# Impact of Consumer-Driven Health Plans (CDHPs) on Medication Adherence and Health Care Spending

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## Dedication

This dissertation is dedicated to my family.

## Summary

### BACKGROUND

Consumer-driven health plans (CDHPs) represent an increasing proportion of private health plan members in the United States. Under a basic CDHP model, members receive an annual allocation of money into an account and can use this to pay for medical and pharmacy services. Unused funds can be rolled over to the next year and be added to the next year's fund deposit. Once the account is exhausted, members are financially responsible for the medical and pharmacy services until a deductible is met. After the deductible is met, members are either totally covered or are partially financially responsible for the services (i.e., when there is a coinsurance) until the annual out-of-pocket maximum is met.

The two prevailing CDHP models are the Health Reimbursement Arrangement (HRA) and the Health Savings Account (HSA). The primary differences between HRAs and HSAs are: (1) both the employer and the member can contribute to an HSA, while only the employer can contribute to an HRA; and (2) employees own the HSA, while employers own the HRA, so after discontinuing employment or changing health plans, employees lose the money in the HRA.

HSAs are required to link to high-deductible health plans (HDHP). In 2011, an HSA-qualifying HDHP must have an account contribution no more than $3,050 for individual coverage and $6,150 for family coverage, a deductible of at least $1,200 for single coverage and $2,400 for family coverage, and an out-of-pocket limit of at least $5,950 for single coverage and $11,900 for family coverage (Internal Revenue Service,

2010). HRAs need not to be offered in conjunction with a HDHP, although typically the deductible is approximately twice of the employer contribution.

Nationwide, HSA enrollment increased 10-fold in six years from one million in 2005 to 10 million in 2010. Around 80% of HSA members are in group coverage in 2010 (America's Health Insurance Plans 2010). The national market for HRAs was estimated to be approximately eight million in 2010 (Fronstin 2010). All HRA members are in group coverage because the HRA is by regulatory definition an employer group product.

## RESEARCH OBJECTIVE

This dissertation is comprised of three papers that look at the impact of CDHPs enrollment on medication adherence, health care expenditure, and incentives of CDHPs for people with different health status. The research questions that were answered in this dissertation are:

1. Do patients discontinue taking their maintenance drugs for chronic conditions after enrolling in CDHPs?
2. What are the long-term effects of HRAs and HSAs on health care expenditures relative to those of traditional managed care plans?
3. Whether full replacement HRAs or HSAs have different effects than optional HRAs/HSAs?
4. Compared with traditional health plans, do CDHPs have different effects on health care spending for people with different health status?

The first paper evaluated the impact of enrolling in full replacement CDHPs on medication adherence for eight therapeutic drug classes. The second paper examined the long-term impact of enrolling in four different CDHP cohorts on health care expenditures and whether such effects differ between full replacement CDHPs and optional CDHPs. The third paper evaluated how health care spending for enrollees in CDHPs might be different for members with different health status, ranging from low risk to high risk. The second and third papers of my dissertation contribute to the studies of the implications of CDHP enrollment on health care spending. My dissertation results support Feldman and Parente's (2010) view that CDHPs create different incentives for members with different health status.

## PREVIOUS FINDINGS

### *Impact of CDHP on Medication Adherence*

Previous research on medication adherence in CDHP was limited and the results were mixed. Some reported an increased use of maintenance medications and decreased pharmaceutical expenditures among CDHP enrollees (CIGNA 2008). Some report that CDHP has no difference on brand utilization (Parente, Feldman, and Chen 2008), generic utilization (Greene, Hibbard, Merray et all 2008), and medication adherence (Greene et al 2008; Health Partners 2008) compared with traditional plans. Yet other studies found that CDHP members tended to use less prescription drugs (Wilson, Bargman, Pederson et al 2008), were less compliant to drug regimens (Fairman, Sundar, and Cox 2008) and more likely to discontinue chronic illness medications (Greene, Hibbard, Merray et all 2008), and were more likely to skimp on needed medications because of cost (Fronstin and

Collins 2008). These studies have limited generalizability on medication adherence, because they examined the experience of only one or two employers, they measured general medication utilization rather than adherence, or because they looked at cross-sectional differences without controlling for baseline differences. The first paper in this dissertation supplements the literature by examining the change of adherence of eight drug classes in a pre-post cohort that was identified from a group of large employers. Having many employers is a unique aspect of this study.

### *Impact of CDHP on Healthcare Expenditures*

Previous research suggests that expenditures are lower in CDHPs than in traditional plans. Using a three-year pre-post cohort design, Parente et al. examined medical expenditures for members who switched to a CDHP in 2001 and 2002 from a PPO (Preferred Provider Organization) or a HMO (Health Maintenance Organization) offered by a large employer (Parente, Feldman, and Christianson 2004b). The authors found that expenditures were lowest for CDHP members during the first year of CDHP enrollment. But in the second year post-switching, CDHP expenditures were higher than in the HMO cohort and were lower than in the PPO cohort. They also found a larger increase in hospital expenditures in the CDHP cohort compared with the other two cohorts. The authors provided two explanations for the rise of hospital expenditures: emerging moral hazard after CDHP members met their deductibles; and reduced use of preventive care.

These explanations were later examined in an extended study that included data from the third year of observation for the original CDHP cohort. In the extended study,

Feldman et al. found evidence of pent-up demand in the CDHP cohort, but not enough to explain the high medical care spending over time by the CDHP members (Feldman, Parente, and Christianson 2007). The authors also found that higher hospital spending in the CDHP cohort was not associated with a substitution away from cost-effective prescription drug therapy.

In another follow-up study, Parente et al. found that pharmaceutical expenditures in the CDHP cohort were lower than those in the POS cohort in 2001 with no major differences in brand name drug consumption (Parente, Feldman, and Chen 2008). Using the same study setting, Feldman and Parente grouped members within cohorts into three risk groups corresponding to enrollees' predicted medical care expenditures (Feldman and Parente 2010). They found that CDHP members with low predicted spending in the prior year spent less in the three years after CDHP enrollment than did members who enrolled in the traditional plans, while CDHP members with high predicted expenditure spent more than their counterparts in the traditional plans. The authors concluded that the kinked CDHP budget constraint created different incentives for healthy and sick members.

Using a three-year pre-post cohort design with data from employers that offered HSAs, Lo Sasso et al. examined the difference in total expenditures between HSA and non-HSA members (Lo Sasso, Shah, and Frogner 2010). The authors found that HSA members spent 5-7% less than traditional plan members, and pharmacy spending per member was 6-9% lower in the HSAs than in the traditional plans.

Researchers frequently report favorable selection on age, health status, or income when CDHPs are provided as a choice among health plans, although the findings are mixed. Studies commonly find that people who chose CDHPs had higher income than their counterparts who chose traditional plans (Christianson, Parente, and Feldman 2004; Claxton et al. 2005; Parente, Feldman, and Christianson 2004a; Parente, Feldman, and Christianson 2004b; Tollen, Ross, and Poor 2004). Some studies find lower illness burden in CDHP members (Fowles et al. 2004; Fronstin and Collins 2005; Parente, Feldman, and Christianson 2004b), while others report no difference in health status by plan (Christianson, Parente, and Feldman 2004; Tollen, Ross, and Poor 2004). One study found no favorable selection into a CDHP relative to an HMO but did find evidence of favorable selection on age and health status into the CDHP over a PPO (Parente, Feldman, and Christianson 2004a).

Another interesting yet not well-answered question is how health care expenditures respond to benefit design characteristics, such as levels of account contribution, deductible, coinsurance, and out-of-pocket limits. Using data from the RAND Health Insurance Experiment (HIE) (Newhouse and Insurance Experiment Group 1994), Manning et al. (Manning et al. 1987) found a price elasticity of -0.2. The researchers grouped health care services into outpatient and hospital services and further grouped outpatient services by acute and chronic conditions. They found consistent results on the price elasticity across conditions and services.

Previous publications on CDHPs often have had limited variation of benefit designs in the study setting. Parente et al., for instance, suggested that the large increase

in costs in the second follow-up year over the first year could have been caused by the particular design characteristics of the CDHP offered by the studied employer (Parente, Feldman, and Christianson 2004b). These characteristics included: a large fund rolled-over from previous years, a small gap between account contribution and deductible (also known as the doughnut-hole), a zero co-insurance after the deductible was met, and a low stop-loss limit. Using pharmacy claims data from an employer that offered HRAs (with different levels of deductible) and PPOs to its employees, Greene et al. found that members in a high-deductible HRA were more likely to discontinue prescription drugs than those enrolled in low-deductible HRAs or those who enrolled in PPOs (Greene et al. 2008). Using claims data from the small group market, Lo Sasso et al. found that deductibles would have to be raised by almost $4 for every $1 increase in the spending account to keep spending unchanged (Lo Sasso, Helmchen, and Kaestner 2010).

Studies on the impact of full replacement CDHPs on expenditures have mixed findings. Lo Sasso et al. found that those who enrolled in full replacement HSAs spent more than those who enrolled in optional HSAs (Lo Sasso, Shah, and Frogner 2010). In contrast, Parente et al. found that when a CDHP was provided as a full replacement plan, it achieved cost savings but also led to a decrease in use of preventive services (Parente, Feldman, and Yu 2010).

In summary, more evidence of the effects of CDHPS on costs is needed. Previous studies that examined both HSA and HRA members did not distinguish between them, nor did they distinguish members in full replacement CDHPs and optional CDHPs. The second paper of this dissertation identified separate cohorts for full replacement HRAs

and HSAs and for optional HRAs and HSAs. My co-authors and I examined fives years of claims data for a group of large employers that provide a variety of benefit designs.

***Impact of CDHP on Healthcare Spending for People with Different Health Status***

Although a number of studies have estimated the effect of enrolling in a CDHP on expenditures (Parente, Feldman, and Christianson, 2004a and 2004b; Feldman, Parente, and Christianson, 2007; Parente, Feldman, and Chen 2008; Lo Sasso, Shah, and Frogner 2010), very few have estimated whether the incentives created by the CDHP budget constraint vary for different types of people. The first study of this aspect was conducted by Feldman and Parente (2010). Using four years of claims data from a single employer that provided an HRA and traditional plans, Feldman and Parente compared spending among low risk versus high risk enrollees in the HRA and traditional plans. They measured health status by the employee's predicted medical spending in the year prior to the HRA offering. The authors found that HRA enrollees with low predicted spending spent less in the three years after the HRA was introduced than the comparison groups that stayed in the traditional health plans. They also found that HRA enrollees with high predicted spending spent more than their comparable groups of traditional-plan enrollees in the post-HRA years. The authors concluded that healthy CDHP enrollees saved part of the account to pay for future medical contingencies. Their study aligned with theoretical models of medical care demand in high-deductible health plans (Keeler, Newhouse, and Phelps, 1977). But in contrast to the theoretical models that explain consumers' behavior in a single account period depending on how much they have already spent and how

many days are left in the period, Feldman and Parente's study explained behavior over several accounting periods.

Understanding whether CDHPs have different impacts on spending for different types of people is important for employers and insurers. As the only type of health insurance plan that grew in 2010 (AAPPO 2011), more people switched to CDHPs than left them. If CDHPs are more effective for certain types of people, employers and insurers should take this into consideration before offering such insurance products to members. In the third paper of this dissertation, my co-authors and I use a multi-year model in which low-risk CDHP enrollees facing uncertain health status in subsequent years will save part of their HRAs in the current year to pay for future health care when they get sick. Our work improves on Feldman and Parente's study by examining five years of claims data for a group of large employers that provide a variety of benefit designs. Having employers with different characteristics is a unique aspect of our study.

## STUDY SETTING AND DATA SOURCES

The CDHPs that were used in this dissertation were identified from a national health care company that provides health insurance plans to 25 million people nationwide. CDHPs have experienced a fast growth in this insurer during the past six years. While the CDHP membership was only three quarters of a million in 2005, it doubled in 2006 and almost reached four million in 2011. Initially CDHP was most commonly offered as an option alongside traditional plans, but recently an increasing number of employers have fully replaced their traditional plans with CDHP.

The study employers (n=55) and their members (n=142,325) were identified from the large group market of this insurer. All employers offered only traditional plans, including Preferred Provider Organizations (PPOs), Point of Services (POSs), and Exclusive Provider Organizations (EPOs)), in 2005. Starting in 2006, employers provided HRAs and/or HSAs either as a full replacement for the traditional plans or as an option in addition to a traditional plan. The original study population included two years (2005 and 2006) of data and was used for the first paper. The study population was extended to include data from 2007 to 2009 and was used for the second and the third papers. A retrospective pre-post cohort design was used in all three papers.

The data sources that were used to create outcome variables and explanatory variables included: enrollment information, member's socio-demographic characteristics, health status, plan benefit characteristics, employer's characteristics, bank transaction data, as well as medical and pharmacy claims.

**PRINCIPAL FINDINGS**

The first paper, **"***Medication Adherence and Enrollment in a Consumer-Driven Health Plan***",** evaluated the change of medication adherence in a two-year (2005 and 2006) two-cohort (full replacement CDHPs (HRAs and HSAs were combined into one CDHP cohort) and traditional plans) setting. We identified CDHP patients who were enrolled in a traditional managed care plan in 2005 (pre-year) and a full-replacement CDHP in 2006 (post-year). The comparison group included traditional-plan patients who voluntarily enrolled in a traditional plan in both years. Adherence measures included (1) post-year continuation rate among continuous users, (2) time to refill the first prescription in the

post-year, (3) change in the compliance rate from the pre- to the post-year, and (4) total days with continuous drug supply in the post-year. Analysis was conducted on eight drug classes: asthma, cardiac, cholesterol, diabetes, epilepsy, hypertension, rheumatoid arthritis (RA), and thyroid. We found that the CDHP patients had a slightly higher illness burden and used more medication in the pre-year. The continuation rate was relatively high for all drug classes, although the CDHP cohort had a lower probability of continuing cardiac and cholesterol drugs. We found that CDHP patients took slightly longer on average to refill their first prescription in the post-year for cardiac, hypertension, cholesterol, and thyroid drugs. The compliance rate dropped over time in both cohorts, but the reduction was bigger among CDHP patients for asthma, cardiac, and cholesterol drugs. We also found that the CDHP patients terminated their continuous drug supply earlier for epilepsy drugs and cholesterol drugs.

The second paper, "*A Five-Year Study of Health Expenditures among Full Replacement CDHPs, Optional CDHPs, and Traditional Managed Care Plans*", examined the impact of enrolling in CDHPs on health care expenditures using a five-year (2005 through 2009) five-cohort (full replacement HRAs, full replacement HSAs, optional HRAs, optional HSAs, and traditional plans) setting. We compared the effects of optional HRA/HSA cohorts with those of the optional traditional plan cohort, and the effects of full replacement HRAs/HSAs with those of optional HRAs/HSAs. We found that enrolling in optional HRAs was associated with higher spending compared with staying in traditional plans. Enrolling in optional HSAs was associated with comparable spending with continuous enrollment in traditional plans, though higher spending was

observed in some years. We found that full replacement HRAs are cost neutral to optional HRAs, while full replacement HSAs saved costs over optional HSAs.

We found that benefit design characteristics such as free preventive care and cost sharing were associated with decreased plan paid amounts as well as total expenditures. Higher employer contributions, on the other hand, were associated with higher plan-paid and total expense. The price elasticity of demand was only -0.01 when coinsurance increased from 10% to 20%. Although this elasticity is smaller than the one reported by Manning et al. (1987) using RAND HIE data (-0.2), the absolute value for both was much less than one, implying very inelastic demand with respect to the price change.

