

DETERMINANTS AND EFFECTS OF PLAN SELECTION IN THE NON-GROUP HEALTH INSURANCE
MARKET

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ABSTRACT

Emily Meredith Gillen: Determinants and Effects of Plan Selection in the Non-Group Health Insurance Market
(Under the direction of Kristen Hassmiller Lich)

Effective 2014, the Patient Protection and Affordable Care Act (ACA) required US citizens to be enrolled in an adequate health insurance plan. To provide a platform where individuals could compare and purchase health plans deemed to provide sufficient levels of coverage, the ACA required states to establish (or allow the federal government to establish) health insurance Marketplaces. Plans qualified to be sold on the exchange had to adhere to ACA regulations, for example replacing medical underwriting with community modified premiums. In addition, federal assistance was available on a needs basis. As a result of ACA devised changes, the non-group health insurance market increased 211% from 2013 to 2015 (Carman, Eibner, & Paddock, 2015a).

The objectives of this research were to understand: (1) how consumers behaved in year one of the new health insurance Marketplaces; and (2) how they responded to plan benefits in the non-group health insurance market. This study utilized claims data from a large insurer with over 85% market share in the state non-group health insurance market (The Kaiser Family Foundation State Health Facts, 2013). I found individuals with advanced premium tax credits who were less healthy were more likely to use their credits to purchase more generous health plans. Individuals were more likely to access additional outpatient services after they reached their out-of-pocket maximum and self-selection into a narrow network plan had no impact on number of outpatient visits but did increase the percentage of visits with participating providers. Narrow network plans were associated with a reduction in out-of-pocket costs.

Historically, the non-group market has not often been studied, but it's becoming increasingly important (Nadash & Day, 2014; M. V. Pauly & Nichols, 2002; Sommers, 2014). With each year of operation the non-group market continues to grow and the Marketplaces continue to evolve. Industry leaders and policymakers need to understand the behavior of the unique consumers in this market in order to create future policies that preserve or increase access to quality care while containing costs.

Dedicated to my family

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LIST OF ABBREVIATIONS

ACA	The Patient Protection and Affordable Care Act
ACSCs	Ambulatory Care Sensitive Conditions
AHRQ	Agency for Healthcare Research and Quality
AIC	Akaike's Information Criterion
APTC	Advanced Premium Tax Credit
CHF	Congestive Heart Failure
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
CSR	Cost-Sharing Reduction
E&M	Evaluation and Management
ER	Emergency Room
FE	Fixed Effects
FPL	Federal Poverty Level
HSA	Health Savings Account
HDHP	High Deductible Health Plan
HMO	Health Maintenance Organizations
ICD-9 Codes	International Classification of Diseases, 9th revision, Clinical Modification codes
IP	Inpatient
MCC	Marginal Cost of Care
OOP Max	Out-of-Pocket Maximum
OP	Outpatient
OR	Odds Ratio
POS	Point of Service
PPO	Preferred Provider Organization
PQIs	Prevention Quality Indicators
QHP	Qualified Health Plan
QIC	Quasilielihood under the Independence Model Information

RAND HIE	RAND Health Insurance Experiment
REF	Reference Category
RE	Random Effects
RR	Risk Ratio
US	United States
VIF	Variance Inflation Factor

CHAPTER 1: DETERMINANTS AND EFFECTS OF PLAN SELECTION: OVERVIEW

Specific Aims

The Marketplaces established by the Patient Protection and Affordable Care Act (ACA) fundamentally altered the health insurance market by fostering a consumer-driven atmosphere and expanding the non-group market in an industry previously dominated by group purchasing. The Marketplaces were platforms through which consumers could compare qualified health plans (QHPs) being sold in the non-group health insurance market in their area. QHPs were health insurance plans that were certified as having met the regulations and standards of the ACA, such as limits on out-of-pocket spending, coverage of essential health benefits, and modified community rated premiums (Department of Health and Human Services, 2014). Additionally, the actuarial value of the QHPs had to align with ACA specified generosity levels represented by metal designations ("The Patient Protection and Affordable Care Act," 2010). Federal assistance, in the form of premium reducing tax credits and cost sharing reductions, was available to qualified individuals who enrolled in a QHP (Kaiser Family Foundation, 2012a). The ACA also required that QHPs extend benefits to all potential beneficiaries, regardless of any pre-existing conditions. Coverage of pre-existing conditions, modified community ratings, and premium subsidies attracted new entrants to the market who had previously been unable to purchase health insurance. The individual mandate, which required all US citizens to have adequate health insurance, also spurred new entrants to the market, perhaps some who had not previously been interested in health insurance coverage. Between 2013 and 2015, the non-group market expanded 211% from 8.5 million individuals to 17.9 (Carman et al., 2015a).

Not all individuals in the non-group market in 2014 were enrolled in a QHP. Although all individuals had the option to switch to a QHP, many individuals who were enrolled on a non-group plan prior to 2014 were allowed to remain in that plan and chose to do so (Lucia, 2014). Consumers in the 2014 non-group market had more choices than ever before. Nonetheless, selecting a health insurance plan can be challenging, even though the Marketplaces tried to ease the cognitive burden of plan selection through

standardization. Health insurance plan selection is difficult because it involves understanding complicated plan designs, comparison of multiple plan options, consideration of future known healthcare needs, and decision-making under uncertainty (Lore, Gabel, McDevitt, & Slover, 2012) (Baicker, Congdon, & Mullainathan, 2012) (Long et al., 2014). Although difficult, selecting a health plan is important and can have real consequences on healthcare utilization and out-of-pocket costs.

In this dissertation I elucidated observable characteristics associated with plan selection in the 2014 non-group health insurance market and analyzed the effect of plan selection on healthcare utilization and out-of-pocket costs to the beneficiary. The objectives of this research were to understand: (1) how consumers behaved in year one of the new health insurance Marketplaces; and (2) how they responded to plan incentives in non-group health insurance market. To achieve this I addressed three specific aims:

Aim 1. Determine the key observable factors associated with plan switching and plan selection in the health insurance Marketplace.

Aim 2. Analyze the extent to which the marginal cost of care affected the utilization of healthcare services for ambulatory care sensitive conditions.

Aim 3 Assess the effect of network choice on number of outpatient visits, percentage of visits with providers participating in the narrow network, and out-of-pocket costs.

The data come from a large insurer. In 2014, this insurer was one of only two companies offering QHPs in the state Marketplace and the only insurer offering QHPs in every county; in 2013, it had 86% of the non-group market (The Kaiser Family Foundation State Health Facts, 2013). I utilized claims data which included not only healthcare services but the costs of those services as well. I also directly observed plan benefit information such as deductibles, coinsurance, and premiums.

Study findings could positively impact the non-group health insurance market by providing a better understanding of consumer behavior in the first year of Marketplace operation. Historically, the non-group market has not often been studied, but it's becoming increasingly important as it continues to grow under the provisions of the ACA (Nadash & Day, 2014; M. V. Pauly & Nichols, 2002; Sommers, 2014). The non-group market operates differently than the markets for public and employer-sponsored group health insurance; in the non-group market each individual agent self-selects a health plan based on their budgetary allowances, age, sex, risk tolerance, and expected healthcare utilization (K. Ericson & A. Starc,

2012; Lako, Rosenau, & Daw, 2011). Effective policies require that consumers understand the health insurance system and appropriately respond to incentives in the benefits structure of health plans. Industry leaders and policymakers need to understand consumer behavior with regards to recent reforms in order to create future policies that preserve or increase access to quality care while containing costs.

The non-group health insurance market, in which individuals compare a large number of options and purchase health plans directly from insurers, is growing (Carman et al., 2015a). The ACA sets up a market that promotes consumerism and individual choice (Oberlander, 2014). Industry leaders and policymakers need to provide understandable information to consumers so that individuals are able to make informed decisions when selecting and using health insurance benefits. Individuals must take a broader view of health insurance by not reacting solely to the immediate, up-front costs of the monthly premium, but also considering the effects of cost sharing on utilization and network size on provider selection. By analyzing enrollment during the first year of health insurance Marketplaces we can better learn how individuals are operating within the market and how they are using the plans they select.

