 2005 was $3,593 (SD=3,887). The mean expenditure in Decile 1 in 2006 was $7 (SD=11); the mean expenditure in Decile 10 in 2006 was $3,244 (SD=3,396). The distributions of these expenditures were skewed, for example, in 2006 the median, mean, 95th percentile, and highest drug expenditures were $541, $852, $2,487 and $97,632.

Exhibit 3

Comparison of Risk Adjustment Approaches: Part D Drug Expenditures and Plan Liability in 2006

		Outcome: Part D Drug Expenditures in 2006	
Category	**Risk adjustment method**	**Mean Absolute Prediction Error (MAPE) in $**	**% of Variation Explained (Adj R^2)**
1. Demographics	Age + Gender	684	0.24%
2. Part D risk adjuster	RxHCC (summary score)	571	12.08%
3. Part C risk adjuster	CMS-HCC (summary score)	609	9.55%
	HCC (184 indicators)	568	17.24%
4. Drug use	RxGroup (155 indicators)	459	28.92%
5. Drug expenditures	Cost 2005	425	39.03%
	Cost 2005 + $Cost^2$	392	42.41%
6. RxHCC + Drug information	RxHCC + RxGroup	451	29.64%
	RxHCC + Cost 2005	394	41.19%
	RxHCC + Cost 2005+$Cost^2$	392	43.49%
		Outcome: Plan Liability in 2006	
Category	Risk adjustment method	Mean Absolute Prediction Error (MAPE) in $	% of Variation Explained (Adj R^2)
1. Demographics	Age + Gender	357	0.45%
2. Part D risk adjuster	RxHCC (summary score)	302	19.09%
3. Part C risk adjuster	CMS-HCC (summary score)	321	14.02%
	HCC (184 indicators)	299	22.36%
4. Drug use	RxGroup (155 indicators)	249	37.89%
5. Drug expenditures	Cost 2005	270	33.13%
	Cost 2005 + $Cost^2$	243	42.05%
6. RxHCC+ Drug information	RxHCC+RxGroup	245	39.10%
	RxHCC + Cost 2005	248	39.84%
	RxHCC + Cost 2005+$Cost^2$	230	45.67%

Source: Authors' analysis

This exhibit displays the performance of six categories of risk adjustment approaches in predicting actual 2006 Part D prescription drug expenditures and plan liability using a linear regression model. The table displays the performance with respect to each outcome. RxHCC refers to the current CMS Part D risk adjustment score, which CMS calculates at three points in time in 2006; this table reports results using the final RxHCC score of the year. CMS-HCC refers to the CMS risk adjustment score for MA/M+C plans, which is based on outpatient and inpatient diagnoses. HCC refers to the indicators from the CMS-HCC risk adjustment scoring approach, which also uses outpatient and inpatient diagnoses. RxGroup refers to indicators for drug groups based

on outpatient drug data. Cost 2005 refers to all prescription drug expenditures from 2005 for drugs covered under the Part D program; Cost 2005^2 refers to a squared term for 2005 drug expenditures.