The third paper, **"***Do Consumer-Driven Health Plans Have Different Effects on Health Care Spending for People with Different Health Status?***",** studied how health care spending for enrollees in CDHPs might be different for members with different health status in a five-year (2005 through 2009) two-cohort (HRAs and traditional plans) setting. We found that CDHP contracts with a high probability of spending less than the account in the baseline year (i.e. low risks) spent less in following years than comparable groups that remained in the traditional health plans. We found this difference in all service categories: total expenditure, medical expenditure, and pharmacy expenditure. This finding supports the prediction from our theoretical model that healthy CDHP enrollees will behave as if spending from the accounts has a positive opportunity cost though they face zero cost-sharing before the accounts are exhausted, and they will save their account to pay for future medical use. We also found that medium-low, medium-high, and high-risk HRA contracts had comparable health care spending with their peer

groups in traditional plans, and high-risk HRA contracts tend to spend more on pharmacy. Our findings agree with Feldman and Parente's study (2010).

## IMPLICATIONS

The findings of this dissertation have implications for employers. Employer should be aware of that CDHPs might lead to discontinuation of chronic disease medications by patients. As more employers consider offering CDHPs to their employees, HSAs seem to provide better control of costs than HRAs. Meanwhile, as many employers are looking at full replacement CDHPs, our results suggest that full replacement may not be worthwhile because there may be no saving (in HRAs), or the saving is relatively small (in HSAs). In fact, a trend in favor of HSAs has been observed in UHC's member population. In March 2006, five years before this dissertation was written, HRAs accounted for 64% and HSAs accounted 36% of the CDHP market (0.87 million and 0.49 million for HRAs and HSAs, respectively). Five years later in March 2011, though the HRA membership grew 108% from 0.87 million to 1.80 million, its market penetration decreased to 48% (1.80 million of 3.76 million). This is because during the same time frame the HSA membership increased 300% from 0.49 million to 1.96 million. This shifting toward HSA enrollment suggests that employers adding CDHPs are adding HSAs mostly, existing HRA employers are switching to HSAs, and more employers are offering full replacement HSAs.

Another implication for employers is they can examine the claims for a prior year before offering a CDHP. If a majority of employees have low risks, offering a CDHP might reduce health care costs compared with the traditional plans, even if the CDHP

design is relatively generous. However, if more employees have medium-high or high risks, a higher coinsurance above the deductible or a larger gap between the deductible and out-of-pocket maximum might be necessary to control costs.

Our findings also have implications for insurers. Discontinuation of medication among patients with chronic conditions may result in worse health conditions and eventually higher costs. Insurance companies should consider promoting strategies to improve adherence. Such strategies can be messages and reminders on drug refills, more cost-efficient drug purchasing method, and incentives, such as rewards or discounts, for patients to stay adherent to therapeutic regimens.

Another implication for insurer is we found that plan characteristics play an important role in constraining costs. Insurance companies can analyze claims to compare the benefits in HRAs/HSAs with those in traditional plans and to examine the association of costs with benefits. If CDHPs are too generous or too thin, adjustments in benefit design might be necessary to achieve neutral costs between CDHPs and traditional plans.

**LIMITATIONS**

This dissertation has some limitations. The first paper used only one year of post-CDHP data. It also did not distinguish between HRAs and HSAs. This study did not evaluate the impact of specific pharmacy benefits, such as benefit tiers or amount of co-payment or coinsurance associated with each tier was examined; nor the specific benefit designs, such as deductible or amount of contribution made to the healthcare accounts. Such information was not available to the researchers at the time the study was conducted. The lack of this information, however, should not change the conclusions of

this study. Although the available demographic characteristics were similar for the two study cohorts, the baseline medication utilization was lower among members who chose to continuously enroll in a traditional plan, indicating that there may be unmeasured differences between the populations.

The second paper used four post-CDHP years and also distinguished between full replacement and optional CDHPs as well as between HRAs and HSAs. However, caution should be taken in generalizing our results to large employers offering only traditional plans or using other insurance carriers and to small groups. Employers included in this study offered CDHPs either as a choice or as a full replacement plan in 2006, after offering only traditional plans in 2005. We did not include a cohort of employers that offered only traditional plans from 2005 through 2009. Although our employers were from different regions and different industries, all firms offered UHC products, which could be different from the products of other health insurers. Another limitation of this study is that we did not have information on whether firms offered plans from other carriers. That being said, our study still provides generalizeable results in the sense that more than 20% of CDHP members nationally are covered by UHC, large groups account for nearly 90% of the UHC CDHP population, and employers commonly offer insurance product(s) from a single insurer.

The third paper did not include the incidence of a health shock in the family (e.g., a myocardial infarction or pregnancy), nor did it track the co-morbidity risks in the post-CDHP years. It also did not control for the insurance premium. The sample size was

also relatively small in the fifth year due to the loss of eligible study subjects in a long-term cohort study.

Overall, our studies indicate that the CDHP effects are not the same for all enrollees and these differences should be recognized in future CDHP research. As CDHPs become more popular, analysis of costs and utilization in CDHPs should be addressed by distinguishing *how* they are offered (as choice or as full replacement plan), *what* type of CDHPs are offered (HRAs or HSAs), as well as *where* an enrollee is likely to be located on the CDHP budget constraint.

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# Chapter I: Medication Adherence and Enrollment in a Consumer-Driven Health Plan[1]

[1] I co-authored this article with Regina Levin and James Gartner. This article was published on American Journal of Managed Care online exclusive in 2010, issue 16, volume 2, pages 43-50

## BACKGROUND

Poor adherence to drug regimens is a costly problem. It increases the risk for negative health outcomes as well as healthcare costs (Johnson and Bootman 1995; The Task Force for Compliance, 1994; Sokol, McGuigan, and Verbrugge et al, 2005). And yet non-adherence is common; approximately 40% to 60% of patients do not take medications as prescribed (Nichol, Venturini, and Sung 1999; Ray 1999; Haynes, McKibbon, and Kanani 1996; Osterberg and Blaschke 2005; Fedder 1982; World Health Organization 2003; National Community Pharmacists Association 2006). High deductible health plans have the potential to discourage drug adherence by placing additional financial burdens on members. In these plans, members may face larger out-of-pocket expenses at the beginning of the plan year in the form of higher deductibles, which could contribute to delays in refilling prescriptions or stopping medication altogether. Using enrollment and claims data from a national insurer, this retrospective cohort study tested whether patients who enrolled in a fully replaced consumer-driven health plan became less adherent to medications for chronic conditions when compared with those who continuously enrolled in a traditional managed care plan.

### *Consumer-Driven Health Plan (CDHP)*

During the past five years, consumer-driven health plans have experienced fast growth. It has been estimated that in 2008 there were 10 to 12 million CDHP enrollees nationally (Fronstin 2008). In this insurer the CDHP membership was three quarters of a million in 2005. It almost doubled in 2006 and exceeded 3 million in 2009. Initially CDHP was most commonly offered as an option alongside traditional plans, but recently

an increasing number of employers have fully replaced their traditional plans with CDHP. This insurer experienced a 67% increase between 2006 and 2008 in the total number of employers that offered full replacement CDHP. Only full replacement CDHP was used in this study to eliminate the selection bias that might have occurred in option CDHP.

Consumer-driven plans typically consist of a personal care account and a deductible (usually $3,000 to $4,000). Under a basic CDHP model, members receive an annual allocation of money into an account and can use this to pay for medical and pharmacy services. Unused funds can be rolled over to the next year and be added to the next year's fund deposit. Once the account is exhausted, members are financially responsible for the medical and pharmacy services until a deductible is met. After the deductible is met, members are partially financially responsible for the services until the annual out-of-pocket maximum is met. There are two types of accounts: HRA (Health Reimbursement Account) and HSA (Health Savings Account). The primary differences are 1) both the employer and the member can contribute to the HSA while only the employer can contribute to the HRA, and 2) the employee owns the HSA while the employer owns the HRA so after discontinuing employment, the employee loses the money in the HRA account. HRA and HSA represent roughly equal market penetration in recent years (Fronstin 2008).

Prescription drugs in the CDHP are paid in a different way from traditional managed care plans. In CDHP members pay the full amount the insurer has contracted with the pharmacy until members have satisfied the deductible. Once the deductible is

satisfied, patients are responsible for a copayment amount. In traditional managed care plans, members are responsible for prescription copays regardless of whether the deductible is satisfied[2]. Typically, traditional plans use a tiered pharmacy design with different copayment tiers for brand versus generic drugs.

## LITERATURE

At the time this study was conducted, research on medication adherence in CDHP was limited and the results were mixed. Some reported an increased use of maintenance medications and decreased pharmaceutical expenditures among CDHP enrollees (CIGNA 2008). Some report that CDHP has no difference on brand utilization (Parente, Feldman, and Chen 2008), generic utilization (Greene, Hibbard, Merray et all 2008), and medication adherence (Greene et al 2008; Health Partners 2008) compared with traditional plans. Yet other studies found that CDHP members tended to use less prescription drugs (Wilson, Bargman, Pederson et al 2008), were less compliant to drug regimens (Fairman, Sundar, and Cox 2008) and more likely to discontinue chronic illness medications (Greene, Hibbard, Merray et all 2008), and were more likely to skimp on needed medications because of cost (Fronstin and Collins 2008). These studies have limited generalizability on medication adherence, because they examined the experience of only one or two employers, they measured general medication utilization rather than adherence, or because they looked at cross-sectional differences without controlling for baseline differences.

## METHODS

### *Setting and Design*

[2] In some cases plans will have separate deductibles for the pharmacy benefit.

This insurer substantially increased membership in CDHP in 2006. The number of contracted employers increased by 300% to 14,500 and the total number of enrollees doubled to 1.5 million. That year 55% of the employers fully replaced the traditional plan with a CDHP. The full replacement employers represented 35% of the new member population.

This retrospective cohort study identified a CDHP cohort from 33 employers and a traditional plan cohort from 47 employers. All employers were middle to large size (>=100 employees). These employers offered traditional plans that had been provided by the same insurer in 2005 and started offering CDHP to employees in 2006. Both self-insured and fully-insured employers were included. Employers in the CDHP cohort offered CDHP as the only choice (full replacement plan), while those in the traditional cohort offered traditional plan as an option in addition to a CDHP. The traditional plans included PPO, POS, and EPO[3], and the CDHP included HRA and HSA. A preliminary examination of the data showed that HSA members had similar adherence patterns as HRA members. HRA and HSA were combined together in the CDHP cohort and will be analyzed separately in an analysis to follow this study. Tiered pharmacy designs were used in all traditional plans.

***Study Subjects***

The unit of analysis is per patient per drug class. Patients were eligible for the CDHP cohort if they enrolled in a traditional managed care plan in 2005 ("pre-year") and a full replacement CDHP in 2006 ("post-year"). Those who were eligible for the

[3] PPO (Preferred Provider Organization), POS (Point of Services), and EPO (Exclusive Provider Organization)

traditional plan cohort voluntarily enrolled in a traditional plan in 2005 and 2006. Other inclusion criteria included continuous enrollment, under 64 years of age on the last day of the 24-month study frame between January 1, 2005 and December 31, 2006[4], both pharmacy and medical benefit coverage, and no other source of health insurance. Patients who used insurance from another carrier were excluded from this study due to the unavailability of insurance claims.

For a given drug class, a patient was identified if s/he had at least one prescription in that drug class during the first quarter of the pre-year and at least one refill during the last quarter of the pre-year. Those who did not have script in the pre-year were excluded from the analysis due to the unavailability of baseline prescribing experience. Eight therapeutic classes for conditions including asthma, cardiac, diabetes, epilepsy, hypertension, cholesterol, rheumatoid arthritis, and thyroid, were selected because the drugs in these classes are rarely used to treat other conditions and should be taken continuously. Patients were allowed to switch drugs as long as they continued with a drug in the same class. Specific Therapeutic Class code, a drug classification system developed by the First DataBank, was used to define drug classes. Study subjects who had prescriptions in multiple drug classes were treated as separate individuals.

***Risk Assessment***

Using enrollment data and medical and pharmacy claims, patients' health risk scores in the pre-year were computed and used in multivariate modeling. Health risk score measures the relative resources that are expected to be required for health care.

[4] All employers except two had January-start coverage and the study frame was from January 1, 2005 to December 31, 2006. The study frame for those two non January-start employers was also 24 months, but shifted from the applied starting month.

Health risk was assessed with ERG (Episode Risk Groups), a derivative work based on ETG (Episode Treatment Group) methodology, a widely used software product for illness classification and episode building[5]. The literature reports that ERG risk scores highly correlates with other risk-adjusted measures of practice efficiency, such as ACG (Adjusted Clinical Groups), BOI (Burden of Illness Score), CCI (Clinical Complexity Index), DCG (Diagnostic Cost Groups), and GDG (General Diagnostic Groups) (Thomas Grazier, and Ward 2004).

***Outcome Measures***

Adherence with regimens was measured from four perspectives. *Continuation rate* measures the proportion of eligible patients who had a positive number of prescription(s) in the post-year, when there was evidence that these patients had a minimum of two refills of drug in that class in the span of the pre-year. For patients who did fill prescriptions in the post-year, *time to fill the first prescription* measures number of days between the last date of drug supply for the last refill of the pre-year and the beginning date of the first filled script of the post-year. *Compliance rate* measures the proportion of patients who had a medication possession ratio (MPR) greater than 0.8 (*Appendix 1-A*). *Time with continuous drug supply* measures number of days with continuous drug supply until discontinuation occurred, or until the end of the post-year, whichever occurred first. A discontinuation is identified if the gap between two consecutive refills is longer than a pre-defined grace period (*Appendix 1-B*).

***Statistical Analysis[6]***

[5] Product of Ingenix, a subsidiary of UnitedHealth Group
[6] More details of statistical methods are available in *Appendix 1-C*.

Descriptive statistics were conducted for demographic variables, the T-test for continuous variables such as age and baseline year risk score, and the Chi-Squared test for gender distribution. To test if patients in the two cohorts were equally likely to continue refilling behavior in the post-year, a logistic regression model adjusting for demographic characteristics, the pre-year risk score, and the pre-year total days of drug supply was applied. An ANOVA model adjusting for demographic characteristics and risk score compared whether patients in the two cohorts took an equal amount of time to refill the first prescription in the post-year.

A difference-in-difference logistic regression model was used to evaluate whether the changes in the compliance rate from the pre-year to the post-year was the same for CDHP and traditional plan enrollees. In this model, the coefficient of the interaction between cohort and year represents the change in the odds ratios between cohorts in a natural logarithm. This method has the advantage of evaluating the true cohort effect by controlling for the time effect. The odds ratios of the pre-year compliance rate over the post-year for each cohort and the estimated ratio of the two odds ratios were reported.

To compare if enrollees in the two plan types were equally likely to discontinue in the post-year, a Cox Proportional Hazard model adjusting for demographic characteristics, the pre-year risk score, and the pre-year total days with continuous drug supply was used. Patients who had a continuous drug supply through the end of the post-year were considered censored observations. The proportional hazard assumption was verified using Kaplan-Meier survival curves. The adjusted hazard ratio of

discontinuation for CDHP enrollees was reported using traditional plan enrollees as the reference group.

## RESULTS

### *Descriptive Analysis*

Table 1-1 summarizes the demographic characteristics, pre-year risk level, and general drug utilization for unique patients who had filled prescriptions for the chronic condition (n=33,393). Compared with patients in the traditional cohort (n=30,455), those in the CDHP cohort (n=2,938) had a slightly higher risk score in the pre-year (2.7 vs. 2.6, $p<.1$), a higher proportion of female (56% vs. 52%, $p<.01$), more days with drug supply in the pre-year for all drug classes together (374 days vs. 365 days, $p<.001$), and higher drug utilization in the pre-year for all drug classes together (9.8 vs. 9.4 scripts, $p<.001$). Total days of supply decreased in the post-year in both cohorts and the drop was larger for CDHP patients (29 days drop in CDHP cohort vs. 14 days in traditional plans, $p<.001$). So did the total number of scripts (dropped 0.8 in CDHP vs 0.6 scripts in traditional plans, $p<.001$). The average age and proportion of patients who were filled prescriptions in more than one drug class was approximately equal in the two cohorts.