Organization of this Dissertation

To inform the reader of important fundamentals of the ACA and to provide context, Chapter 2 provides relevant details of the ACA as well as an overview of the current literature. Chapters 3 through 5 are manuscripts addressing the three specific aims. Each of these chapters was written for individual submission to peer-reviewed publications and, as such, contains an introduction and conclusion relevant to the paper objective. Chapter 6 discusses the research findings and policy implications of this dissertation, examines the strengths and limitations of the study, and lays out a future research agenda based upon the results. Each of the appendices provide information that is beyond the scope of a journal article.

CHAPTER 2: BACKGROUND ON THE AFFORDABLE CARE ACT AND HEALTH INSURANCE LITERATURE REVIEW

This chapter was designed to orient the reader to the current state of the non-group health insurance market. First I provide background information on health insurance and the provisions of the ACA relevant to this dissertation. Following the background section I provide a review of the current literature on plan selection and the effect of health insurance on utilization.

Background

The health insurance market can be complicated and the ACA brought many reforms to the market. In the background section below I provide fundamental information on health insurance and relevant provisions of the ACA.

Health Insurance 101

Health insurance plans use contract negotiations and risk pooling to provide beneficiaries with discounts on healthcare services. For a monthly premium, individuals enroll in a plan which assists them in paying for healthcare services throughout the policy year. To stave off moral hazard, the assumption that when individuals are shielded from the full costs of services they exhibit less discretion in their demand for care, insurance companies incorporate cost-sharing into plan design (Aron-Dine, Einav, & Finkelstein, 2013; Arrow, 1963). Cost-sharing refers to the portion of healthcare costs for which the beneficiary is responsible and can take the form of deductibles, coinsurance, copayments, or annual spending caps. Deductibles are the amount that the member has to pay before the insurance company begins to pay for services, although not all plans have deductibles. Coinsurance is the portion of the cost of care for which the member is responsible. Coinsurance is expressed as a percentage, and is applicable after the deductible has been paid. Copayments are fixed amounts that the member owes at the time of service and do not count towards the deductible. Annual spending caps, also referred to as out-of-pocket maximums, are the limits on expenditures for which the beneficiary is responsible. The out-of-pocket maximum includes deductibles, coinsurance, and copayments, but not premiums (Department of Health and Human Services, 2014).

There are different types of health plans, all of which employ some elements of cost-sharing. Traditional health plans, such as preferred provider organization (PPOs) and point of service (POS) plans, often use copayments to encourage routine outpatient visits instead of more costly inpatient admissions, when possible. A recent trend has been the shift towards consumer directed plans or high deductible health plans (HDHPs). HDHPs encourage individuals to take more responsibility for healthcare by imposing large deductibles (defined as >\$1,250 in 2014) which must be met before plans contribute towards the cost of services (Buntin et al., 2006; Internal Revenue Service, 2015).

In addition to cost-sharing, health plans use contracting and provider networks to encourage more consumer engagement in the selection of healthcare services. Starting as early as the 1970's, mounting pressure from rising healthcare costs led to the managed care boom of the 1990s (Mechanic, 2004). The term "managed care organizations" applies to a set of healthcare products including pre-paid group practices, capitated plans, and Health Maintenance Organizations (HMOs) (Mechanic, 2004). A common, but not defining, trait of managed care was utilization management under which a third-party regulated care for beneficiaries (Mechanic, 2004). The late 1990's saw a backlash against managed care organizations and a return to fee-for-service plans. PPOs and POSs, under which insurers contract with groups of providers and facilities to offer in-network services to members at reduced rates, gained in popularity (Department of Health and Human Services, 2014). PPOs allow beneficiaries to get care from wherever they choose, but members pay more for care delivered from providers and facilities who were not contracted to be "preferred providers" within the plan network. Today's healthcare system includes hybrid plans, which combine aspects of HMOs, PPOs, POSs, and HDHPs to reduce moral hazard and encourage more consumer involvement (Mechanic, 2004).

The Affordable Care Act and Market Expansion

On March 23, 2010, the ACA was signed by President Barack Obama ("The Patient Protection and Affordable Care Act," 2010). The law was famously over 900 pages long and, though it covered a variety of aspects of the healthcare system, many of the most well-known provisions focused on the health insurance market. Provisions included the establishment of the Medicare Payment Advisory Commission (section 3127), allowing dependents younger than 26 to remain on their parents' health insurance plans (section 2714), and a path for the expansion of state-based Medicaid programs (section 2001) ("The

Patient Protection and Affordable Care Act," 2010). The passage of the ACA immediately provided coverage for individuals with pre-existing conditions (guaranteed issue), first through high-risk pools and then by prohibiting plans from excluding pre-existing conditions (section 1101) ("The Patient Protection and Affordable Care Act," 2010). Arguably, one of the most impactful portions of the law was the individual mandate, as it has come to be called, and the creation of the state-based and federal-facilitated marketplaces. The individual mandate stipulated that all individuals purchase, and are covered by, adequate health insurance, unless exempt (section 1501) ("The Patient Protection and Affordable Care Act," 2010). To provide access to adequate health insurance, the ACA called for the creation of the health insurance Marketplaces (Marketplaces), a forum where individuals in each state could shop for insurance plans that would provide acceptable levels of coverage. The Marketplaces were intended to (and arguably have) facilitated the comparison and purchasing of health insurance plans

In 2014, 15 states opted to operate their own state-based Marketplaces while Marketplaces in other states were either supported or fully run by the Federal Government (Office of the Assistant Secretary for Planning and Evaluation, 2014). Regardless of whether the Marketplace was run by the federal or state government, for plans to be sold in the Marketplace they had to first be certified as a qualified health plan (QHP) by the Department of Insurance of the state in which the Marketplace would be operating. To obtain the QHP designation, plans had to adhere to various restrictions and stipulations outlined in the ACA. Among the ACA provisions, plans had to align actuarial value with established metal levels, use modified community ratings when setting premiums, and cover a set of essential health benefits.

Metal Level Designations

QHPs were assigned a metal level (platinum, gold, silver, or bronze) based on the plan's actuarial value. Actuarial value is the average total cost that a plan will cover, for example a plan with an actuarial value of 90% means, on average, the plan covers 90% of all healthcare costs and the beneficiary is responsible for 10%. Actuarial value was based on "actual average spending by a wide range of consumers in a standard population," and was calculated using a standard algorithm developed by the Department of Health and Human Services (Department of Health and Human Services, 2013) (section 1301) ("The Patient Protection and Affordable Care Act," 2010). Insurers had to adjust QHP benefits to make actuarial value of a plan match the actuarial values assigned to each metal level. Generally,

platinum plans have an actuarial value of 90%, gold plans have an actuarial value of 80%, silver 70% (with the notable exception for plans enhanced by cost-sharing reductions (CSR) that increase the actuarial value of silver plans for qualified low income individuals), and bronze plans have an actuarial value of 60%. Catastrophic plans, which were available to individuals under 30 or those who qualify for a “hardship exemption,”¹ had to meet ACA standards of offered benefits, but could have actuarial values below 60%. Within each metal level there could have been a variety of premium and cost-sharing arrangements, so long as actuarial value remained within metal level specifications (Department of Health and Human Services, 2013).