### *Continuation to the Post-Year*

The continuation rate was relatively high for all drug classes (Table 1-2). Results from the multivariate logistic regression model suggested that CDHP patients were equally likely to continue their prescriptions in the post-year for six conditions and were less likely to continue for cardiac and cholesterol drugs, where the differences were small (cardiac: 97% vs. 98%, $p < 0.05$; cholesterol: 96% vs. 98%, $p < 0.01$).

***Number of Days to the First Refill in the Post-Year***

Among those who did continue in the post-year, the average time between the last refill of the pre-year and the first refill of the post-year ranged from one week to one month (Table 1-2). The length of this gap was slightly longer for CDHP patients for cardiac (4 days more), hypertension (4 days more), cholesterol (5 days more), and thyroid drugs (2 days more).

***Medication Possession Ratio (MPR)***

The average medication possession ratio (MPR) dropped slightly in the post-year (-.05 in CDHP and -.03 in traditional plans, $p<.001$), though it should be noted that the change of MPR was big for a small group of patients. In both plans, the bottom five percent of patients had a greater than 50% drop of MPR and the top five percent had a greater than 50% increase of MPR (Table 1-3). Outliers, defined as MPR less than .1 or greater >3, accounted for a very small proportion of the population in both groups (<1 percent for each situation of the outliers). Table 1-3 also suggests that the CDHP cohort is highly overlapped with the traditional cohort on the average of pre-year MPR.

***Compliance Rate***

The dichotomous measure for compliance was derived from MPR. For a given drug class, a patient was compliant if his/her MPR was greater than 0.8. Among patients who filled a prescription in the post-year, compliance became worse in the post-year compared to that in the pre-year for all drug classes (Table 1-4). If the adjusted ratio of the odds ratios (the comparison of the compliance reduction from the pre-year to the post-year between the two cohorts) is less than one, it indicates that the reduction was larger

for the CDHP cohort. The CDHP population had a statistically significantly greater reduction in compliance for three drug classes. The adjusted ratio of odds ratio was 0.77 for asthma ($p<.05$), 0.78 for cardiac ($p<.05$), and 0.69 for cholesterol drugs ($p<.001$). The drug class with the greatest reduction in compliance and the greatest difference between CDHP and traditional plan patients was for hypercholesterolemia. For this drug class, compliance rates for CDHP members dropped from 77% to 62%, compared to a change from 75% to 68% for patients who remained in a traditional managed care plan. Regardless of the type of health plan in the post-year, compliance rate was relatively low for rheumatoid arthritis drugs in both the pre-year and the post-year which suggests that patients with rheumatoid disease might not receive sufficient treatment[7].

***Number of Days with Continuous Drug Supply***

Among patients who continued in the post-year, the total time with continuous drug supply was relatively long for both study groups - ranging from seven months for rheumatoid arthritis medications to nine months for thyroid medications (Table 1-5). A test on the likelihood of supply termination suggests that CDHP patients were more likely to discontinue refilling for two drug classes. CDHP enrollees terminated earlier for epilepsy (21 days shorter, hazard ratio=1.25, $p<.05$) and cholesterol drugs (27 days shorter, hazard ratio=1.25, $p<.001$) than traditional plan enrollees.

**DISCUSSION**

There has been an increasing concern that patients may discontinue taking their maintenance drugs for chronic conditions if they are required to pay more. Unlike

[7] Patients with RA may have switched to medications (injections) given in doctor's office and this may not be reflected in pharmacy claims but in medical claims. This would appear to be non-compliance but it not.

members with a multi-tier pharmacy design who pay a portion of the full price through coinsurance or copayment, those in CDHP pay the full price for drugs until the deductible is met. Maintaining control of chronic illnesses can delay or prevent complications and can therefore lead to savings on future health care.

This study tested the hypothesis that enrolling in an account-based high deductible consumer-driven health plan leads to adverse prescription drug refilling behavior. Using two years claims data from multiple employers, this analysis compared patients who enrolled in a full replacement CDHP with those who voluntarily continuously enrolled in a traditional managed care plan. Eight drug classes were studied and patients were identified if they had at least two scripts in the pre-year for a given drug class. The utilization for all drug classes together decreased in both cohorts and the decrease was slightly more in the CDHP cohort.

Four aspects of regimen adherence were examined in the post-year: an overall medication continuation rate, time to refill the first prescription; the change in compliance rate from the pre-year; and the number of days with continuous drug supply. CDHP patients were equally likely to continue their prescriptions for six conditions but were less likely to refill cardiac and cholesterol drugs. CDHP patients took slightly longer to resume their first prescriptions in the post-year for cardiac, hypertension, cholesterol, and thyroid drugs. CDHP patients also had poorer compliance for asthma, cardiac, and cholesterol medications. In addition, CDHP patients terminated their continuous drug supply earlier than traditional plan patients. The greatest concern however is poor compliance for medications for hypercholesterolemia. Adherence was

consistently and statistically significantly lower for CDHP patients taking medication for this condition with all measures.

These results are slightly different from a recently published study that found no difference in the decline in compliance between the high-deductible plan and traditional plan for all five drug classes studied [14] and another study that found no difference in medication persistency on all three drug classes studied [8].

**LIMITATIONS**

One limitation of this study is we only used pharmacy claims to define medication adherence. We might have omitted the medications that are administered in physician's office (e.g., injections for patients with rheumatoid) and therefore had an under-estimation of the adherence. If patients purchased medications in retail stores or convenient clinics, no claims would be submitted to our claims system and this would appear to be non-adherence while it is actually not.

This study did not evaluate the impact of specific pharmacy benefits, such as benefit tiers or amount of co-payment or coinsurance associated with each tier was examined; nor the specific benefit design at the employer level, such as insurance premium or amount of contribution made to the healthcare account. Such information was not available to the researchers at the time the study was conducted. The lack of this information, however, should not change the conclusions of this study. Although the available demographic characteristics were similar for the two study cohorts, the baseline medication utilization was lower among members who chose to continuously enroll in a

[8] This paper is under review. The author information is not disclosed.

traditional plan, indicating that there may be unmeasured differences between the populations.

**Table 1-1. Descriptive Analysis for Patients Using Medications for Chronic Conditions [a]**

| Characteristics / Cohort | CDHP | Traditional |
|---|---|---|
| **Unique patients, n [b]** | 2,938 | 30,455 |
| **Age in Years, Mean** | 50 | 50 |
| **ERG Risk Score in Pre-Year, Mean** | 2.7 | 2.6* |
| **Female, %** | 55% | 52%** |
| **Patients Taking Medications in Multiple Drug Classes, %** | 41% | 40% |
| **Total Patients, n [c]** | 4,865 | 49,009 |
| **Patients Who Had Scripts in Post-Year, n (% [d])** | 4,685 (96%) | 47,626 (97%) |
| **General Utilization, Mean [e]** | | |
| **Pre-Year Days of Supply** | 374 | 365*** |
| **Post-Year Days of Supply** | 345 | 351* |
| **Change of Days of Supply** | -29 | -14*** |
| **Pre-Year Total Scripts** | 9.8 | 9.4*** |
| **Post-Year Total Scripts** | 9.0 | 8.8* |
| **Change of Total Scripts** | -0.8 | -0.6*** |

[a] Patients were eligible for the study if they were <65 at the end of the two-year study frame, used commercial health insurance plan from the same insurer, did not switch employer, did not use insurance from multiple carriers, and had continuous medical coverage and drug coverage. For a given drug class, patients were identified if they had at least one prescription during the first quarter of the pre-year and at least another one prescription during the last quarter of the pre-year.

[b] Analysis of age, risk score, and gender applied to unique patients.

[c] Patients who had prescriptions in more than one drug class were treated as different individuals.

[d] Percent of total patients in the row above

[e] Utilization for all drug classes used in this study. Analysis applied to patients who had scripts in the post-year.

*p<0.05, **p<0.01, ***p<0.001;

**Table 1-2: Continuation Rate and Adjusted Number of Days to The 1st Prescription in Post-Year. By Drug Class [a]**

| Measure | Total Patients, Patients Continued in Post-Year, and Continuation Rate | | | | | | Adjusted Number of Days to 1st Prescription in Post-Year (LSMeans) [c] | |
|---|---|---|---|---|---|---|---|---|
| Cohort | CDHP | | | Traditional | | | CDHP | Traditional |
| Drug Class | N | n | % | N | n | % [b] | Days | Days [d] |
| **Asthma** | 816 | 763 | 94% | 7,143 | 6,721 | 94% | 28 | 29 |
| **Cardiac** | 1,016 | 987 | 97% | 9,980 | 9,803 | 98%* | 14 | 10*** |
| **Diabetes** | 375 | 369 | 98% | 3,923 | 3,873 | 99% | 11 | 8 |
| **Epilepsy** | 216 | 203 | 94% | 2,351 | 2,229 | 95% | 20 | 15 |
| **Hypertension** | 743 | 720 | 97% | 7,499 | 7,285 | 97% | 14 | 10** |
| **Cholesterol** | 978 | 941 | 96% | 10,518 | 10,276 | 98%** | 21 | 16*** |
| **RA** | 176 | 161 | 91% | 1,524 | 1,442 | 95% | 33 | 26 |
| **Thyroid** | 545 | 541 | 99% | 6,071 | 5,997 | 99% | 13 | 10* |

[a] For a given drug class, an eligible patient was continued in the post-year if s/he had at least one prescription in the post-year. Eligible patients must have had at least one refill in the first quarter and another one in the last quarter of the pre-year.

[b]. Significance test examined if the CDHP cohort was equally likely to continue in post-year as traditional cohort.

[c] Patients who qualified for this measure were those who continued in the post-year. The number of days to resume prescriptions was defined as the duration between the starting date of the first prescription in the post-year and the ending date of the last prescription in the pre-year.

[d] Significance test examined whether the LSMEANS of the two populations were equal.

*p<0.05, **p<0.01, ***p<0.001;

**Table 1-3. Distribution of Medication Possession Ratio (MPR). By Cohort.** [a]

| Cohort / Percentile | 1st | 5th | 25th | Mean (Std Dev) | Median | 75th | 95th | 99th |
|---|---|---|---|---|---|---|---|---|
| **CDHP (n=4,865)** | | | | | | | | |
| Pre-Year MPR | .22 | .47 | .85 | 1.01 (0.42) | .97 | 1.03 | 1.89 | 2.67 |
| Post-Year MPR | .11 | .28 | .75 | .96 (0.47)* | .95 | 1.02 | 1.95 | 2.82 |
| Change of MPR (Post-Year – Pre-Year) | -.94 | -.59 | -.16 | -.05 (0.32)*** | -.02 | .07 | .42 | .89 |
| % Change (Change of MPR*100 / Pre-Year MPR) | -84% | -58% | -16% | -1.3% (.44)** | -1.9% | 6.9% | 54% | 162% |
| **Traditional (n=49,009)** | | | | | | | | |
| Pre-Year MPR | .20 | .44 | .81 | 1.00 (0.43) | .96 | 1.04 | 1.92 | 2.64 |
| Post-Year MPR | .09 | .30 | .75 | .97 (0.49) | .95 | 1.03 | 1.97 | 2.87 |
| Change of MPR (Post-Year – Pre-Year) | -.87 | -.51 | -.14 | -.03 (0.30) | -.01 | .08 | .46 | .93 |
| % Change (Change of MPR*100 / Pre-Year MPR) | -81% | -55% | -14% | 1.1% (.51) | -1.2% | 8.5% | 60% | 157% |

[a] Comparison was made on the mean of pre-year MPR, post-year MPR, change of MPR from pre-year to post-year, and percent change of MPR between CDHP and traditional plans
*p<0.05, **p<0.01, ***p<0.001;

**Table 1-4. Comparison of Change in Compliance Rate from Pre-Year to Post-Year and Adjusted Ratio of Odds Ratios. By Drug Class [a]**

| Cohort | CDHP | | | Traditional | | | Adjusted Ratio of Odds Ratios |
|---|---|---|---|---|---|---|---|
| Measure | Compliance Rate [b] | | Odds Ratio (Pre-Year =1) [c] | Compliance Rate [b] | | Odds Ratio (Pre-Year =1) [c] | CDHP vs. Traditional |
| Drug Class | Pre-Year | Post-Year | | Pre-Year | Post-Year | | |
| **Asthma** | 71% | 62% | 0.67 | 62% | 59% | 0.85 | 0.77* |
| **Cardiac** | 84% | 77% | 0.61 | 81% | 77% | 0.78 | 0.78* |
| **Diabetes** | 83% | 81% | 0.90 | 83% | 81% | 0.91 | 0.99 |
| **Epilepsy** | 70% | 61% | 0.66 | 72% | 65% | 0.73 | 0.90 |
| **Hypertension** | 81% | 78% | 0.79 | 81% | 76% | 0.72 | 1.11 |
| **Cholesterol** | 77% | 62% | 0.49 | 75% | 68% | 0.70 | 0.69*** |
| **RA** | 63% | 53% | 0.65 | 61% | 53% | 0.73 | 0.87 |
| **Thyroid** | 86% | 81% | 0.67 | 82% | 79% | 0.83 | 0.80 |

[a] Patients who qualified for this measure were those who continued in the post-year. For a given drug class, a patient continued in the post-year if s/he was eligible for the study (had at least one refill in the first quarter and another one in the last quarter of the pre-year), and had at least one prescription in the post-year.

[b] Compliance rate was calculated as the percentage of patients who had MPR (medication possession ratio)>0.8

[c] Pre-year was the reference group (odds ratio=1) in both cohorts. Odds ratio < 1 indicates that compliance in the post-year was lower than that in the pre-year

[d] Ratio of odds ratios compares the changes of compliance rate between CDHP and traditional cohort. Ratio of odds ratios < 1 suggests that the reduction of compliance from pre- to post-year was greater in the CDHP cohort than the decrease in the traditional cohort

*p<0.05, ***p<0.001;

**Table 1-5. Average Number of Days with Continuous Drug Supply in Post-Year and Adjusted Hazard Ratio on Likelihood of Discontinuation. By Drug Class [a]**

| Measure | Number of Days with Continuous Drug Supply in Post-Year (Mean) [b] | | Hazard Ratio to Discontinuation For CDHP (Hazard Ratio=1 for Traditional Cohort) [c] |
|---|---|---|---|
| **Drug Class / Cohort** | **CDHP** | **Traditional** | |
| **Asthma** | 227 | 231 | 1.06 |
| **Cardiac** | 268 | 278 | 1.02 |
| **Diabetes** | 251 | 265 | 1.07 |
| **Epilepsy** | 220 | 241 | 1.25* |
| **Hypertension** | 265 | 274 | 1.08 |
| **Cholesterol** | 226 | 253 | 1.25*** |
| **RA** | 209 | 223 | 1.13 |
| **Thyroid** | 281 | 279 | 0.95 |

[a] Patients who qualified for this measure were those who continued in the post-year. For a given drug class, a patient continued in the post-year if s/he was eligible for the study (had at least one refill in the first quarter and another one in the last quarter of the pre-year), and had at least one prescription in the post-year.

[b] A patient had continuous drug supply as long as the duration between two consecutive refills was shorter than a pre-defined grace period, which was half of the supply days of the first identified prescription for this patient.

[c] Hazard ratio was obtained from Cox Proportional Hazard model that adjusted for age, gender, pre-year risk score, and pre-year number of days with continuous drug supply. Traditional plan enrollees were the reference group (hazard ratio=1)

*p<0.05, ***p<0.001;

# Chapter II: A Five-Year Study of Health Expenditures among Full Replacement CDHPs, Optional CDHPs, and Traditional Managed Care Plans[9]

[9] I c-authored this article with Dr. Roger Feldman and Dr. Stephen T. Parente. This work was submitted for publication and is under review.

Consumer-driven health plans (CDHPs) represent an increasing proportion of private health plan members in the United States. A recent study suggested that CDHPs were the only type of health insurance plan that grew in 2010, compared with Preferred Provider Organizations (PPOs) and Health Maintenance Organizations (HMOs), and the growth was strong among large employers (AAPPO 2011). The two prevailing CDHP models are the Health Reimbursement Arrangement (HRA) and the Health Savings Account (HSA). The primary differences are: (1) both the employer and the member can contribute to an HSA, while only the employer can contribute to an HRA; and (2) employees own the HSA, while employers own the HRA, so after discontinuing employment or changing health plans, employees lose the money in the HRA. National CDHP enrollment was estimated to exceed 18 million in 2010 (AHIP 2010, Fronstin 2010, AAPPO 2011) and HSAs are getting more popular among employers and employees than HRAs (AAPPO 2011).

Although some studies have estimated the effect of enrolling in a CDHP on expenditures, very few have studied the how the effects might be different between full replacement CDHPs and optional CDHPs. Understanding such questions is important for employers and insurers. As more people switch to CDHPs than leave them and employers no longer offer choices of plans, if full replacement CDHPs do not really save costs, employers and insurers should take this into consideration before adopting full replacement plans or recommending such plans to employers. The current study used the longest cohorts in studies of CDHPs to date to answer two research questions: what are the long-term effects of HRAs and HSAs on health care expenditures relative to those of

traditional managed care plans; and whether full replacement HRAs or HSAs have different effects than optional HRAs/HSAs. We examined the impact of choosing an HRA or HSA along with other insurance choices, as well as the impact of fully replacing non-CDHP plans with HRAs and HSAs. Doing so not only allowed us to examine whether CDHP members behave differently from traditional plan members when choices of plans are available; we could also compare the effectiveness of full replacement and optional plans. Observing full replacement CDHPs also allowed an additional control for self-selection beyond that of baseline health.

**Literature Review**

The literature suggests that expenditures are lower in CDHPs than in traditional plans. Using a three-year pre-post cohort design, Parente et al. examined medical expenditures for members who switched to a CDHP in 2001 and 2002 from a PPO (Preferred Provider Organization) or a HMO (Health Maintenance Organization) offered by a large employer (Parente, Feldman, and Christianson 2004b). The authors found that expenditures were lowest for CDHP members during the first year of CDHP enrollment. But in the second year post-switching, CDHP expenditures were higher than in the HMO cohort and were lower than in the PPO cohort. They also found a larger increase in hospital expenditures in the CDHP cohort compared with the other two cohorts. The authors provided two explanations for the rise of hospital expenditures: emerging moral hazard after CDHP members met their deductibles; and reduced use of preventive care.

These explanations were later examined in an extended study that included data from the third year of observation for the original CDHP cohort. In the extended study,

Feldman et al. found evidence of pent-up demand in the CDHP cohort, but not enough to explain the high medical care spending over time by the CDHP members (Feldman, Parente, and Christianson 2007). The authors also found that higher hospital spending in the CDHP cohort was not associated with a substitution away from cost-effective prescription drug therapy.

In another follow-up study, Parente et al. found that pharmaceutical expenditures in the CDHP cohort were lower than those in the POS cohort in 2001 with no major differences in brand name drug consumption (Parente, Feldman, and Chen 2008). Using the same study setting, Feldman and Parente grouped members within cohorts into three risk groups corresponding to enrollees' predicted medical care expenditures (Feldman and Parente 2010). They found that CDHP members with low predicted spending in the prior year spent less in the three years after CDHP enrollment than did members who enrolled in the traditional plans, while CDHP members with high predicted expenditure spent more than their counterparts in the traditional plans. The authors concluded that the kinked CDHP budget constraint created different incentives for healthy and sick members.

Using a three-year pre-post cohort design with data from employers that offered HSAs, Lo Sasso et al. examined the difference in total expenditures between HSA and non-HSA members (Lo Sasso, Shah, and Frogner 2010). The authors found that HSA members spent 5-7% less than traditional plan members, and pharmacy spending per member was 6-9% lower in the HSAs than in the traditional plans.

Researchers frequently report favorable selection on age, health status, or income when CDHPs are provided as a choice among health plans, although the findings are mixed. Studies commonly find that people who chose CDHPs had higher income than their counterparts who chose traditional plans (Christianson, Parente, and Feldman 2004; Claxton et al. 2005; Parente, Feldman, and Christianson 2004a; Parente, Feldman, and Christianson 2004b; Tollen, Ross, and Poor 2004). Some studies find lower illness burden in CDHP members (Fowles et al. 2004; Fronstin and Collins 2005; Parente, Feldman, and Christianson 2004b), while others report no difference in health status by plan (Christianson, Parente, and Feldman 2004; Tollen, Ross, and Poor 2004). One study found no favorable selection into a CDHP relative to an HMO but did find evidence of favorable selection on age and health status into the CDHP over a PPO (Parente, Feldman, and Christianson 2004a).

Another interesting yet not well-answered question is how health care expenditures respond to benefit design characteristics, such as levels of account contribution, deductible, coinsurance, and out-of-pocket limits. Using data from the RAND Health Insurance Experiment (HIE) (Newhouse and Insurance Experiment Group 1994), Manning et al. (Manning et al. 1987) found a price elasticity of -0.2. The researchers grouped health care services into outpatient and hospital services and further grouped outpatient services by acute and chronic conditions. They found consistent results on the price elasticity across conditions and services.

Previous publications on CDHPs often have had limited variation of benefit designs in the study setting. Parente et al., for instance, suggested that the large increase

in costs in the second follow-up year over the first year could have been caused by the particular design characteristics of the CDHP offered by the studied employer (Parente, Feldman, and Christianson 2004b). These characteristics included: a large fund rolled-over from previous years, a small gap between account contribution and deductible (also known as the doughnut-hole), a zero co-insurance after the deductible was met, and a low stop-loss limit. Using pharmacy claims data from an employer that offered HRAs (with different levels of deductible) and PPOs to its employees, Greene et al. found that members in a high-deductible HRA were more likely to discontinue prescription drugs than those enrolled in low-deductible HRAs or those who enrolled in PPOs (Greene et al. 2008). Using claims data from the small group market, Lo Sasso et al. found that deductibles would have to be raised by almost $4 for every $1 increase in the spending account to keep spending unchanged (Lo Sasso, Helmchen, and Kaestner 2010).

Studies on the impact of full replacement CDHPs on expenditures have mixed findings. Lo Sasso et al. found that those who enrolled in full replacement HSAs spent more than those who enrolled in optional HSAs (Lo Sasso, Shah, and Frogner 2010). In contrast, Parente et al. found that when a CDHP was provided as a full replacement plan, it achieved cost savings but also led to a decrease in use of preventive services (Parente, Feldman, and Yu 2010).

In summary, more evidence of the effects of CDHPS on costs is needed. Previous studies that examined both HSA and HRA members did not distinguish between them, nor did they distinguish members in full replacement CDHPs and optional CDHPs. Our study identified separate cohorts for full replacement HRAs and HSAs and for optional

HRAs and HSAs. We examined fives years of claims data for a group of large employers that provide a variety of benefit designs. Having this many employers is a unique aspect of our study.

## Methods

### *Study Population and Cohort Assignment*

The study population was selected from the large-group market (100 or more employees) of UnitedHealth Care (UHC), one of the largest health insurers in the U.S. and also one of the largest in the CDHP market. HRAs and HSAs offered by UHC represent roughly equal market penetration. The group market for both at UHC rose from 1.3 million in 2009 to 1.8 million (HRAs) and 2 million (HSAs) in 2011 and most of the growth was in large-group coverage. Large employers were chosen for this study because small groups are often combined into bigger insurance pools to obtain better prices, which would make it hard to track small-group information at the employer-plan level. Using large employers also had the advantage of retaining a relatively large sample size for a longitudinal study.

We originally identified 55 employers and 142,325 members for a two-year (2005 and 2006) study (Chen, Levin, and Gartner 2010). In the baseline year, 2005, all employers offered traditional plans (PPOs, Point of Service (POSs), or Exclusive Provider Organization (EPOs))[10] to their employees. These traditional plans had relatively low in-network annual deductibles (e.g., the average individual deductible was

[10] Some employers offered more than one PPO, POS, or EPO plan. One employer also offered an indemnity plan (a fee-for-service plan that does not use a network of preferred providers) with only a very small number of enrollees. We did not include this indemnity plan in our study.

$500~$600) in 2005. Starting in 2006, all employers offered HRAs and/or HSAs either as a full replacement for the traditional plans or as an option in addition to a traditional plan. On average, employers that offered full replacement CDHPs had fewer members than employers that offered CDHPs as options. Although it is possible that an employer offered health plans from other insurers than UHC to its employees, such information was unavailable to us.

The unit of analysis is the individual member, including primary subscribers, who are normally employees, and dependents, who can be children. All members enrolled in a traditional plan in the baseline year. Members were assigned to five mutually exclusive study cohorts depending on the insurance plan they enrolled in for the first follow-up year, 2006: a full replacement HRA, a full replacement HSA, an optional HRA, an optional HSA, or an optional traditional plan cohort.

Members were excluded if they were older than 64 years on December 31, 2006, did not have both medical and pharmacy coverage, used health plans from other insurers than UHC[11], and had total allowed spending exceeding $200,000[12] in any calendar year. Members were required to continuously enroll for 24 months in 2005 and 2006.

We extended the study for three more years (2007-2009) and checked members' cohort assignment annually. For a specific year and a specific cohort, a member would be continuously eligible if s/he stayed in the same type of plan in that year as s/he did in

[11] Claims from other insurers were not available.
[12] Such members accounted for only 0.01% to 0.04% in the five cohorts. Withdrawing these members did not have a disproportionate impact of any of the cohorts.

2006[13], had 12 months enrollment in medical and pharmacy coverage in that year, and also met the requirement for age and not using multiple insurers. The distribution of members between CDHPs and traditional plans was consistent in all years (20% were in the four CDHP cohorts in 2005 and 2006, 22% in 2007, and 23% in 2008 and 2009) (Table 2-1).

If a member became ineligible for that cohort, the outcome measures would not apply for that year for that member. Our sample size decreased to 110,581 in 2007 (78% of the original population), 74,253 in 2008 (52% of the original population), and 59,500 in 2009 (42% of the original population) (Table 2-1). Members became ineligible for a cohort for a variety of reasons, including changing jobs, switching health plans, or retiring. Examination of members who dropped out of this study suggested that they were not different from the eligible study subjects in term of age, gender, and baseline illness burden. In rare cases a member became eligible again after losing his or her eligibility[14].

***Control Factors***

Members' age[15] and gender were obtained from UHC's member profile table. We used the average per-capita income by zip code (U.S. Census Bureau 2010) as a proxy for the member's income because this information was not available in the member profile table. We also assigned each member to a geographic region defined by the

[13] Members who switched within the same type of plans (e.g., from one traditional plan to another traditional plan) were included in the original cohort.
[14] Fewer than 2% of those who were ineligible in 2007 became eligible again in 2008 and fewer than 3% became eligible again 2009. One percent of those who were ineligible in 2008 became eligible again in 2009.
[15] Integer between a member's date of birth and December 31, 2006

Census Bureau. Member level co-morbidity risk scores in the baseline year were computed with ERGs (Episode Risk Groups) using enrollment data and medical and pharmacy claims[16]. Co-morbidity risk scores measure the relative resources that were expected to be required for health care. High risk scores imply greater illness burden. A score of 1.00 indicates risk comparable to that of the average person for the large managed care population that was used to develop ERG; a score of 1.10 indicates 10 percent greater risk; a score of 0.85 indicates 15 percent lower risk, and so on. The literature reports that ERG risk scores correlate highly with other risk-adjusted measures of practice efficiency (Thomas, Grazier, and Ward 2004). In addition, we controlled for contract type (individual vs. family) and employer fixed effects.

We also controlled for a variety of plan benefit characteristics, including the account contribution, deductibles, copayment for office visits, coinsurance rates, and whether or not preventive care is 100% covered (zero co-payment and zero coinsurance for wellness visits), which often include physician office services such as routine physical examinations, cancer screening, well-baby and well-child care, vision and hearing screenings, and immunizations. The employer account contribution was set to $0 for the traditional plans that did not have health care accounts.

### *Statistical Analysis*

The outcome measure was per-member-per-year expenditure and its break-down by plan- paid and member-paid amounts. We used generalized linear models (GLM) that

[16] ERG is a derivative of the ETGs (Episode Treatment Groups) methodology, a widely used software product for illness classification and episode building. Both ERGs and ETGs are products of Ingenix, a subsidiary of UnitedHealth Group.

specified a Gamma distribution and a log link, $\ln(E(y)) = x\beta$, or $E(y|x) = \exp(x\beta)$, to model the impact of CDHPs on health care expenditures. With the log link, the effect of the cohort on costs in a particular year can be interpreted directly as a multiplicative effect without transforming the result from logarithms back to the original scale (Buntin and Zaslavsky 2004). We estimated a five-cohort model in which the primary variables of interest are the interactions of cohorts and four dummy variables for years 2006 through 2009. In this model, the coefficient of optional HRAs and year 2006 interaction, for instance, represents the percent difference in expenditure between optional HRAs and optional traditional plans (the omitted reference group) in the first year of HRA offering. We also compared the coefficients of two interactions: optional HRAs/HSAs with year and full replacement HRAs/HSAs with year. This difference tells us whether full replacement CDHPs have different impacts on costs compared with optional CDHPs. We examined the sensitivity of our model by comparing the coefficients in the five-cohort model with three sub-group analyses: an optional-only analysis (including the three optional cohorts only); a HRA-only analysis (including only full replacement HRAs and optional HRAs); and a HSA-only analysis (including only full replacement HSAs and optional HSAs). All analyses were conducted with statistical software SAS 9.1™ (Cary, NC). Results are reported in the following section.

## Results

### *Descriptive Analysis*

#### 1. Socio-Demographic Characteristics

CDHP members had similar age and gender distributions as traditional plan members (Table 2-2). The average age in all cohorts was approximately 35 years and females accounted for approximately half of the member population. Family contracts had an average of 3.2 members and accounted for approximately 80% of the total contracts in all cohorts. Members lived in geographically diverse census regions, including Midwest, Northeast, South, and West.

The co-morbidity risk scores in the baseline year were measurably lower in the optional CDHP cohorts (0.9 for HRAs and 0.8 for HSAs) than their peers in optional traditional plans (1.2) and members in firms that provided CDHPs as the only choice (1.2 for HRAs and 1.3 for HSAs), suggesting that healthier people with less need of care chose CDHPs.

Baseline total expenditure follows the same pattern as health status. Members in optional CDHP cohorts spent the least ($1,945 for HRAs and $1,863 for HSAs), followed by full replacement CDHP members ($2,683 in HRAs and $2,807 in HSAs), and then by optional traditional plan members ($2,974).