Federal Assistance Programs

Federal assistance was provided to eligible individuals who purchased QHPs in the Marketplace. Generally, assistance was available on a sliding scale to individuals with income between 100% and 400% of the Federal Poverty Level (FPL), with additional levels of assistance available to individuals with income between 100% and 250% FPL. In addition to means-tested income qualifications, receipt of federal assistance required individuals to be United States citizens or legal immigrants. Additionally, individuals who qualified for any public form of health insurance coverage (i.e. Medicaid, the Children's Health Insurance Program, Medicare, or military coverage) and individuals with access to affordable employer-sponsored health insurance plans² were not eligible for federal assistance (Kaiser Family Foundation, 2012a). Assistance was not available to individuals on catastrophic plans even if they were purchased in the Marketplace.

In 2014, there were two types of federal assistance made available to qualified individuals to make health insurance more affordable: advanced premium tax credits (APTCs) and CSRs. Unlike many of tax credits which are distributed around income tax filing dates, the APTC was immediately applied to plan premiums to lower the monthly cost of the health insurance plan. The amount of the APTC was a function of the price of the second lowest cost silver plan in an individual's region and that individual's income as a percentage of FPL. Although generally the APTC was available to individuals with income between 100%

¹ There are fourteen “hardship exemptions” which deal with income, employment and other factors that can influence an individual's ability to access health insurance (<https://www.healthcare.gov/exemptions/>).

² If an employee did not have access to employer-sponsored health insurance plan with an actuarial value of at least 60% or if the portion of the subscriber premium for which the employee was responsible exceeded 9.5% of the employee's total income, than that individual would be eligible for federal assistance if they purchased a QHP in the Marketplace.

and 400% of FPL, receipt of the APTC was based on the percentage of an individual's income that would have been consumed by the cost of the second lowest cost silver plan. APTCs were calculated so that individuals with income between 300-400% FPL would not be required to spend more than 9.5% of their income on premiums. If the second lowest cost silver plan in a region was greater than 9.5% of an individual's income, that individual would be eligible for APTCs, but if the premiums of the second lowest cost silver plan were lower than their income that individual would be required to pay the full price of the premium of whatever plan they chose. The percentage of their income individuals are responsible for spending on health insurance premiums decreases as income as a percent of FPL decreases; for example, individuals with income between 100% and 133% FPL are only required to spend 2% of their income on insurance premiums (Figure 1) (Kaiser Family Foundation, 2012a)

Unlike APTCs, which could be used to purchase plans of all metal levels, CSR qualification was dependent on an individual having enrolled in a silver level QHP. Individuals between 100% and 250% FPL are eligible for CSR (which are available in addition to, and not in lieu of, APTCs). CSRs effectively serve to increase the actuarial value of silver plans. For example, an individual between 150% and 200% FPL who purchases a silver plan, would pay the premium for that plan (less any APTCs) but in return would get a QHP with an actuarial value of 87% (meaning they would only be responsible for approximately 13% of costs out-of-pocket) (Table 1) (Kaiser Family Foundation, 2012a).

Table 1: Sliding Scale Federal Assistance for 2014

Income as a % of FPL	Maximum percent of income to be spent on premium (for APTC amount)	Actuarial Value of a Silver Plan (accounting for CSR assistance)	Out-of-Pocket Limits (individual/ family)
under 100%	no maximum	70%	\$6,350 / \$12,700
100%-133%	2%	94%	\$2,250 / \$4,500
133%-150%	3%-4%	94%	\$2,250 / \$4,500
150%-200%	4%-6.3%	87%	\$2,250 / \$4,500
200%-250%	6.3%-8.05%	73%	\$5,200 / \$10,400
250%-300%	8.05%-9.5%	70%	\$6,350 / \$12,700
300%-400%	9.50%	70%	\$6,350 / \$12,700
over 400%	no max	70%	\$6,350 / \$12,700
Federal Poverty Level = FPL		(Kaiser Family Foundation, 2012a)	

Out-of-Pocket Maximums

The ACA required all QHPs have an out-of-pocket maximum, a cap on total healthcare expenditures for which a beneficiary is responsible over the course of a policy year. The out-of-pocket maximum included all expenditures for approved services accessed within the beneficiary's provider network, such as deductibles, coinsurance, and copayments. The out-of-pocket maximum does not include premiums or non-covered services. Out-of-network care is usually subject to a separate out-of-pocket maximum or to no out-of-pocket maximum at all (Department of Health and Human Services, 2014). In 2014, the out-of-pocket maximum for in-network care was \$6,350 for an individual plan and \$12,700 for a family plan (Kaiser Family Foundation, 2012a). Individuals eligible for cost-sharing federal assistance programs are only responsible for a fraction of the out-of-pocket maximum (Table 1).

Modified Community Ratings

In addition to federal assistance, the ACA attempted to make health insurance plans more affordable by requiring that QHPs employed modified community ratings when setting premiums. Prior to ACA regulations, non-group health plan premiums were calculated using medical underwriting. Medical underwriting is a common practice used by insurers to set premiums based on an individual's age, sex, past healthcare utilization, and expected health status (Kaiser Family Foundation, 2012b). Modified community rating means premiums are only a function of region, age, number of dependents on the policy, tobacco use, and the actuarial value of the plan (section 2701) ("The Patient Protection and Affordable Care Act," 2010). The ACA regulates the degree to which premiums can vary by age; the premium for the oldest adult cannot be more than 3 times the premium for the youngest adult. The

provision regarding tobacco use is similar in that users cannot be charged more than 1.5 times the premium of non-users. Modified community ratings provide lower premiums to individuals who were previously expensive under medical underwriting but, because they level the playing field, modified community rated premiums can be higher than underwritten premiums for some individuals (Goldman, Leibowitz, Buchanan, & Keeseey, 1997; Whitmore, Gabel, Pickreign, & McDevitt, 2011).

Essential Health Benefits

To qualify as a QHP, a plan must cover a set of essential health benefits which include the items and services within at least the following 10 categories: (1) ambulatory patient services; (2) emergency services; (3) hospitalization; (4) maternity and newborn care; (5) mental health and substance use disorder services, including behavioral health treatment; (6) prescription drugs; (7) rehabilitative and habilitative services and devices; (8) laboratory services; (9) preventive and wellness services and chronic disease management; and; (10) pediatric services, including oral and vision care (section 1302) ("The Patient Protection and Affordable Care Act," 2010).

The details of the services offered within the essential health benefit categories are based on a state specific benchmark plan which must be either one of the "...three largest small group plans, the three largest state employee health plans, the three largest federal employee health plan options, or the largest HMO (health maintenance organization) offered in the state's commercial market," (*Rules and Regulation*, 2013). Costs for these services get distributed among all QHP beneficiaries, even those who do not use the services; for example, because community rated premiums do not discriminate by sex all plans pay for maternity and newborn care coverage, even if the beneficiary is a male.

Grandfathered and Transitional Plans

Not all beneficiaries in the 2014 non-group market were enrolled in a QHP. The ACA contained a provision to allow individuals enrolled in a non-group plan as of March 23, 2010 (when the law passed) to remain in that particular plan ("Grandfathered") rather than being forced to switch to a QHP. In 2013, it was announced that individuals who did not qualify for Grandfathered status would be allowed to remain in a non-ACA compliant plan in 2014 so long as they were already enrolled in a non-group plan as of October 1, 2013 ("Transitional") (Lucia, 2014). During the open enrollment period of 2014, individuals in Grandfathered or Transitional plans had two options: (1) to stay in their same 2013 plan or (2) switch to a

QHP. Grandfathered and Transitional plans were not subject to the same regulations required of QHPs; notably, no federal assistance was provided on non-QHPs, premiums continued to be set using medical underwriting, and there were no minimum essential health benefit requirements.

Literature Review

Although the ACA brought a lot of change to the non-health insurance market, there is much that can be learned from past reform efforts, both domestic and international (Nadash & Day, 2014). In the section below I provide a review of the current literature on re-enrolling on a health plan versus switching health plans, complications to choosing a health plan, and the effect of cost-sharing on utilization.