Members who chose optional HRAs came from areas that had lower average incomes than those who chose traditional plans ($23,904 vs. $25,025 when employers offered only optional HRAs; $21,413 vs. $24,913 when employers offered both optional HRAs and HSAs). In contrast, members who chose optional HSAs came from areas with

comparable or higher average income than those who chose traditional plans ($28,411 vs. $28,217 when employers offered only optional HSAs; $31,240 vs. $24,193 when employers offered both optional HSAs and HRAs) suggesting income selection into the HSAs when multiple plans were offered.

### 2. Benefit Design Characteristics

The benefit design in 2006 is summarized in Table 2-3. The average annual employer contribution was $613 for individuals and $1,230 for families in full replacement HRAs, and was $674 for individuals and $1,903 for families in optional HRAs. The average annual employer contribution was $772 for individuals and $1,613 for families in full replacement HSAs, and was $644 for individuals and $996 for families in optional HSAs.

Deductibles in CDHPs were considerably higher (median value: individual $1,500~$3,000 and family $3,000~$4,000) than in traditional plans (individual $300 and family $900). The out-of-pocket maximum (not shown in Table 2-3) is often proportionally higher than the deductible. Coinsurance for hospital admissions was primarily zero or 10%. The only exception is the optional HRAs, in which nearly half of the benefit designs have a 20% coinsurance. Copayments for office visits were relatively low in CDHPs ($2~$7) and relatively high in traditional plans ($16). Members in CDHPs were more likely to have free coverage of preventive care (ranging from 60% to 92% in the CDHP cohorts) than their counterparts in traditional plans (25%).

### *GLM Coefficient Estimates*

Table 2-4 and 2-5 summarize the coefficient estimates from the generalized linear models (GLMs). In Table 2-4, we focus on the impacts of enrolling in optional CDHPs on health care expenditures relative to optional traditional plans[17] as well as the impacts of other control factors. The comparison between optional CDHPs and full replacement CDHPs is reported in Table 2-5.

#### 1. Effect of Enrolling in Optional HRAs and HSAs on Expenditures

Relative to staying in traditional plans, enrolling in optional HRAs was associated with higher expenditures in all years (2006: 9%; 2007: 8%; 2008: 8%; 2009: 16%) and higher plan paid amount in one year only (2009: 14%). Enrolling in optional HSAs was relatively cost-comparable with staying in traditional plans, although fluctuations around zero were observed in the effects on total expenditure (2006: -6%; 2007: 9%; 2008: 8%) as well as in plan-paid amounts (2006: -11%; 2007: 7%; 2008: 7%). The impact turned insignificant in 2009.

Enrolling in both optional CDHP cohorts was associated with much higher member-paid amounts, suggesting that expenses were shifted to members in optional CDHPs. The effects were on average higher in HSAs (2006: 80%; 2007: 75%; 2008: 67%; 2009: 64%) than in HRAs (2006: 59%; 2007: 55%; 2008: 46%; 2009: 41%), and slightly decreased over time in both cohorts.

[17] These are coefficient estimates of the interaction between optional HRAs/HSAs and year dummy variables.

The coefficients of the cohort dummy variables represent the permanent, unmeasured differences in health care expenditures among people who choose a CDHP versus those who stay in traditional plans. The coefficients of optional HRAs were negative on all expenditures (total expenditure: -.22; plan-paid: -.23, member-paid: -.3) and HSAs (total expenditure: -.2; plan-paid: -.14; member-paid: -.55), suggesting that optional CDHP enrollees were lower spending individuals on average.

### 2. Difference between Full Replacement HRAs and Optional HRAs

Do the effects of CDHP enrollment differ for optional and full replacement CDHP members? We looked into this question by comparing the coefficients of full replacement CDHPs with those of optional CDHPs[18] (Table 2-5). We found that enrolling in full replacement HRAs had the same effect on expenditures as enrolling in optional HRAs. The only exception was in 2007 when full replacement HRAs were associated with 19% higher plan-paid amount compared with optional HRAs.

Enrolling in full replacement HSAs was initially associated with higher costs relative to enrolling in optional HSAs (2006: 6% for total expenditure and plan-paid amount). Starting in 2007, enrollment in full replacement HSAs was associated with lower total expenditures (2007: -6%; 2008: -7%) and plan-paid amounts (2007: -10%; 2008: -14%). The difference was not significant in 2009. Enrolling in full replacement HSAs was associated with higher member-paid amounts in all years (2006: 28%; 2007:

[18] The statistical test is whether the coefficient of the interaction between full replacement HRAs/HSAs and year dummy variable equals that of the interaction between optional HRAs/HSAs and year dummy variable.

30%; 2008: 26%; 2009: 35%) relative to enrolling in optional HSAs, suggesting that members in full replacement HSAs shared more costs than those in optional HSAs.

By comparing the coefficients of the cohort dummy variables between full replacement CDHPs and optional CDHPs (Table 2-5), we again found that full replacement HRA enrollees were on average the same-level spending individuals as optional HRA enrollees, whereas full replacement HSAs were lower (-17% on cohort main effect comparison) spending individuals on average relative to optional HSA enrollees.

### 3. Effects of Other Control Factors

The effects of other control factors on health care expenditures are also worthy of discussion (Table 2-4). We found that older, female, higher illness burden, higher income, lived in Midwest region, and covered by an individual contract were associated with higher expenditure.

All benefit design characteristics examined in this study, except the employer contribution, were associated with lower total expenditures and lower plan-paid amounts, suggesting that cost-sharing and generous preventive care coverage might lower health care costs. All characteristics except copayment for office visits and employer contribution were associated with higher member-paid amounts. The price elasticity of demand as coinsurance increased from 10% to 20% was -0.01, suggesting a very small response to a price increase.

### 4. Sensitivity Analysis

We analyzed three sub-groups to test the sensitivity of the full five-cohort model, including three optional cohorts only, two HRA cohorts only, and two HSA cohorts only. The coefficient estimates on cohort and year interactions in these sub-group analyses are almost identical to those in the full models in Table 2-4 and 2-5. Results of the sensitivity analysis are not reported due to the space limit.

## Discussion

Using five years of claims data for a population from multiple employers, we observed per-member-per-year expenditures among five cohorts: members switching voluntarily (optional plan) or involuntarily (full replacement plan) to HRAs or HSAs, and members staying voluntarily in a traditional managed care plan. We compared the effects of optional HRA/HSA cohorts with those of the optional traditional plan cohort, and the effects of full replacement HRAs/HSAs with those of optional HRAs/HSAs.

Our findings suggest that enrolling in optional HRAs was associated with a higher level of spending compared with staying in traditional plans. Enrolling in optional HSAs was associated with a level of spending comparable with continuous enrollment in traditional plans, though higher spending was observed in some years. We found that full replacement HRAs are cost neutral to optional HRAs, while full replacement HSAs saved costs over optional HSAs.

Our results were not surprising given the relatively generous plan benefits in HRAs compared with HSAs. The different account ownership arrangements in consumer-driven health plans could also explain the different spending behaviors

associated with them. Because the employer-owned HRA accounts are not portable across employers or health plans, even though the funds can be rolled over from year to year, members may prefer spending now rather than saving for later. In contrast, HSAs are portable with members, who can decide to use the funds at any time. For instance, members can leave the funds untouched and save for future health care use[19], or even take the funds with them if they change employers or health plans. The benefit rush that might occur in HRAs is less likely to be observed in HSAs. Benefit rush refers to situations in which one wants to spend all the money in the account when s/he starts looking for a new job or worries about losing a job, faces retirement, or changes plans at the same employer.

Though enrolling in all CDHP cohorts appeared to be associated with much higher member-paid amounts, it should be noted that the increased member-paid amounts would be absorbed on a pre-tax basis by the spending account. In 2006, the average employer contribution exceeded the average member-paid amounts in all CDHPs, suggesting that members' out-of-pocket expenses were on average fully covered by the employer contribution.

We found that benefit design characteristics such as free preventive care and cost sharing were associated with decreased plan paid amounts as well as total expenditures. Higher employer contributions, on the other hand, were associated with higher plan-paid and total expense. The price elasticity of demand was only -0.01 when coinsurance increased from 10% to 20%. Although this elasticity is smaller than the one reported by

[19] In a separate study of HSA account balances, we observed some members keeping their HSA accounts open even if they were no longer enrolled in HSAs at UHC.

Manning et al. (1987) using RAND HIE data (-0.2), the absolute value for both was much less than one, implying very inelastic demand with respect to the price change.

Our findings have implications for employers. As more employers consider offering CDHPs to their employees, HSAs seem to provide better control of costs than HRAs. Meanwhile, as many employers are looking at full replacement CDHPs, our results suggest that full replacement may not be worthwhile because there may be no saving (in HRAs), or the saving is relatively small (in HSAs). In fact, a trend in favor of HSAs has been observed in UHC's member population. While HSA members accounted for 37% of the CDHP members in 2006, the first follow-up year of this study, HSA market penetration increased to 52% of the CDHP population in 2011. This shifting toward HSA enrollment suggests that employers adding CDHPs are adding HSAs mostly, existing HRA employers are switching to HSAs, and more employers are offering full replacement HSAs.

**Limitations**

Caution should be taken in generalizing our results to large employers offering only traditional plans or using other insurance carriers and to small groups. Employers included in this study offered CDHPs either as a choice or as a full replacement plan in 2006, after offering only traditional plans in 2005. We did not include a cohort of employers that offered only traditional plans from 2005 through 2009. Although our employers were from different regions and different industries, all firms offered UHC products, which could be different from the products of other health insurers. Another limitation of this study is that we did not have information on whether firms offered plans

from other carriers. That being said, our study still provides generalizeable results in the sense that more than 20% of CDHP members nationally are covered by UHC, large groups account for nearly 90% of the UHC CDHP population, and employers commonly offer insurance product(s) from a single insurer.

**Table 2-1. Sample Size by Cohort by Year**

| Cohort | Full Replacement HRAs | Full Replacement HSAs | Optional HRAs | Optional HSAs | Optional Traditional Plans | Total |
|---|---|---|---|---|---|---|
| # of Members (% of Total Members in That Year) | | | | | | (% of Members in 2005 and 2006) |
| Year 2005 and 2006 | 2,784 (2%) | 10,021 (7%) | 3,556 (3%) | 11,501 (8%) | 114,401 (80%) | 142,263 (100%) |
| Year 2007 | 2,296 (2%) | 8,857 (8%) | 3,053 (3%) | 10,014 (9%) | 86,362 (78%) | 110,581 (78%) |
| Year 2008 | 1,939 (3%) | 4,646 (6%) | 2,238 (3%) | 8,371 (11%) | 57,059 (77%) | 74,253 (52%) |
| Year 2009 | 631 (1%)[20] | 4,169 (7%) | 2,009 (3%) | 6,814 (11%) | 45,877 (77%) | 59,500 (42%) |

[20] Two full replacement HRA employers terminated their contracts in 2009.

**Table 2-2. Descriptive Analysis of Study Population in Baseline Year (2005)** [21]

| **Cohort** | Full Replacement HRA (N=2,784) | Full Replacement HSA (N=10,021) | Optional HRA (N=3,556) | Optional HSA (N=11,501) | Optional Traditional Plans (N=114,401) |
|---|---|---|---|---|---|
| Age (Mean)*** | 35 | 35 | 34 | 33 | 35 |
| Female (%) *** | 47% | 52% | 50% | 46% | 50% |
| Risk Score (Mean)*** | 1.2 | 1.3 | 0.9 | 0.8 | 1.2 |
| Expenditure (Mean)*** | $2,683 | $2,807 | $1,945 | $1,863 | $2,974 |
| Family Contract (%)*** | 78% | 79% | 77% | 83% | 78% |
| Residence Region (%)*** | | | | | |
| Midwest | 49% | 81% | 29% | 8% | 18% |
| Northeast | 10% | 2% | 3% | 9% | 12% |
| South | 32% | 14% | 51% | 29% | 40% |
| West | 9% | 3% | 17% | 54% | 31% |
| Per–Capita Income by Zip Code (Mean) *** | $23,663 | $28,188 | $23,245 | $28,462 | $27,071 |
| When Employers Offered Optional CDHPs | | | | | |
| Employers Offered Only Optional HRAs But Not HSAs | NA | NA | $23,904*** | NA | $25,025 |
| Employers Offered Only Optional HSAs But Not HRAs | | | NA | $28,411 | $28,217 |
| Employers Offered Both Optional HRAs and HSAs | | | $21,413*** | $31,240*** | $24,913 |

[21] *** p<.0001. Chi-squared tests were used for discrete variables. Analysis of variance (ANOVA) was used for continuous variables.

## Table 2-3. Benefit Design Characteristics in 2006[22]

| Cohort | Full Replacement HRA (N=2,784) | Full Replacement HSA (N=10,021) | Optional HRA (N=3,556) | Optional HSA (N=11,501) | Optional Traditional Plans (N=114,401) |
|---|---|---|---|---|---|
| Employer Contribution *** [23] | | | | | |
| Mean (Median) | | | | | |
| Individual | $613 ($500) | $772 ($500) | $674 ($700) | $644 ($523) | $0 |
| Family | $1,230 ($1,000) | $1,613 ($1000) | $1,903 ($2,300) | $996 ($1,100) | $0 |
| Total | $943 ($1,000) | $1,168 ($505) | $1,323 ($1,000) | $835 ($600) | $0 |
| Deductible Mean*** (Median) | | | | | |
| Individual | $1,610 ($1,500) | $2,043 ($2,000) | $1,863 ($2,000) | $2,778 ($2,850) | $536 ($300) |
| Family | $3,041 ($3,000) | $4,079 ($4,000) | $3,910 ($4,000) | $3,548 ($3,600) | $1,374 ($900) |
| Member Coinsurance For Hospital Admission (%)*** | | | | | |
| 0% | 40% | 96% | 17% | 16% | 32% |
| 10% | 43% | 3% | 36% | 77% | 36% |
| 20% | 17% | 1% | 47% | 6% | 32% |
| Office Visit Copayment Mean***(Median) | $2 ($0) | $5 ($0) | $7 ($0) | $2 ($0) | $16 ($20) |
| 100% Preventive Care Coverage (%) [24] *** | 92% | 60% | 87% | 87% | 25% |

[22] *** p<.0001

[23] Employer contribution amount was set to $0 for the traditional plans that did not have health care accounts.

[24] Zero co-payment and zero coinsurance.

**Table 2-4. Coefficient Estimates in Generalized Linear Models (GLMs) [25]**

| Parameter[26] [27] | Total Expenditure Est | CL | Sig | Plan Paid Est | CL | Sig | Member Paid Est | CL | Sig |
|---|---|---|---|---|---|---|---|---|---|
| Full Replacement HRA*Year 2006 | 0 | (-0.07,0.07) | | -0.01 | (-0.09,0.07) | | 0.54 | (0.48,0.6) | *** |
| Full Replacement HSA*Year 2006 | 0 | (-0.03,0.04) | | -0.04 | (-0.08,0) | * | 1.08 | (1.05,1.11) | *** |
| Optional HRA*Year 2006 | 0.09 | (0.02,0.15) | ** | 0.02 | (-0.05,0.09) | | 0.59 | (0.54,0.64) | *** |
| Optional HSA*Year 2006 | -0.06 | (-0.09,-0.02) | ** | -0.11 | (-0.15,-0.06) | *** | 0.8 | (0.77,0.83) | *** |
| Full Replacement HRA*Year 2007 | 0.14 | (0.07,0.22) | *** | 0.18 | (0.09,0.26) | *** | 0.48 | (0.41,0.54) | *** |
| Full Replacement HSA*Year 2007 | 0.03 | (-0.01,0.07) | | -0.02 | (-0.07,0.02) | | 1.05 | (1.01,1.08) | *** |
| Optional HRA*Year 2007 | 0.08 | (0.02,0.15) | * | -0.01 | (-0.08,0.06) | | 0.55 | (0.5,0.61) | *** |
| Optional HSA*Year 2007 | 0.09 | (0.05,0.12) | *** | 0.07 | (0.03,0.12) | *** | 0.75 | (0.72,0.78) | *** |
| Full Replacement HRA*Year 2008 | 0.08 | (0,0.16) | * | 0.05 | (-0.04,0.14) | | 0.39 | (0.33,0.46) | *** |
| Full Replacement HSA*Year 2008 | 0.01 | (-0.04,0.05) | | -0.06 | (-0.12,-0.01) | * | 0.93 | (0.89,0.97) | *** |
| Optional HRA*Year 2008 | 0.08 | (0.01,0.15) | * | 0.03 | (-0.05,0.11) | | 0.46 | (0.4,0.52) | *** |
| Optional HSA*Year 2008 | 0.08 | (0.04,0.12) | *** | 0.07 | (0.03,0.12) | ** | 0.67 | (0.64,0.71) | *** |
| Full Replacement HRA*Year | 0.23 | (0.11,0.35) | *** | 0.28 | (0.14,0.42) | *** | 0.39 | (0.29,0.49) | *** |

[25] * p<.05; ** p<.01; *** p<.001

[26] The omitted reference groups are the interactions of optional traditional group and year dummy variables.