Plan Switching vs. Re-enrollment

Status quo bias

Switching health plans requires different motivation and levels of effort than joining a new health plan or re-enrolling in a current plan. In the US commercial health insurance market, individuals routinely re-enroll in a health plan during open enrollment periods or select a new health plan at a fixed point in time, often when they start a job or incur a qualifying event (e.g., getting married or having a child). However, switching plans during an open enrollment period requires active consumer participation. The active decision to switch health plans involves seeking out and comprehending potentially hard to find and complicated information (Lako et al., 2011; Frank, 2009).

Previous studies have found that individuals tend to reenroll in, rather than switch, health plans; this tendency not to switch plans is referred to as status quo bias (Frank, 2009; Strombom, Buchmueller, & Feldstein, 2002). Evidence of status quo bias has been observed in non-US health insurance markets (where switching health plans has lower transaction costs) and among Medicare beneficiaries (even when switching would result in lower premiums and out-of-pocket costs) (Hunt Kearsley, Upchurch, Holmes, & Weinberger, 2012; Lako et al., 2011; Neuman, 2009). A study of enrollment in Medicare Part D, a pharmaceutical program for seniors, found that participants often did not choose the plan that would have been associated with the lowest levels of out-of-pocket costs and were often reluctant to switch to lower cost plans once enrolled (J. Gruber, 2009). Other countries have also seen evidence of individuals not switching, regardless of potential cost savings (Lako et al., 2011).

However, price is not the only factor in the decision to re-enroll or switch plans, switching health plans can sometimes require individuals to choose a new provider or hospital system (Pendzialek, Simic, & Stock, 2014). Additionally, there is often no perfect substitute between plans because of provider contracting and brand recognition (K. M. Ericson & A. Starc, 2012; Keeler & Rolph, 1988).

Although status quo bias is difficult to break, switching can occur when price and / or benefit differences are sufficiently large. Buchmueller and Feldstein found that when the University of California increased premiums by \$20 a month, 30% of beneficiaries switched plans, that was a 600% increase in the rate of switching compared to when premiums were constant across years (Buchmueller & Feldstein, 1997). A recent systematic literature review of the price elasticity of demand for health insurance found low elasticity of demand (-0.2 - -1.0) in the US.³ However, the study was conducted before the ACA and countries with mandatory health insurance tended to have higher elasticity, perhaps due to more options in the marketplace (Pendzialek et al., 2014). With more options and variation in price in the non-group health insurance market in the US, consumers in the Marketplace may be more willing to switch health plans in the future.

Not all individuals have the same propensity to switch health plans. In general, older and less healthy individuals are less likely to switch plans ((Buchmueller & Feldstein, 1997; Pendzialek et al., 2014). Older individuals tend to be less price sensitive than younger individuals are therefore may be less likely to respond to premium increases by switching to a lower cost plan (K. Ericson & A. Starc, 2012). Less healthy individuals and individuals with established provider relationships are less likely to switch because new plan benefits and networks may lead to disruptions in continuity of care (Lako et al., 2011).

Adverse Selection

Conditional on the decision to switch, health plan selection is influenced by price, age, sex, risk tolerance, and expected healthcare utilization (K. Ericson & A. Starc, 2012; Lako et al., 2011). Risk tolerance and expectations of future utilization can create differences in how individuals respond to prices: healthier individuals opt for cheaper, less generous plans while individuals who are less healthy

³ Elasticity of demand refers to the percentage change in demand for a good or service when the price increases by one unit; an elasticity of -0.2 means that a one unit increase in the price of health insurance would cause a 0.2% decrease in demand (Mankiw, 2012). A perfectly inelastic good would have a price elasticity of 0 (a one unit change in the price decreases demand by 0%).

and/or expect higher healthcare costs purchase more generous (and expensive) plans (Naessens et al., 2008; van den Berg et al., 2008).

The theory of adverse selection states that individuals who anticipate high medical costs are more likely to enroll in plans that offer more generous coverage and individuals who are healthier are more likely to choose a cheaper plan or opt out of the health insurance market entirely (Swartz & Garnick, 2000). Large price differentials may exacerbate adverse selection. If the price differences are large enough they may encourage healthier individuals to switch out of the expensive plan leaving only higher-risk individuals who are less price sensitive and do not respond to price changes in the same way (van den Berg et al., 2008). A plan with majority of unhealthy beneficiaries will have an unbalanced risk pool, which in turn drives up premiums even further (D. Z. Cutler, RJ., 1998). Since insurers are not allowed to employ medical underwriting in setting premiums, the ACA contains language to mitigate the effects of unbalanced risk pools between health insurers. The ACA provisions are known as the three R's: risk adjustment, reinsurance, and risk corridors (Blumenthal, 2014).

Tcherins et al. describe an example of adverse selection in the behavior of employees who switch plans due to health-related factors (absent any policy changes). In this example there are four groups of individuals who were studied over a multi-year period: (1) a group who stays on a less generous plan for the study period, (2) individuals who switch from a less generous plan to a more generous plan, (3) a group who stays on a more generous plan, and (4) those who switch from a more generous to a less generous plan. Individuals who switch to a more generous plan (group 2) utilize more care than all other groups and individuals who switch to a less generous plan (group 4) utilize less care than all other groups (Tchernis, Normand, Pakes, Gaccione, & Newhouse, 2006). The Tchernis et al. study suggests that sicker individuals switched to a more generous health plan because they were anticipating higher health costs and, accordingly, they used more care. Similarly, a 2008 study found that when forced to choose between two health plans (one with high premiums and low patient cost-sharing, the other with lower premiums and a higher deductible) individuals with chronic and preexisting conditions were more likely to enroll in the higher cost, more generous plan (Naessens et al., 2008).

Barriers to Choosing a Health Plan

Decision Fatigue

On average, the non-group health insurance market has offered more choices than are typically offered to individuals who obtain health insurance through an employer, and the ACA has expanded the number of insurers in the non-group market (Hanoch & Rice, 2006; M. Pauly, Percy, & Herring, 1999). Although numbers vary by state and rating region, on average, consumers in the 2014 Marketplaces chose between 47 plans from 5 insurers while almost 50% of individuals with employer-sponsored coverage were offered plans from only one or two insurers (Jost, 2014). Studies of enrollment in Medicare Part D have found that participants had a difficult time choosing between plans (Hanoch, Rice, Cummings, & Wood, 2009; Lau & Stubbings, 2012). Although studies have shown that older individuals may have more challenges making selections from a large choice set, there is also evidence of younger individuals having difficulties choosing between health insurance plans (Hanoch & Rice, 2006; Barnes, Hanoch, & Rice, 2015). As the number of choices increase, making a selection from a set of options becomes more cognitively challenging and individuals may experience decision fatigue (Rice, 2013) (Lako et al., 2011). Decision fatigue is a phenomena where, when faced with a multitude of options, individuals may rush into a suboptimal decision merely to end the decision making process (Iyengar & Lepper, 2000).

Complex Benefit Designs

The complex non-linear structure of health insurance can be difficult to understand and can make direct comparisons between plans challenging (Lore et al., 2012; Baicker et al., 2012; Long et al., 2014). Individuals do not always understand health insurance related terminology, and if individuals do not understand the benefit structure of their plan, they may not respond to incentives in the intended way (Loewenstein et al., 2013). If people do not respond to incentives as designed then (1) health plans will not have their intended effect of encouraging consumers to use care more responsibly, and (2) consumer satisfaction may decrease when individuals are confused about coverage limits and / or out-of-pocket costs (Dembe, Lu, & Sieck, 2010).