[27] Employer fixed effects were included in the model but not reported in this table.

| Parameter[26] [27] | Total Expenditure Est | CL | Sig | Plan Paid Est | CL | Sig | Member Paid Est | CL | Sig |
|---|---|---|---|---|---|---|---|---|---|
| 2009 Full Replacement HSA*Year 2009 | 0.02 | (-0.03,0.06) | | -0.06 | (-0.11,0) | | 0.99 | (0.95,1.03) | *** |
| Optional HRA*Year 2009 | 0.16 | (0.08,0.23) | *** | 0.14 | (0.06,0.22) | *** | 0.41 | (0.34,0.47) | *** |
| Optional HSA*Year 2009 | 0.03 | (-0.01,0.07) | | -0.03 | (-0.08,0.02) | | 0.64 | (0.61,0.68) | *** |
| Age (Scaled by 10 Years) | 0.18 | (0.18,0.18) | *** | 0.19 | (0.18,0.19) | *** | 0.16 | (0.16,0.16) | *** |
| Male vs. Female | -0.09 | (-0.1,-0.08) | *** | -0.05 | (-0.06,-0.05) | *** | -0.11 | (-0.12,-0.11) | *** |
| Risk Score | 0.32 | (0.32,0.33) | *** | 0.33 | (0.32,0.33) | *** | 0.23 | (0.23,0.24) | *** |
| Income (Scaled by $10,000) | 0.02 | (0.02,0.02) | *** | 0.01 | (0.01,0.02) | *** | 0.03 | (0.03,0.04) | *** |
| Individual vs. Family | 0.02 | (0.01,0.03) | *** | 0.03 | (0.02,0.04) | *** | 0.02 | (0.01,0.03) | *** |
| Contract Contribution (Scaled by $1,000) | 0.02 | (0,0.03) | * | 0.03 | (0.01,0.05) | ** | -0.01 | (-0.02,0.01) | |
| Deductible (Scaled by $1,000) | -0.03 | (-0.04,-0.02) | *** | -0.04 | (-0.06,-0.03) | *** | 0.06 | (0.05,0.06) | *** |
| Coinsurance 10% (ref: 0%) | -0.01 | (-0.02,0) | | -0.04 | (-0.06,-0.03) | *** | 0.18 | (0.17,0.19) | *** |
| Coinsurance 20% (ref: 0%) | -0.02 | (-0.03,0) | * | -0.08 | (-0.09,-0.06) | *** | 0.33 | (0.32,0.34) | *** |
| Office Visit Copay (Scaled by $10) | -0.03 | (-0.04,-0.03) | *** | -0.03 | (-0.04,-0.03) | *** | -0.06 | (-0.07,-0.06) | *** |
| Preventive Care Coverage | -0.09 | (-0.11,-0.06) | *** | -0.1 | (-0.12,-0.07) | *** | 0.03 | (0.01,0.05) | ** |
| Cohort (ref: Traditional) | | | | | | | | | |
| Full Replacement HRA | -0.15 | (-0.33,0.03) | | -0.15 | (-0.36,0.07) | | 0.16 | (0,0.31) | * |
| Full Replacement HSA | -0.37 | (-0.51,-0.24) | *** | -0.38 | (-0.54,-0.23) | *** | -0.33 | (-0.45,-0.21) | *** |
| Optional HRA | -0.22 | (-0.27,-0.17) | *** | -0.23 | (-0.29,-0.18) | *** | -0.3 | (-0.35,-0.26) | *** |
| Optional HSA | -0.2 | (-0.23,-0.17) | *** | -0.14 | (-0.18,-0.1) | *** | -0.55 | (-0.58,-0.52) | *** |
| Year (ref: | | | | | | | | | |

| Parameter[26] [27] | Total Expenditure | | | Plan Paid | | | Member Paid | | |
|---|---|---|---|---|---|---|---|---|---|
| | Est | CL | Sig | Est | CL | Sig | Est | CL | Sig |
| 2005) | | | | | | | | | |
| Year2006 | 0.3 | (0.28,0.31) | *** | 0.33 | (0.32,0.34) | *** | 0.12 | (0.11,0.13) | *** |
| Year2007 | 0.42 | (0.41,0.43) | *** | 0.47 | (0.45,0.48) | *** | 0.24 | (0.23,0.25) | *** |
| Year2008 | 0.51 | (0.49,0.52) | *** | 0.55 | (0.53,0.56) | *** | 0.34 | (0.33,0.35) | *** |
| Year2009 | 0.59 | (0.58,0.6) | *** | 0.63 | (0.62,0.65) | *** | 0.42 | (0.41,0.43) | *** |
| Region (ref: Midwest) | | | | | | | | | |
| Northeast | -0.05 | (-0.07,-0.04) | *** | -0.07 | (-0.09,-0.05) | *** | 0.01 | (0,0.02) | |
| South | -0.02 | (-0.03,-0.01) | *** | -0.03 | (-0.04,-0.02) | *** | 0.05 | (0.04,0.06) | *** |
| West | -0.05 | (-0.06,-0.03) | *** | -0.04 | (-0.05,-0.02) | *** | -0.03 | (-0.04,-0.02) | *** |

**Table 2-5. Comparison of Full Replacement CDHPs and Optional CDHPs[28]**

| Comparison | Total Expenditure | | | Plan Paid | | | Member Paid | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Est** | **CL** | **Sig** | **Est** | **CL** | **Sig** | **Est** | **CL** | **Sig** |
| HRAs | | | | | | | | | |
| 2006[29] | -0.09 | (-0.18,0.01) | | -0.03 | (-0.13,0.08) | | -0.05 | (-0.13,0.03) | |
| 2007 | 0.06 | (-0.03,0.16) | | 0.19 | (0.08,0.3) | *** | -0.08 | (-0.16,0) | |
| 2008 | 0 | (-0.1,0.1) | | 0.02 | (-0.09,0.14) | | -0.07 | (-0.15,0.02) | |
| 2009 | 0.07 | (-0.06,0.21) | | 0.14 | (-0.02,0.29) | | -0.02 | (-0.13,0.1) | |
| Cohort Main Effect[30] | 0.08 | (-0.11,0.26) | | 0.09 | (-0.13,0.3) | | 0.46 | (0.3,0.62) | *** |
| HSAs | | | | | | | | | |
| 2006[31] | 0.06 | (0.01,0.11) | * | 0.06 | (0.01,0.12) | * | 0.28 | (0.24,0.32) | *** |
| 2007 | -0.06 | (-0.11,-0.01) | * | -0.1 | (-0.16,-0.04) | *** | 0.3 | (0.26,0.34) | *** |
| 2008 | -0.07 | (-0.13,-0.02) | * | -0.14 | (-0.21,-0.07) | *** | 0.26 | (0.21,0.31) | *** |
| 2009 | -0.01 | (-0.08,0.05) | | -0.02 | (-0.09,0.05) | | 0.35 | (0.3,0.4) | *** |
| Cohort Main Effect[32] | -0.17 | (-0.31,-0.04) | * | -0.24 | (-0.4,-0.09) | ** | 0.22 | (0.1,0.34) | *** |

[28] * p<.05; ** p<.01; *** p<.001

[29] The comparison is between interaction of full replacement HRAs with a specific year and interaction of optional HRAs with the same year.

[30] The comparison is between the main effects of full replacement HRA cohort and optional HRA cohort.

[31] The comparison is between interaction of full replacement HSAs with a specific year and interaction of optional HSAs with the same year.

[32] The comparison is between the main effects of full replacement HSA cohort and optional HSA cohort.

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# Chapter III: Do Consumer-Driven Health Plans Have Different Effects on Health Care Spending for People with Different Health Status?[33]

[33] I co-authored this article with Dr. Roger Feldman and Dr. Stephen T. Parente

Consumer-driven health plans (CDHPs) represent an increasing proportion of private health plan members in the United States. In CDHPs, members have a personal care account from which they pay for their health care services. Once the account is exhausted, members are fully responsible for their care until a deductible is met. After that, members are either fully or partially responsible for their care costs until an out-of-pocket maximum is met.

One prevailing CDHP model is the Health Reimbursement Arrangement (HRA). In HRAs, the employer contributes to the account (e.g., $500~$1000 for individual contracts and $1,000~$2,000 for family contracts). The unused portion of the account rolls over into the following year if employee stays enrolled in the HRA. HRAs do not require a high-deductible health plan, though the deductible is often twice the employer's account contribution. HRAs are not portable in the sense that employees will lose the money in the HRA if they discontinue employment or change health plans. The national enrollment in HRAs was estimated to be eight million people in 2010 (Fronstin 2010).

Although several studies have estimated the effect of enrolling in a CDHP on expenditures (Parente, Feldman, and Christianson, 2004a and 2004b; Feldman, Parente, and Christianson, 2007; Parente, Feldman, and Chen 2008; Lo Sasso, Shah, and Frogner 2010), very few have studied whether the incentives created by the CDHP budget constraint vary for different types of people. The first study of this aspect was conducted by Feldman and Parente (2010). Using four years of claims data from a single employer that provided an HRA and traditional plans, Feldman and Parente compared spending among low-risk versus high-risk enrollees in the CDHP and traditional plans. They

measured health status by the employee's predicted medical spending in the year prior to the CDHP offering. The authors found that CDHP enrollees with low predicted spending spent less in the three years after the CDHP was introduced than the comparison groups that stayed in the traditional health plans. They also found that CDHP enrollees with high predicted spending spent more than their comparable groups of traditional-plan enrollees in the post-CDHP years. The authors concluded that healthy CDHP enrollees saved part of the account to pay for future medical contingencies. Their study aligned with theoretical models of medical care demand in high-deductible health plans (Keeler, Newhouse, and Phelps, 1977). But in contrast to the theoretical models that explain consumers' behavior in a single account period depending on how much they have already spent and how many days are left in the period, Feldman and Parente's study explained behavior over several accounting periods.

Understanding whether CDHPs have different impacts on spending for different types of people is important for employers and insurers. As the only type of health insurance plan that grew in 2010 (AAPPO 2011), more people switched to CDHPs than left them. If CDHPs are more effective for certain types of people, employers and insurers should take this into consideration before offering such insurance products to members. In the current study, we use a multi-year model in which low-risk CDHP enrollees facing uncertain health status in subsequent years will save part of their HRAs in the current year to pay for future health care when they get sick. Our work improves on Feldman and Parente's study by examining five years of claims data for a group of large

employers that provide a variety of benefit designs. Having employers with different characteristics is a unique aspect of our study.

## Methods

### *Conceptual Framework*

This study builds on the original work of Feldman and Parente (2010), which developed a multi-period model in which low-risk CDHP enrollees choose present and future health care spending subject to a "kinked" CDHP budget constraint. The authors separated enrollees into three risk groups (low, medium, high) corresponding to their predicted medical care spending in the year before CDHP was introduced. The current research identified one more risk group by introducing another kink in the CDHP budget constraint. Our conceptual framework for the multi-year model is illustrated in Figure 3-1. Initially, assuming there is only one year of enrollment, the CDHP budget constraint is *abcde*, where:

- *ab* is the CDHP account;
- *bc* is the out-of-pocket expense after the account is exhausted but before the annual deductible[34] is met;
- *cd* represents the enrollee's responsibility, i.e., coinsurance[35], after deductible is met but before the annual out-of-pocket maximum is met;

[34] The amount a member pays toward certain covered health services before the health insurance company pays toward the care. If more than one person in a family is covered under the policy, a family annual deductible applies. No one in the family is eligible to receive benefits until the family annual deductible is satisfied.

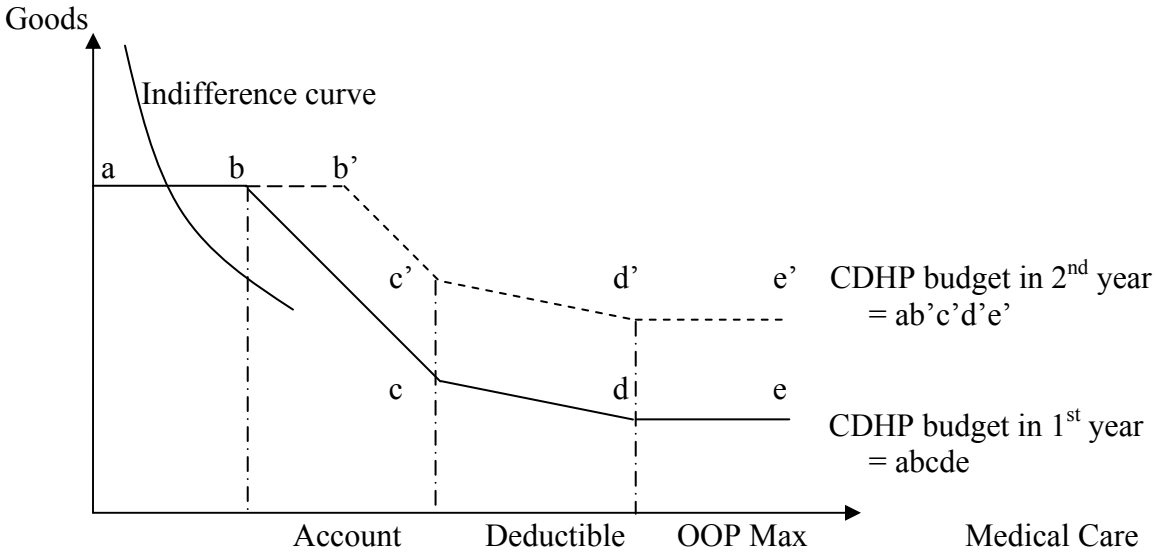
- *de* is the member's budget after the out-of-pocket maximum (OOPM[36]) is met.

Segment *cd* will be horizontal if the major medical insurance policy has no coinsurance. When there is coinsurance, segment *cd* has a downward slope but not as steep as *bc* because normally members are responsible for a fraction of the medical care cost. The distinction between *cd* and *de* will be small if the coinsurance rate is low, which makes *cd* not very different from the "free care" in *de*. In our study population, over one-third of the HRA and traditional plan enrollees had 20% coinsurance, suggesting that the incentives created by HRAs in region *cd* might be different for enrollees in region *de*.

[35] The percentage of eligible expenses payable by members for covered health services after members meet the annual deductible.