Risk Tolerance and Uncertainty

Even for individuals who understand the concepts of health insurance, risk tolerance, and uncertainty can muddle decision making. Individuals tend to have myopic preferences, meaning they overly discount future experiences at the expense of the present. In terms of choosing a health plan, myopic preferences may lead individuals to put more weight on immediate payments for monthly premiums and focus less attention on cost-sharing structures, which will have an effect on out-of-pocket costs when care is utilized in the future (Rice, 2013). Future healthcare costs are often uncertain; while health plans for year 2 are purchased in the end of year 1, healthcare needs for year 2 are partially unknown in year 1. Individuals commonly misperceive health risks either by being overconfident in their ability to avoid common concerns or by overvaluing their susceptibility to low probability events (Baicker et al., 2012; Tversky, 1992). Any attempt to understand how individuals make decisions regarding health insurance must consider behavioral economics and theories of decision making under uncertainty to account for these behaviors (Rice, 2013; Schneider, 2004).

Cost-Sharing and Utilization

Price and Demand

The RAND health insurance experiment (RAND HIE) is considered the gold standard of utilization studies. In 1974, researchers at the RAND Corporation randomized individuals from 6 cities to 1 of 14 health plans defined by distinct combinations of coinsurance (0%, 25%, 50%, and 95%) and out-of-pocket maximums (5%, 10%, or 15% percent of family income up to \$1,000) (Manning et al., 1987). The RAND HIE found that individuals and families with higher levels of cost-sharing utilized fewer services, but the forgone services were for both high and low severity care (Manning et al., 1987). Cost-sharing had a more significant effect on the number of services accessed than on the intensity of utilization and cost-sharing had less of an effect on the cost or quantity of future services accessed in a policy year after the first care event had been accessed (Manning et al., 1987).

Another formative finding by the RAND HIE was the calculation of the price elasticity of demand for healthcare services of -0.2, meaning a ten-unit increase in the price of healthcare only decreased demand for services by 2% (Newhouse and The Insurance Experiment Group, 1993). Lu et al. found a similar price elasticity of demand to that calculated in the RAND study (-0.196), but found demand to be

more elastic at higher levels of cost-sharing (-0.31) (Lu, Frank, & McGuire, 2008). Using data from the RAND HIE, Gilleskie and Mroz found that for every percentage point increase in coinsurance (the percentage of costs paid by an insurer), health expenditures increased by an average of \$6.40 (Gilleskie & Mroz, 2004). The price elasticity of demand in these examples was relative to total healthcare expenditures and not broken out for different types of care.

A recent study of the Chilean health system found the price elasticity for elective care (receipt of which is more discretionary, represented here as psychology visits, home health visits, and physical therapy evaluations) to be fairly elastic (price elasticity of -2.08, -1.88, and -0.32 respectively) compared to marker conditions (an unavoidable, urgent condition, here as gall bladder removal, arm cast setting, and appendectomy) for which the price elasticity was close zero (Duarte, 2012; Basu, Friedman, & Burstin, 2002).

The RAND HIE is still considered the seminal work on how insurance generosity influences demand for healthcare services, however much about the healthcare landscape has changed since the RAND HIE was conducted. The rise and fall of managed care in the 1990's, technological advances in medicine, increasing medical inflation, the ACA, and the introduction of health savings accounts and HDHPs have all changed the way healthcare is consumed in the United States.

High Deductible Health Plans

HDHPs have been shown to lower healthcare expenditures through reductions in preference sensitive and low priority care, but these plans can also cause reductions in necessary care which can have potentially deleterious downstream effects to beneficiary health. A 2014 study used propensity score matching to create an analogous control group for a sample of employees who were obligated to switch to a HDHP. This study found that the HDHPs were associated with a reduction in outpatient care for low priority chronic care but not high severity care, suggesting the plan incentives were producing the intended outcomes. However, the study also found an association between HDHPs and a reduction in high priority visits for chronic conditions, which could indicate a reduction in quality of care and health outcomes (Reddy, Ross-Degnan, Zaslavsky, Soumerai, & Wharam, 2014). In another study of employers mandating employees switch to a HDHP, Fronstin and Roebuck found an immediate decrease in spending the year following the switch but then an increase in expenditures in subsequent years (Fronstin

& Roebuck, 2013). Compared to year 0 (prior to the introduction of the HDHP), in year 1 outpatient ambulatory care dropped 13%, outpatient office visits dropped 14%, emergency room visits dropped 17%, and inpatient hospital visits dropped 33%; however, by year two office visits and outpatient ambulatory care were slightly higher than in year 0 and by year 3 emergency room visits and inpatient hospital visits were higher than year 0 by 8% and 30% respectively.

Although HDHPs have been associated with a reduction in both low and high severity care, the effect is always not constant across subpopulations. Wharam et al. found that HDHP reduced utilization across the board (including for high severity emergency room visits), but these reductions were only evident in low-income populations; individuals with higher levels of income responded to HDHPs as intended - by reducing low severity emergency room events while still accessing care for high severity events. There was evidence of negative health consequence on the low-income individuals in the Wharam et al. study, the reduction in care for high severity events in the first year of plan enrollment led to an increase in utilization in subsequent years, even larger than pre-HDHP rates (Wharam, Zhang, Landon, Soumerai, & Ross-Degnan, 2013). A 2013 study found when their employer forced them to switch to a HDHP, men were more likely to have decreased utilization of all kinds while women accessed care as intended by decreasing low severity events but not high severity care (Kozhimannil, Law, Blauer-Peterson, Zhang, & Wharam, 2013).

CHAPTER 3: PLAN SELECTION IN THE NON-GROUP MARKET IN THE FIRST YEAR OF THE HEALTH INSURANCE MARKETPLACE

Introduction

The Affordable Care Act of 2010 (ACA) established Marketplaces for health insurance where individuals could easily access, and choose among, qualified health plans (QHPs) from a variety of insurers. The ACA required that QHPs meet certain standards, such as regulations on covered benefits and premiums, which were not required of plans in the non-group market prior to 2014. The ACA mandate that all nonexempt US residents have health insurance coverage and that plans accept all consumers regardless of pre-existing conditions began the process of breaking down previously entrenched barriers to entry in the non-group health insurance market and expanded the market to new consumers.

To ease the cognitive burden of selecting a QHP among Marketplace choices, the ACA required insurers to standardize plan offerings; however, switching insurance plans always involves costs such as learning about plan options and determining which plan would best match consumers' individual needs. For certain subgroups of individuals in the non-group market, QHPs had lower premiums and more generous benefits compared to non-QHPs. To begin to understand individual decision-making, we analyzed the characteristics associated with plan switching and plan selection in the 2014 Marketplace. We hypothesized that individuals predicted to have higher healthcare costs would choose more generous plans, while healthier individuals would select QHPs with lower premiums. In other words, since plan generosity is more valuable to individuals predicted to have higher healthcare expenditures, we expect poorer health to be associated with purchasing more generous plans.

Background - Changes in the Non-Group Market Under the Affordable Care Act

Metal Level and Actuarial Value

To standardize plans and help individuals more easily understand plan value, QHPs were assigned a metal level (platinum, gold, silver, or bronze) according to the plan's actuarial value (Department of Health and Human Services, 2014). The actuarial value represents the amount of

expected healthcare costs the issuer will pay; for example, in a plan with an actuarial value of 90% the beneficiary would, on average, be expected to pay 10% of overall healthcare costs. Generally, platinum plans have an actuarial value of 90%, gold plans have an actuarial value of 80%, silver 70% (with the notable exception for plans enhanced by cost sharing reductions (CSRs) that increase the actuarial value of silver plans for qualified low income individuals), and bronze plans have an actuarial value of 60%. Catastrophic plans, available to individuals under 30 and individuals who meet certain income qualifications, must meet ACA standards of benefits offered but can have actuarial values below 60%.

Modified Community Rating

Medical underwriting is a common practice used by insurers to set premiums based on an individual's age, sex, past utilization, and expected health status (Kaiser Family Foundation, 2012b). Underwritten premiums tend to be higher for individuals who are female, older, or less healthy because these individuals are likely to incur higher costs. Under the ACA, QHP premiums are generated through modified community rating, meaning they are a function only of actuarial value, region, age (with limits), number of dependents on the policy, and tobacco use ("The Patient Protection and Affordable Care Act," 2010).

Federal Assistance Programs

Some individuals may be eligible for financial assistance to increase affordability of QHPs. With some exceptions, individuals with income between 100% and 400% of the federal poverty level (FPL) are eligible for an Advanced Premium Tax Credit (APTC) which provides an immediate credit to the purchaser to lower their monthly premium. Individuals with income between 100% and 250% FPL who enroll in a silver plan may also be eligible for additional assistance through CSRs.

Regulations on QHP Generosity and Plan Benefits

In addition to laws governing plan pricing, the ACA dictated certain aspects of plan generosity. In 2014, all QHPs were required to cap out-of-pocket spending within a policy year at \$6,350 or lower. The ACA also prohibited QHPs from denying coverage for pre-existing conditions and required issuers to cover a set of essential health benefits (The Center for Consumer Information & Insurance Oversight). Essential health benefits included a maternity rider which, unlike non-ACA-compliant plans in the non-

group market, was included with no extra cost on all QHPs because modified community rating does not allow for premiums to discriminate by sex.

Grandfathered / Transitional Plans

The ACA contained a provision to allow individuals enrolled in a non-group plan as of March 10, 2010 (when the law passed) to remain in that particular plan (“Grandfathered plans”) rather than switching to a QHP. In 2013, it was announced that individuals who did not qualify for Grandfathered status would be allowed to remain in a non-ACA compliant plan in 2014 so long as they were already enrolled in a non-group plan as of October 1, 2013 (“Transitional plans”) (Lucia, 2014). Individuals in Grandfathered or Transitional plans could stay in their 2013 plan or switch to a QHP; however, they could not enroll in another non-QHP in 2014. Grandfathered and Transitional plans were not subject to the same regulations required of QHPs.

Status Quo Bias and Active Plan Selection

Previous studies have found that individuals tend to reenroll in, rather than switch, plans regardless of potential cost savings (status quo bias) (Frank, 2009; Strombom et al., 2002). Evidence of this “status quo bias” has been observed in non-US health insurance markets (where switching health plans has low transaction costs) and among Medicare Part D beneficiaries (even when switching would result in lower premiums and out-of-pocket costs) (Hunt Kearsley et al., 2012; Lako et al., 2011; Neuman, 2009). In the US commercial health insurance market, individuals regularly select a health plan at a fixed point in time, often when they start a job or incur a qualifying event (e.g. getting married or having a child). However, switching plans, as opposed to automatically reenrolling, requires active consumer participation involving seeking out and comprehending the information necessary for active decision-making (Lako et al., 2011; Frank, 2009).

Conditional on the decision to switch, health plan selection is influenced by age, sex, risk tolerance, price, and expected healthcare utilization (K. Ericson & A. Starc, 2012; Lako et al., 2011). Risk tolerance and expectations of future utilization can create differences in how individuals respond to prices: healthier individuals opt for cheaper, less generous plans while individuals who are less healthy and/or expect higher healthcare costs purchase more generous (and expensive) plans (Naessens et al., 2008; van den Berg et al., 2008). As the non-group market continues to grow, it is important that

policymakers and industry leaders understand the interaction between price and plan generosity for different groups of consumers in the health insurance Marketplaces.

In this study, we used claims data from a large insurer with high market share on the state exchange to explore individual characteristics associated with the decision to switch to a QHP and, conditional on switching, selection of metal level in a Federally Facilitated Marketplace. We examined differences in the effect of APTCs on plan selection for individuals with varying risk of incurring high health costs. We hypothesized that individuals predicted to have higher healthcare expenditures would apply their tax credit towards the purchase of health plans with higher actuarial value while individuals predicted to have lower healthcare expenditures would focus more on premium price and purchase plans with lower actuarial value.

Data and Methods

Data and Sample

The data come from a large insurer, which allowed for direct observation of the true cost of premiums and federal assistance. In 2014, this insurer was one of only two companies offering QHPs in the state Marketplace and the only insurer offering QHPs in every county; in 2013, it had 86% of the non-group market (The Kaiser Family Foundation State Health Facts, 2013). The analytical sample included individuals who were: (1) enrolled in the non-group market with the insurer for at least six months of 2013 (to ensure information was known about an individual's health status and 2013 plan benefits); (2) 19-64 years old as of January 1, 2014 (working age adults who do not transition to Medicare); and (3) enrolled as individuals in a non-group health plan with this insurer as of May 1, 2014 (May 1 was the policy start date for individuals who enrolled on the final day of open enrollment in 2014). We excluded individuals in: (1) plans exclusively serving American Indians and Catastrophic plans (criteria for enrollment were subject to additional qualifications) and (2) family plans or plans in which an individual was enrolled with a dependent or spouse (decisions made for a family unit may have differed than decisions made for a single individual). Claims and plan enrollment data were used for information about individuals and their 2013 and 2014 plan benefits.

Outcome Variable

The outcome variable of interest was metal level, representing the actuarial value of the selected plan: platinum (90% actuarial value), gold (80% actuarial value), silver (70% actuarial value), and bronze (60% actuarial value).

Key Independent Variables

Health Risk

Risk scores have been used to represent health status (Albert, 2006; Thomas, 2006). We used an episode-based health risk score generated by an Ingenix Symmetry® algorithm accounting for age, sex, and healthcare claims from the previous 12 months (Symmetry® Episode Treatment Groups®, 2012). Our model utilized the prospective risk score, which combines demographics and claims data from the past 12 months to calculate a risk score that predicts the risk of an individual being high cost in the subsequent year (Symmetry® Episode Treatment Groups®, 2012). The risk score was standardized to mean=1.0 (indicating average health risk with >1.0 at higher risk of being high cost compared to the rest of the sample) and standard deviation=1.0.

Characteristics of Individuals and Policies

Age, sex, and details of plan benefits came from claims and plan enrollment data. Age on May 1, 2014 was categorized into three age groups (18-35, 36-50, 51-64). Also in the model was a binary variable for whether an individual had an APTC in 2014 as well as a continuous variable for the amount of the APTC (zero if no tax credit was received).

Analysis

The sample was comprised of two types of individuals: those who chose to remain in a Grandfathered / Transitional Plan in 2014 and those who chose to switch to a QHP. Our first analysis examined plan switching using chi-squared and t-tests to compare characteristics of switchers to non-switchers and presents descriptive statistics on cost. Measures of cost include monthly premiums (the monthly price of health insurance), deductibles (the amount the member must pay for services before the plan contributes), and annual out-of-pocket maximums (the maximum amount of expenditures - deductibles, coinsurance, copayments, etc. – paid by the member within a year, after which the plan pays 100% of the cost of additional services) (Department of Health and Human Services, 2014).

Our second analysis used a multinomial logit model to generate estimates of the effects of characteristics on selection of a metal level by those who switched. When modeling plan selection among those who switched, we excluded individuals with CSRs. Qualified individuals were required to enroll in a silver plan in order to receive CSRs, which meant the decision-making process for metal level selection was different for these individuals. The multinomial model for this analysis included only high-risk and low-risk individuals (Figure 1): high-risk were individuals for whom costs were expected to be higher than 75% of the sample while low-risk individuals were expected to have costs in the bottom 25th percentile. We presented odds ratios (OR) and 95% confidence intervals (CI). All analyses were conducted in SAS Enterprise Guide 6.1 (SAS Institute, 2011).

Results

Switching

Of the 96,106 individuals who met eligibility criteria, 81,187 (84%) remained in the same plan in which they were enrolled in 2013 (Grandfathered or Transitional) (Figure 1). Table 2 presents unadjusted, descriptive statistics by whether or not an individual switched to a QHP or stayed on a Grandfathered / Transitional plan. Individuals who switched to a QHP were more likely to have been female (64% v. 42% $P<0.0001$), older (average age 47.3 v. 44.6 $P<0.0001$), and had a greater risk of having higher healthcare costs in 2014 (mean risk score 1.168 v. 0.969 $P<0.0001$).