[36] Once a member reaches the OOPM, benefits for covered health services that apply to the OOPM are payable at 100% of eligible expenses during the rest of that calendar year. If more than one person in a family is covered under the policy, the family OOPM applies.

**Figure 3-1: CDHP Budget Constraint**




When there is more than one year of enrollment, healthy enrollees might think about staying in region *ab* instead of spending the whole account in the first year. Since the account can be rolled over to the following year, there is an opportunity cost to spending from the account in the first year – if a member saves *bb'* dollars in the first year, she can use it in the second year if she gets sick. This amount of savings extends the CDHP budget constraint in the second year to *ab'c'd'e'*. The gap between the account and the deductible becomes *b'c'*, compared with *bc* in the first year. The amount saved in year one *bb*' can be used to pay for health care at a later time. On Figure 3-1, although the indifference curve cuts the budget constraint, a healthy enrollee acts as if the budget slopes downward in the first year, even in the ab segment. Thus the enrollee acts as if an indifference curve is tangent to the budget constraint.

In the theoretical model, we expect that CDHP enrollees who spend less than their accounts in the first year (i.e., those who are in region *ab*) should act as if the last unit of medical care is costly and they will save some money for the following year. CDHP enrollees who spend more than their account but less than the deductible in the first year (i.e., region *bc*) should use medical care as if the marginal cost of last unit is one dollar. For CDHP enrollees who spend more than their deductible but less than the out-of-pocket maximum in the first year (i.e., region *cd*), there are two possibilities: if there is no coinsurance, CDHP enrollees should act as if the marginal unit of medical care is free; if there is coinsurance, CDHP enrollees should act as if the marginal cost of last unit is less than one dollar but not free. CDHP enrollees who spend more than their out-of-pocket maximum in the first year (i.e., region *de*) should act as if the marginal cost of the last unit of medical care is free.

We predict that CDHPs are more effective than traditional plans at controlling cost for healthy low-risk enrollees. We examine this prediction by estimating whether CDHP enrollees predicted to be in region *ab* spend less than their counterparts in traditional plans. We expect that high-risk enrollees, i.e., employees predicted to be in regions *bc*, *cd*, and *de*, will have comparable spending in CDHPs and traditional plans. For easier reference, we label region *ab* as the "low-risk", region, *bc* as "medium-low risk", *cd* as "medium-high risk", and *de* as "high-risk" hereinafter.

### *Study Setting*

We used a retrospective pre-post cohort design. The study population was originally created in 2007 for a two-year (2005 and 2006) drug adherence study (Chen,

Levin, and Gartner 2010) and was extended to a five-year cohort study (Chen, Feldman, and Parente 2010). A total of 12 employers were identified from the large group market at UnitedHealthcare (UHC), a national health insurer that provides insurance products to nearly 25 million members, including 1.8 million HRA members. In 2005, all 12 employers offered traditional plans (Preferred Provider Organization (PPOs), Point of Service (POSs), or Exclusive Provider Organization (EPOs))[37] to their employees. These traditional plans had relatively low in-network annual deductibles (e.g., the average individual deductible was $500~$600) in 2005. Starting in 2006, these employers offered HRAs to their employees either as options (eight employer) in addition to traditional plans or as full replacement (four employers) for traditional plans. Although it is possible that an employer offered health plans from other insurers than UHC to its employees, such information was unavailable to us.

***Member Selection and Cohort Assignment***

All members were enrolled in a traditional plan in the baseline year, 2005. Members were assigned to two mutually exclusive study cohorts depending on the insurance plan they enrolled in during the post-CDHP years: a CDHP cohort if a member switched to an HRA in 2006 and then continuously enrolled in an HRA;[38] or a traditional plan cohort if a member continuously enrolled in a traditional plan[39].

[37] Some employers offered more than one PPO, POS, or EPO plan. One employer also offered an indemnity plan (a fee-for-service plan that does not use a network of preferred providers) in 2005 and 2006 with only a very small number of enrollees (64 member-months in 2005 and 82 member-months in 2006). We did not include this indemnity plan in our study.
[38] An employer could offer more than one HRA. Members who switched to another HRA after 2006 were included in the CDHP cohort.
[39] Members who switched among traditional plans were included in the traditional plan cohort.

Members who were older than 64 years of age on December 31, 2006, who did not have both medical and pharmacy coverage, or who used health plans from other insurers than UHC[40] were excluded from this study. Members were required to be continuously enrolled for 24 months in 2005 and 2006. We extended this two-year cohort in 2010 by checking members' eligibility for each cohort annually. For a specific year and a specific cohort, a member would be continuously eligible if s/he stayed in the same type of plan (HRA or traditional plan) in that year as s/he did in 2006, had 12 months enrollment in medical and pharmacy coverage in that year, and also met the requirement for age and not using multiple insurers. If a member became ineligible for that cohort, the outcome measures would not apply for that year for that member. In rare cases a member became eligible again after losing his or her eligibility[41].

Next, we collapsed members to contracts, also referred to as households or subscribers, who can be a family or an individual. The original cohort had 19,365 contracts, including 2,054 enrolled in HRAs and 17,311 in traditional plans. We lost study subjects due to ineligibility, e.g., contracts changed jobs or switched health plan types (Table 3-1). The sample size decreased to 12,992 in 2007, representing 67% of the original population, to 7,532 in 2008 (39% of the original population) and to 6,274 in 2009 (32% of the original population)[42]. The distribution of contracts between CDHPs

[40] Such members were flagged by a COB (coordination of benefit) indicator in the member profile table. These members were excluded due to the unavailability of claims from other insurers.
[41] Of those who were ineligible in 2007, 1% became eligible again in 2008 and 1% became eligible again in 2009. Of those who were ineligible in 2008, 0.5% became eligible again in 2009.
[42] We compared "droppers" with contracts who remained in the study. The two groups had similar age, co-morbidity risk, and gender distributions.

and traditional plans was consistent across years. The proportion of traditional plan contracts was 89% in 2005 and 2006, 86% in 2007, and 83% in 2008, and 88% in 2009.

### *Explanatory Variables and Outcome Measures*

We constructed all explanatory variables at the employee contract level. The contract-holding employee's age[43] and gender were obtained from UHC's member profile table. We distinguished family contracts (total number of members>1) from individual contracts. We used the average per-capita income by zip code as a proxy for the employee's income because this information was not available in the member profile table (U.S. Census Bureau 2010). We assigned each contract to a geographic region (Midwest, Northeast, South, West) defined by the Census Bureau by matching to the state of a subscriber's residence. We also controlled for employer fixed effects.

The maximum co-morbidity risk scores at the contract level in the baseline year were computed with ERGs (Episode Risk Groups) using enrollment data and medical and pharmacy claims. ERG is a derivative of the ETGs (Episode Treatment Groups) methodology, a widely used software product for illness classification and episode building[44]. Co-morbidity risk scores measured the relative resources that were expected to be required for health care. High risk scores imply more illness burden. The literature reports that ERG risk scores highly correlate with other risk-adjusted measures of practice efficiency, such as ACG (Adjusted Clinical Groups), BOI (Burden of Illness Score), CCI (Clinical Complexity Index), DCG (Diagnostic Cost Groups), and GDG (General Diagnostic Groups) (Thomas, Grazier, and Ward 2004).

[43] Integer between a member's date of birth and December 31, 2006.
[44] ERGs are a product of Ingenix, a subsidiary of UnitedHealthcare.

We also controlled for contract-level benefit design characteristics in 2006, including the employer account contribution, deductibles, coinsurance rate after the deductible is met, copayment for office visits, and whether or not a contract had 100% preventive medical care visits (zero copayment and zero coinsurance), which often include physician office services such as routine physical examinations, cancer screening, well-baby and well-child care, vision and hearing screenings, and immunizations. The employer account contribution was set to $0 for the traditional plans that did not have health care accounts.

Our outcome measures are the annual contract-level health care expenditure and its break-down by medical and pharmacy expense. We used five years of claims data: spending in the baseline year was used to predict the probabilities that a member fell in each of the risk regions; the remaining four years of spending (2006-2009) were used to examine the impact of CDHP enrollment on spending in each risk region. More details of our empirical approach are described in the next section.

***Empirical Approach and Statistical Analysis***

Our theoretical model predicts that CDHPs are more effective than traditional plans at controlling costs for healthy people and are equally effective for people with higher risks. In our empirical approach, we control for health status differences by using claims data from the baseline year, when all employees were in the traditional plans, to predict baseline spending at the employee contract level. The predicted baseline spending controls for the effects of observed health conditions, as well as the permanent

but unobserved effects of cohort membership, on subsequent health care spending. Our empirical work was implemented in four steps.

First, we predicted baseline health care spending by estimating a multivariate regression model for the natural logarithm of baseline expenditure, measured as the total paid amount in 2005. We set contracts with zero total paid amounts in the baseline year (n=1,555, 8% of 19,365 contracts) equal to $5. After this adjustment, the average paid amount was $6,586. In the regression model we controlled for the cohorts as well as the explanatory variables described in the previous section (except for the benefit design characteristics in 2006). The coefficient estimates of this model represent the association of explanatory variables and baseline expenditure. For instance, if the coefficient estimate for an explanatory variable is positive, it suggests this variable is associated with higher spending, and vice versa. We kept the predicted natural logarithm of the total paid amount ($\hat{Y}$) and the standard error of the mean predicted value ($SE(\hat{Y})$) produced by the regression model. Both values would be used in the following step.

Next, we predicted the probability that each contract would fall in to each of the four spending regions in the baseline period according to the formulae (1):

$$\text{P1} = \text{P(low-risk)} = \text{P}\left( z < \frac{K_1 - \hat{Y}_i}{SE\left(\hat{Y}_i\right)} \right)$$

$$\text{P2} = \text{P(medium-low-risk)} = \text{P}\left( \frac{K_1 - \hat{Y}_i}{SE\left(\hat{Y}_i\right)} < z < \frac{K_2 - \hat{Y}_i}{SE\left(\hat{Y}_i\right)} \right)$$

(1)

$$\text{P3} = \text{P(medium-high-risk)} = \text{P}\left( \frac{K_2 - \hat{Y}_i}{SE\left(\hat{Y}_i\right)} < z < \frac{K_3 - \hat{Y}_i}{SE\left(\hat{Y}_i\right)} \right)$$

P4 = P(high-risk) = 1 - P(low-risk) - P(medium-low-risk) - P(medium-high-risk)

where $\hat{Y}_i$ is the predicted natural logarithm of total spending for the $i_{th}$ contract and $SE(\hat{Y}_i)$ is the standard error of that prediction, both obtained from the regression model in the first step. $K_1$, $K_2$ and $K_3$ are the natural logarithms of the CDHP "kinks", namely, account contribution, deductible, and out-of-pocket maximum, derived from the contract-level plan characteristics. We calculated the median value of account contribution, deductible, and out-of-pocket maximum for all contracts in all employers by contract type and inserted this median value into formulae (1). Each contract would have four probabilities, one for each region, and the four probabilities added up to one.

Next, we compared whether the cohorts had statistically equal probability of spending in each region (e.g., mean P1 of CDHPs vs. mean P1 of traditional plans). We used unequal variance t-tests for those pair-wise comparisons without multiplicity adjustment, where the standard errors associated with the means of the probability were obtained from bootstrap sampling based on 1,000 random samples with replacement.

In the fourth step, we identified the impact of CDHP enrollment on health care spending with data from 2006 through 2009 by estimating generalized linear models (GLMs) that specified a Gamma distribution and a log link. With the log link in GLM, this effect can be interpreted directly without transforming the estimates from logarithms back to the original scale (Buntin and Zaslavsky 2004). The effects of enrolling in CDHPs on costs for a particular risk group are captured by interacting the probability of spending in each region with cohort indicators, e.g., P1*CDHP vs. P1*Traditional

plans[45]. Our model controlled for the main effect of time (2007 through 2009 compared with 2006 (omitted year)) and cohort, as well as the explanatory variables described in the previous section.

We fitted different GLM models for total, medical, and pharmacy paid amounts. We analyzed the data this way because the plans have different designs on whether pharmacy services are subject to the same deductible as medical services. By default, traditional plans have separate deductibles. In HRAs, it is case by case. The association between risk status and CDHP enrollment therefore might be different for medical and pharmacy expenses. All analyses were conducted with statistical software SAS 9.1™ (Cary, NC).

## Results

CDHP enrollees had similar age, gender distribution, and family size to traditional plan enrollees (Table 3-1) but were measurably healthier (risk score 1.6 vs. 2.0) and spent less in the baseline year ($5,031 vs. $6,771), suggesting a favorable CDHP selection by health status. CDHP enrollees came from areas with comparable per-capita income to traditional plan enrollees.

### *Predicting Baseline Expenditure*

Table 3-2 presents the regression model for the natural logarithm of the paid amount in the baseline year. The estimated coefficients of contract-holder's age, female, average income in the zip code of residence, family contract, and living in regions other

[45] We did not estimate a separate CDHP effect for each year (e.g., P1*CDHP*2006) because our research question was whether the CDHP effect varied by health status, not how this effect varied by time.

than West (reference group) were all positive, suggesting that these factors were associated with higher spending. The highest risk score in the contract also has a positive effect on spending. Each unit increase of risk score was associated with 46% ($e^{.37} - 1 = .46$) higher spending. The estimated coefficient of the HRA (-.25) cohort indicator was negative, suggesting favorable selection into those plans compared with the traditional plans.

***CDHP Kinks and Plan Characteristics***

The top half of Table 3-3 shows the CDHP kinks. The median account contribution (*K1*) was $600 individual/$1,400 family in HRAs. The median deductible (*K2*) was higher in HRAs ($2,000 individual/$3,500 family) than that in traditional plans ($250 individual/$750 family). The average gap between the mean account contribution and the mean deductible (i.e., segment *bc* in Figure 3-1) was bigger in HRAs than the deductibles in traditional plans, suggesting that HRAs were less generous[46] than traditional plans in terms of higher deductibles, even after adjusting for the account contribution in CDHPs.

The median out-of-pocket maximum (*K3*) was also higher in HRAs ($2,250 individual/$6,000 family) than that in traditional plans ($1,500 individual/$3,000 family). The average gap between the mean deductible and the mean out-of-pocket maximum (i.e., segment *cd* in Figure 3-1) was bigger in HRAs than in traditional plans, suggesting that HRAs had less generous benefits after the deductible was met. The average gap between the contribution and out-of-pocket maximum was also higher in HRAs than in

[46] From a personal communication with a UHG chief actuary, the insurance premiums are 15-20% lower in CDHPS than in traditional plans. However, premium information was not available to the researchers.

traditional plans, suggesting that HRAs had higher out-of-pocket limits even after adjusting for the account contribution.

The bottom half of Table 3-3 shows the other plan design characteristics that were used as control factors in modeling the CDHP effects (more details in next section). Copayment was slightly higher on average in the traditional plan cohort ($10) than in the HRA cohort ($8). It is noteworthy that while 75% of CDHP contracts had zero copayment for office visits, but 15% had $30 or higher copayment. Coinsurance was higher in the HRA cohort than in the traditional plan cohort. Only 12% of the HRA contracts had 0% coinsurance, while over 41% of the traditional plan contracts had 0% coinsurance, again suggesting that HRAs might have less generous benefits after the deductible is reached. CDHP contracts also were more likely to have free preventive care coverage (83%) than traditional plan contracts (55%).

The average probabilities of members falling in each risk region and the standard deviations based on 1,000 bootstrapped random samples with replacement are shown in Table 3-4. On average, contracts had higher probabilities of being in Region 1 and 2 than in other regions. Across cohorts, the HRA cohort had higher probability of spending in Region 1, suggesting favorable risk selection into the HRAs.