Less Costly - Modified Community Ratings and Premium Costs

Without tax credits, QHP premiums were, on average, more expensive than premiums for Grandfathered / Transitional plans. For individuals in the sample without APTCs, the average monthly QHP premium was \$472.36, however, with APTCs the average QHP monthly premium was \$205.23, lower than the average 2014 Transitional / Grandfathered Plan premium (\$328.13) (Table 2). The average APTC value in this sample was \$354.45, and 75% of individuals in a QHP received an APTC.

More Generous - QHP Regulations and Plan Generosity

The same subgroups that would have been most likely to benefit from modified community rating (women, older individuals, and higher predicted costs) also would have been most likely to benefit from ACA regulations on QHP benefits. In general, QHPs were more generous than Grandfathered / Transitional Plans; the average actuarial value for QHPs was significantly higher than the 2014 actuarial

value for Grandfathered / Transitional Plans (87.5% v. 60.3% $P < 0.0001$). Compared to individuals with lower cost sharing in 2013, a higher percentage of individuals in less generous 2013 plans switched to QHPs in 2014. Individuals who switched to QHPs had higher 2013 out-of-pocket maximums (OOP max) (50% of those in QHPs had OOP max $> \$6,000$ in 2013 v. 39% of individuals who were in Grandfathered / Transitional plans in 2014, $P < 0.0001$) and higher deductibles (82.5% of those in QHPs had 2013 deductibles between \$1,000 and \$6,000 and 4.5% had 2013 deductibles $> \$6,000$ v. 79% and 2.7% for those in 2014 Grandfathered/Transitional plans, $P < 0.0001$) (Table 2).

Decision-Making among Beneficiaries who Switched Plans: Choice of Metal Level

Plan selection was modeled separately for 1,691 high-risk (cut-off risk score = 1.287) and 1,692 low-risk (cut-off risk score = 0.392) individuals (Figure 2). High-risk individuals were older (51.0 v. 40.4, $P < 0.0001$), more likely to be female (69% v. 61%, $P < 0.0001$), and had higher average APTCs (\$153.75 v. \$124.97, $P < 0.0001$). Compared to low-risk individuals, high-risk individuals were less likely to select bronze plans (15.2% v. 35.7%, $P < 0.0001$) and more likely to select platinum (22.1% v. 10.4%, $P < 0.0001$) and gold plans (28.5% v. 20.8%, $P < 0.0001$) (Table 3).

Effect of APTC on Metal Level

Both high and low-risk individuals with APTCs had lower odds of selecting a platinum or gold plan over a silver plan compared to individuals without a tax credit (high-risk, platinum: OR = 0.25, CI: 0.19-0.33; high-risk, gold: OR = 0.45, CI: 0.35-0.57; low-risk, platinum: OR = 0.44, CI: 0.30-0.63; low-risk, gold: OR = 0.98, CI: 0.77-1.26). Compared to high-risk individuals without APTCs, high-risk individuals with APTCs had lower odds of selecting a bronze plan over a silver plan (OR = 0.40, CI: 0.30-0.55). The opposite was true for low-risk individuals, compared to those without APTCs, low-risk individuals with APTCs had higher odds of selecting a bronze plan over a silver plan (OR = 1.35, CI: 1.09- 1.66) (Table 4).

Effect of Demographics on Metal Level

Compared to individuals age 36-50, younger individuals (age 18-35; both high-risk and low-risk without tax credits) had increased odds of selecting a platinum or gold plan over a silver plan (high-risk, platinum: OR = 1.45, CI: 1.18-1.79; high-risk, gold: OR = 1.27, CI: 1.04-1.56; low-risk, platinum: OR = 2.00, CI: 1.63-2.45; low-risk, gold: OR = 1.42, CI: 1.21-1.66). There was no statistically significant effect of being younger on selecting a bronze plan. Compared to individuals age 36-50, older individuals (age 51-65;

both high-risk and low-risk without tax credits) had lower odds of selecting a platinum or gold plan over a silver plan (high-risk, platinum: OR =0.32, CI: 0.17-0.39; high-risk, gold: OR =0.48, CI: 0.40-0.56; low-risk, platinum: OR= 0.03, CI: 0.02-0.05; low-risk, gold: OR=0.13, CI: 0.10-0.17). Low-risk, older individuals without APTCs had lower odds of selecting a bronze plan over a silver plan compared to low-risk individuals age 36-50 without a APTCs (OR =0.71, CI: 0.58-0.86) while age had no effect on the odds of selecting a bronze or silver plan for high-risk individuals between the ages of 36 and 65 without APTCs (OR =1.22, CI: 0.99-1.51) (Table 4).

Discussion

The health insurance Marketplaces reduced barriers to enrollment in non-group health plans; in 2013 there were 8.5 million individuals in the non-group market and by 2015 that number had grown to 17.9 million (Carman et al., 2015a). Using claims from an insurer with high market share in the non-group market, we provide evidence to support our hypothesis that individuals would break status quo bias if the alternative plans were less expensive and/or more generous. Individuals who would benefit most from modified community ratings and regulations imposed on QHPs were more likely to switch. Individuals who switched to a QHP were more likely to be female, older, and at higher risk for being high cost. To decouple the influence of alternative plans being less costly and more generous, we conducted a multinomial model of plan selection for the highest and lowest risk individuals. As hypothesized, receipt of APTCs was associated with selecting more generous plans for high-risk individuals and less generous plans for low-risk individuals. Contrary to prior studies which found older individuals to be less price sensitive, our results found older individuals were more likely to select less costly plans. This finding may suggest unintended consequences of age based pricing.

Effect of APTCs on Metal Level

Low-risk individuals with APTCs had higher odds of selecting a bronze plan than a silver plan compared to low-risk individuals who did not receive APTCs. As hypothesized, healthier individuals who expect to use fewer healthcare services selected plans with lower actuarial value and lower premiums. This finding suggests low-risk individuals were more likely to switch health plans because QHPs were less costly; rather than applying their tax credit towards the purchase of a more generous health plan, they used the APTC to save money on health insurance, which they could then spend on other goods

and services. Individuals who qualify for an APTC would be lower income and therefore may be more concerned about the premium price than the actuarial value of the plan.

High-risk individuals with APTCs had lower odds of selecting a bronze plan over a silver plan compared to high-risk individuals without APTCs; this may suggest that these individuals are using their tax credit on more generous health insurance, prioritizing that choice over spending their income on other goods. Individuals at risk for higher healthcare expenditures would be willing to spend more in premiums for a plan with higher actuarial value. The APTCs would make the silver plans affordable so these individuals would be more likely to choose silver over bronze plans; however, without APTCs, some high-risk individuals may have been priced out of plans with actuarial values above bronze.

Age and Metal Level

Controlling for receipt of APTCs and being at risk of higher expenditures, older individuals had lower odds of selecting a platinum or gold plan over a silver plan. This is surprising given prior work suggesting that older individuals are less price sensitive than younger individuals (K. Ericson & A. Starc, 2012). However, without tax credits, premiums for more generous plans may have been too high for older individuals; premiums for older individuals can be up to three times as large as those for younger individuals ("The Patient Protection and Affordable Care Act," 2010). Older individuals, and those predicted to have incurred more costs, were more likely to switch to a QHP in 2014, but perhaps without tax credits the premiums on gold and platinum QHPs were high enough to deter older individuals, even those who are high-risk (D. Cutler, Lincoln, & Zeckhauser, 2010; Lore et al., 2012).