### *Impact of CDHP Enrollment on Spending*

The coefficient estimates from the generalized linear models are shown in Table 3-5. Consistent with predictions of our theoretical model, low-risk CDHP contracts spent 18% less than low-risk traditional plan contracts. Spending was not statistically different

between medium-low, medium-high, and high-risk HRA contracts and traditional plan contracts with comparable health status.

The impact of enrolling in HRAs on medical and pharmacy expenses had the same direction as that on total expense. Compared with traditional plan contracts with the same risks, low-risk HRA contracts spent 17% less on medical care and 19% less on pharmacy services. Medium-low, medium-high, and high-risk HRA contracts spent the same on medical care and pharmacy. The only exception was that high-risk HRA contracts spent 16% more on pharmacy.

Other controlled factors affected expenditures in different ways. Age, female gender, average income in the zip code of residence, family contract, and risk burden were positively related to total health care expenditure. Deductible, coinsurance, copayment, and free wellness visits had negative impacts on total expenditure, suggesting that cost-sharing and generous coverage of preventive care were associated with lower health care spending.

**Discussion**

Our empirical analysis suggests that the effect of CDHP enrollment differs for people with different health status. Our most important finding is that CDHP contracts with a high probability of spending less than the account in the baseline year (i.e. low risks) spent less in following years than comparable groups that remained in the traditional health plans. We found this difference in all service categories: total expenditure, medical expenditure, and pharmacy expenditure. This finding supports the prediction from our theoretical model that healthy CDHP enrollees will behave as if

spending from the accounts has a positive opportunity cost though they face zero cost-sharing before the accounts are exhausted, and they will save their account to pay for future medical use. We also found that medium-low, medium-high, and high-risk HRA contracts had comparable health care spending with their peer groups in traditional plans, and high-risk HRA contracts tend to spend more on pharmacy. Our findings agree with Feldman and Parente's study (2010).

Overall, our results indicate that analyses of costs and utilization in CDHPs should distinguish where an enrollee is likely to be located on the CDHP budget constraint. Theoretical and empirical CDHP effects are not the same for all enrollees. These differences need to be recognized in future research.

Our findings have implications for employers and insurers. Employers can examine the claims for a prior year before offering a CDHP. If a majority of employees have low risks, offering a CDHP might reduce health care costs compared with the traditional plans. However, if most of the employees have relatively high risks, it might not be worthwhile to offer a CDHP. As more employers are offering CDHPs to fully replace the traditional plans, do CDHPs really save money? Insurers might want to check the case-mix of the employer's member population before recommending what plan to offer.

**Table 3-1. Sample Size and Descriptive Analysis of Study Population (n=19,365) [47]**

| Cohort | CDHPs | Traditional Plans |
|---|---|---|
| Sample Size (% Total) | | |
| Year 2005 and 2006 (N=19,365) | 2,054 (11%) | 17,311 (89%) |
| Year 2007 (N=12,992) | 1,762 (14%) | 11,230 (86%) |
| Year 2008 (N=7,532) | 1,285 (17%) | 6,247 (83%) |
| Year 2009 (N=6,274) | 759 (12%) | 5,515 (88%) |
| Baseline Descriptive Factors | | |
| Employee's Age (Mean)*** | 45 | 46 |
| Female (%) | 34% | 33% |
| Baseline Year (2005) Risk Score *** | 1.6 | 2.0 |
| Baseline Year (2005) Expenditure *** | $5,031 | $6,771 |
| Per Capita Income by Zip Code (Mean) | $24,108 | $24,446 |
| Individual Contract (%) | 48% | 46% |
| Members in Family Contract | 3.13 | 3.06 |
| Residence Region (%)*** | | |
| Midwest | 26% | 21% |
| Northeast | 8% | 8% |
| South | 48% | 28% |
| West | 18% | 43% |

[47] *** p<.0001

**Table 3-2. Baseline Spending Model Dependent Variable = Ln($Paid Total)[48]**

| Parameter (N=66,078) | Estimate | StdErr | tValue | Probt |
|---|---|---|---|---|
| Intercept | 4.77 | 0.22 | 21.33 | <.0001 |
| CDHP vs. Traditional Plan | -0.25 | 0.05 | -4.96 | <.0001 |
| Age (Scaled by 10 years) | 0.22 | 0.01 | 17.27 | <.0001 |
| Female vs. Male | 0.58 | 0.03 | 21.11 | <.0001 |
| Co-morbidity Score | 0.38 | 0.00 | 76.2 | <.0001 |
| Income (Scaled by $10k) | 0.08 | 0.01 | 5.42 | <.0001 |
| Region (ref: West) | | | | |
| Midwest | 0.09 | 0.04 | 2.27 | 0.0235 |
| Northeast | 0.07 | 0.05 | 1.29 | 0.1975 |
| South | 0.08 | 0.04 | 2.03 | 0.0423 |
| Family vs. Individual Contract | 1.61 | 0.03 | 61.04 | <.0001 |

[48] Employer fixed effects were included in the model but not reported.

**Table 3-3. Plan Design Characteristics in 2006 (n=19,365)[49]**

| Cohort | CDHPs | Traditional Plans |
|---|---|---|
| CDHP Kinks Mean*** (Median) | n=2,054 | n=17,311 |
| Contribution (*K1*)*** [50] | | |
| Individual | $673 ($600) | $0 ($0) |
| Family | $1,645 ($1,400) | $0 ($0) |
| Deductible (*K2*)*** | | |
| Individual | $1,816 ($2,000) | $682 ($250) |
| Family | $3,546 ($3,500) | $1,708 ($750) |
| Out-of-pocket Maximum (*K3*)*** | | |
| Individual | $3,131 ($2,250) | $1,782 ($1,500) |
| Family | $6,298 ($6,000) | $3,852 ($3,000) |
| Other Benefit Characteristics | | |
| Copay for Office Visits Mean*** (Median) | $8 ($0) | $10 ($10) |
| Coinsurance after Deductible Is Met (%***) | | |
| 0% | 12% | 41% |
| 10% (including 15%) | 52% | 13% |
| 20% | 36% | 46% |
| 100% Preventive Care Coverage (%***) [51] | 83% | 55% |

[49] *** p<.0001

[50] Only the employer contributes to an HRA. Contribution amount was set to $0 for the traditional plans that did not have health care accounts.

[51] Zero co-payment and zero coinsurance.

**Table 3-4. Predicted Baseline Spending Regions by Cohort (n=19,365)**

| Mean | P1 | P2 | P3 | P4 |
|---|---|---|---|---|
| CDHPs (n=2,054) | | | | |
| Mean | 0.42 | 0.36 | 0.10 | 0.12 |
| Standard Deviations | 0.88 | 0.40 | 0.12 | 0.17 |
| Traditional Plans (n=17,311) | | | | |
| Mean | 0.32 | 0.37 | 0.12 | 0.19 |
| Standard Deviations | 0.70 | 0.57 | 0.24 | 0.29 |
| Unequal Variance T-Test | 4.66 | -0.10 | -2.95 | -7.50 |

**Table 3-5. Coefficient Estimates in Generalized Linear Models (GLMs) [52]**

| | Total Expenditure | | | Medical Expenditure | | | Pharmacy Expenditure | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | Est. | SE | P-Value | Est. | SE | P-Value | Est. | SE | P-Value |
| Intercept | 7.25 | 0.10 | <.0001 | 7.17 | 0.11 | <.0001 | 5.23 | 0.10 | <.0001 |
| CDHP Effect By Health Status | | | | | | | | | |
| P1*CDHP | -0.18 | 0.05 | <.0001 | -0.17 | 0.05 | 0.0006 | -0.19 | 0.05 | <.0001 |
| P2*CDHP | 0.00 | 0.06 | 0.9883 | -0.06 | 0.06 | 0.3191 | 0.10 | 0.06 | 0.0783 |
| P3*CDHP | -0.01 | 0.08 | 0.8533 | -0.07 | 0.09 | 0.3972 | 0.08 | 0.08 | 0.2802 |
| P4*CDHP | 0.11 | 0.07 | 0.1224 | 0.05 | 0.08 | 0.5337 | 0.16 | 0.07 | 0.0256 |
| Age (Scaled by 10 years) | 0.22 | 0.01 | <.0001 | 0.20 | 0.01 | <.0001 | 0.31 | 0.01 | <.0001 |
| Female vs. Male | 0.06 | 0.01 | <.0001 | 0.07 | 0.02 | <.0001 | -0.03 | 0.01 | 0.0149 |
| Income (Scaled by $10k) | 0.03 | 0.01 | <.0001 | 0.02 | 0.01 | 0.005 | 0.03 | 0.01 | <.0001 |
| Family vs. Individual Contract | 0.62 | 0.02 | <.0001 | 0.57 | 0.02 | <.0001 | 0.52 | 0.02 | <.0001 |
| Co-morbidity Score | 0.17 | 0.00 | <.0001 | 0.15 | 0.00 | <.0001 | 0.22 | 0.00 | <.0001 |
| Account Contribution (Scaled by $1,000) | 0.02 | 0.03 | 0.5923 | 0.04 | 0.03 | 0.2127 | -0.06 | 0.03 | 0.0348 |
| Deductible (Scaled by $1,000) | -0.02 | 0.01 | 0.001 | -0.02 | 0.01 | 0.0732 | -0.05 | 0.01 | <.0001 |
| Coinsurance (ref: 0%) | | | | | | | | | |
| 10% | -0.06 | 0.02 | 0.0155 | -0.08 | 0.03 | 0.001 | 0.06 | 0.02 | 0.0145 |
| 20% | -0.16 | 0.03 | <.0001 | -0.09 | 0.03 | 0.0045 | -0.10 | 0.03 | 0.002 |
| Copayment for Office Visits (Scaled by $10) | -0.09 | 0.01 | <.0001 | -0.07 | 0.02 | <.0001 | -0.14 | 0.01 | <.0001 |
| Preventive Care Coverage Yes vs. No | -0.18 | 0.03 | <.0001 | -0.20 | 0.03 | <.0001 | -0.20 | 0.03 | <.0001 |
| Year (ref: 2006) | | | | | | | | | |
| 2007 | 0.14 | 0.01 | <.0001 | 0.27 | 0.02 | <.0001 | 0.02 | 0.02 | 0.1978 |
| 2008 | 0.12 | 0.02 | <.0001 | 0.26 | 0.02 | <.0001 | 0.05 | 0.02 | 0.0083 |
| 2009 | 0.20 | 0.02 | <.0001 | 0.35 | 0.02 | <.0001 | 0.06 | 0.02 | 0.0015 |
| Region (ref: West) | | | | | | | | | |
| Midwest | 0.03 | 0.02 | 0.0895 | -0.01 | 0.02 | 0.6755 | 0.14 | 0.02 | <.0001 |
| Northeast | -0.03 | 0.02 | 0.1795 | -0.04 | 0.03 | 0.1182 | -0.04 | 0.02 | 0.115 |
| South | 0.03 | 0.02 | 0.1032 | -0.01 | 0.02 | 0.4639 | 0.16 | 0.02 | <.0001 |

[52] Employer fixed effects were included in the model but not reported.

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*Appendix 1-A: Medication Possession Ratio (MPR)*

Medication Possession Ratio (MPR) is the ratio of the number of days with a supply of medication to the total days under observation. This ratio is a continuous variable and it can be smaller than one (if the days of drug supply are less than the total days of observation) or greater than one (if the days of drug supply are more than the total days of observation). MPR is often recoded to a binary variable which is easier to understand. A patient is compliant (1) if his/her MPR is greater than a cut-off value (normally 0.7~0.8) and is not compliant (0) if MPR is less than that cut-off value. A commonly used cut-off point is 0.8 which is also used in the present study. For example, if a patient had a total of six 30-day refills of cardiac drugs during a year, her MPR was 0.5 (=6*30/365) for this drug class and she did not achieve the defined compliance threshold ($0.5 < 0.8$).

*Appendix 1-B: Grace Period to Define Discontinuation of Refills*

In practical refilling, patient may not refill their prescription on exactly the day after their current order is ended. If the refill date is later than the end date of the previous refill, a gap is formed between these the two refills. A long gap is not preferable for patients with chronic conditions because they should take medication continuously to better control their conditions. The grace period represents a maximally allowed gap between two consecutive refills that patients are considered having "continuous" drug supply. If the gap is longer than the grace period, a discontinuation is claimed to occur. The grace period is defined as half the supply days of a patient's first identified script in the present study. The grace period might be different from patient to patient. For instance, if a patient's first script had 30 days of supply and she refilled her second 30-day script on the 43$^{rd}$ day, and her third 30-day script on the 90$^{th}$ day, her grace period was 15 days and she discontinued after the 73$^{rd}$ (=43+30) day, because the gap between the second and the third script was greater than the grace period, 15 days.

*Appendix 1-C: Statistical Modeling*

We used a multivariate logistic regression model to compare whether the discontinuation rate was the same between CDHP and traditional plan cohort with formulae (1):

(1) Continuation in post-year (Y/N) = $\beta 0 + \beta 1 Cohort + \beta 1 Age + \beta 2 Gender + \beta 3 Pre\text{-}year\ risk\ score + \beta 4 Pre\text{-}year\ total\ days\ of\ continuous\ drug\ supply$

where the dependent variable was whether or not (Y/N) a patient with existing prescribing experience in the pre-year had refilled any prescriptions in a specific drug class in the post-year. The independent variables were cohort, age, gender, pre-year risk score, and pre-year total number of days with continuous drug supply. Some statisticians recommend that in logistic regressions, the sample size for each situation (e.g., continuation Y or N in both cohorts) should have least five events. For thyroid drugs, we had only four events of discontinuation in the CDHP cohort. Our estimation therefore might be biased for thyroid drugs because of the insufficient sample size.

We used an analysis of variance (ANOVA) model to evaluate whether the gap between the last refill in the pre-year and the first refill in the post-year was the same between CDHP and traditional plan cohort with formulae (2):

(2) Time to refill the 1st prescription in the post-year (# of days) = $\beta 0 + \beta 1 Cohort + \beta 2 Age + \beta 3 Gender + \beta 4 Pre\text{-}year\ risk\ score$

where the dependent variable was the gap in terms of number of days. The independent variables were cohort, age, gender, and pre-year risk score:

We used a difference-in-difference (DD) logistic regression model to examine whether the change of compliance from pre-year to post-year was the same between CDHP and traditional plan cohort with formulae (3):

(3) Compliance (Y/N) = $\beta 0 + \beta 1 Cohort + \beta 2 Year + \beta 3 Cohort*Year + \beta 4 Age + \beta 5 Gender + \beta 6 Pre\text{-}year\ risk\ Score$

In this model, each patient has two records: one for pre-year and one for post-year. The dependent variable was the compliance rate. The independent variables were cohort, year, interaction of cohort and year, age, gender, and pre-year risk score:

Finally, we used a Cox Proportional Hazard (CPH) model to examine whether the likelihood of discontinuing the drug supply was the same between CDHP and traditional plan cohort in the post-year with formulae (4).

(4) Post-year total days with continuous drug supply = $\beta 0 + \beta 1 Cohort + \beta 2 Age + \beta 3 Gender + \beta 4 Pre\text{-}year\ risk\ Score + \beta 5 Pre\text{-}year\ total\ days\ of\ continuous\ drug\ supply$

where the dependent variable was the number of days with continuous drug supply in the post-year. The independent variables were cohort, age, gender, pre-year risk score, and pre-year total number of days with continuous drug supply. The dependent variable was censored at 365 days. For each drug class, we have around 50% of patients who were censored (asthma: 46%; cardiac: 58%; diabetes: 56%; epilepsy: 47%; hypertension: 57%; cholesterol: 48%; RA: 41%; thyroid: 58%).