Limitations

There are several limitations of our study. First, we lack a good proxy measure for income. Income for individuals in a 2014 QHP could be roughly imputed from receipt of various levels of federal assistance, but eligibility was unknown for individuals who did not switch. We explored income variables at the census tract level (Kozhimannil et al., 2013; Reddy et al., 2014; Wharam et al., 2013); however, these variables did not correlate with what we knew about income for individuals in our sample with CSR and APTC. Without adequate indicators of income, we were unable to estimate who would have been eligible for federal assistance but declined to take advantage of these programs by not switching to a QHP. Additionally, the dataset only included tax credits received at the time plans were purchased

(APTCs), when individuals opted to defer receipt of tax credits until the income tax filing date credits were not observed. Second, generalizability was limited because we studied beneficiaries enrolled with one particular insurer in both 2013 and 2014; however this insurer had a significantly large market share of the State's non-group health insurance beneficiaries (The Kaiser Family Foundation State Health Facts, 2013). Finally, individuals who were new to the insurance market in 2014 may have exhibited different behaviors than those in our sample. Individuals with CSR also may have behaved differently but they were also excluded from the sample. The focus of this analysis was the effect of the APTC on metal level. A majority of individuals eligible for CSR would have selected silver plans because, had they selected another metal level, they would have been ineligible for the subsidy. Additionally, CSR recipients are very low income (100%-250% FPL), which also may have affected plan selection.

Conclusions

The Marketplace allows (and the ACA requires) everyone in the US who is not otherwise exempt to purchase a health plan or pay a penalty. Receipt of APTCs influenced behavior in the plan selection process and had different effects depending on predicted future healthcare expenditures. Plans with low actuarial value have been criticized for not offering individuals' sufficient financial security and adequate access to care. However, considering consumers operate under a fixed budget for health insurance and all other goods, for some individuals who expect low healthcare spending over the following year, a plan with lower actuarial value may provide adequate benefits and access while allowing them to purchase other needed and desired goods and services. For individuals at risk of high healthcare costs, APTCs allow individuals to purchase plans with higher actuarial value than would otherwise have been affordable.

Healthcare costs are projected to rise, and with increased healthcare costs comes increases in premiums (CBO, 2015). Future studies of plan selection should look at the effects of increased premiums on plan selection. If average premiums increase more than the second lowest cost silver plan (on which APTCs are calculated), then the APTCs will be lower relative to the average premium, guiding low income individuals, even less healthy individuals, into low cost silver or bronze plans (Taylor, Saltzman, Bauhoff, Pacula, & Eibner, 2015). Additionally, studies should be conducted to determine how price sensitivity and

plan selection affect utilization and health status. Even within a metal level, plans can have different levels of cost sharing which can impact utilization and out-of-pocket costs (Lore et al., 2012).

Individuals on non-group plans in 2013 may have opted not to switch to a QHP in 2014 for a variety of reasons, one of which may have been overcoming the inertia of status quo bias. Considering the number of uninsured individuals has been decreasing (Carman et al., 2015a), studies of switching plans and overcoming status quo bias will be of increasing importance as the consumer-driven Marketplaces for non-group health insurance continue to grow.

Tables and Figures

Figure 1: Sample Inclusion

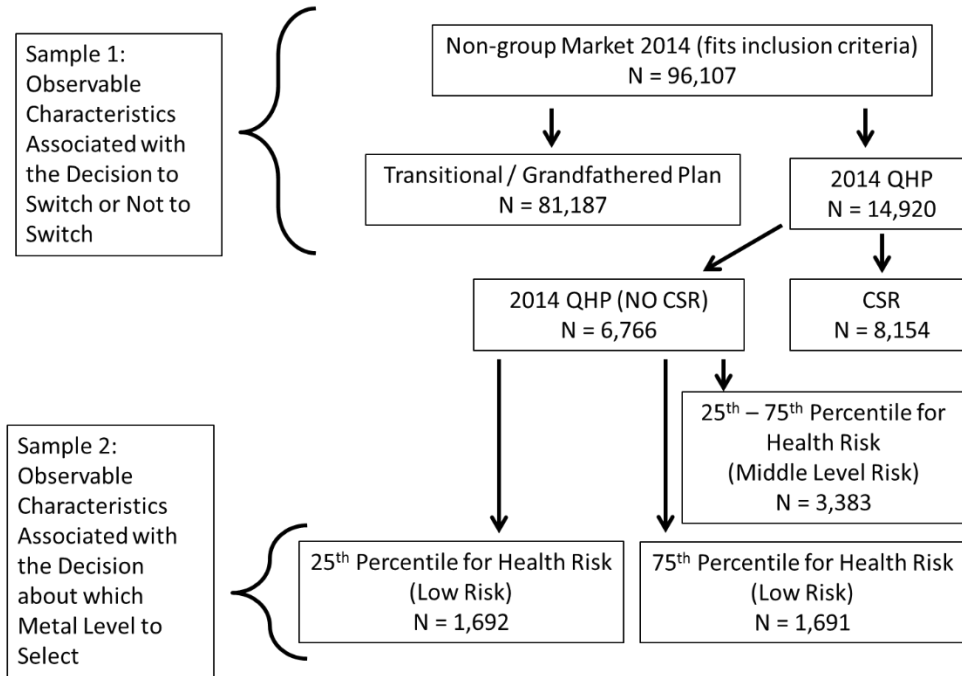


Table 2: Aim 1 Unadjusted Summary Statistics by 2014 Plan Type

	Qualified Health Plan	Transitional / Grandfathered
N	14,919	81,187
Average 2014 Premium (without the application of APTC)	\$ 472.89*	\$ 328.46
Average 2014 Premium (with the application of APTC)	\$ 205.23*	\$ 328.46
Average Actuarial Value of 2014 Plan	0.875*	0.603
Established with a Primary Care Provider in 2013	76%*	66%
Health Risk Score (standardized)	1.168*	0.969
Average Age	47.3*	44.6
Percent Female	64%*	42%
Competition from other insurers in the region	29%*	32%
Median Household Income (\$, census)	\$53,300*	\$55,500
Deductible Between \$1,000 and \$6,000 (2013)	82.5%*	79%
Deductible over \$6,000 (2013)	4.5%*	2.7%
Out-of-Pocket Maximum above \$6,000 (2013)	49.5%*	39%

APTC = Applied Premium Tax Credit

* = p<0.001

Table 3: Aim 1 Summary Stats by Health Risk and Metal Level

	High-Risk						Low-Risk				
	Platinum	Gold	Silver	Bronze	Total		Platinum	Gold	Silver	Bronze	Total
Metal Level	22.1%	28.5%	34.2%	15.2%	1,692	Metal Level	10.4%	20.8%	33.1%	35.7%	1,691
Age between 18 and 35	32.8%	32.1%	27.2%	7.8%	268 15.8%	Age between 18 and 35	15.0%	25.6%	33.4%	26.1%	767 45.4%
Age between 36 and 50	27.1%	30.1%	31.8%	11.0%	365 21.6%	Age between 36 and 50	10.4%	22.8%	35.9%	30.9%	460 27.2%
Age between 51 and 64	17.7%	27.0%	36.7%	18.6%	1,059 62.6%	Age between 51 and 64	2.8%	11.0%	30.0%	56.3%	464 27.4%
Female	22.0%	29.0%	34.4%	14.6%	1,175 69.4%	Female	10.1%	21.6%	35.5%	32.9%	1,038 61.4%
APTC	21.3%	31.9%	31.6%	15.2%	769 45.5%	APTC	9.0%	20.4%	22.0%	48.5%	763 45.1%

APTC = Applied Premium Tax Credit

Table 4: Aim 1 Multinomial Model Results (Referent Outcome is Silver)

		High-Risk (N = 1,692)	Low-Risk (N = 1,691)
	Outcome	Odds Ratios (95% Confidence Intervals)	Odds Ratios (95% Confidence Intervals)
Female	Platinum	0.900 (0.777-1.042)	0.798 (0.664 - 0.959)
Female	Gold	1.023 (0.893 -1.172)	0.971 (0.839 – 1.124)
Female	Bronze	0.888 (0.758 -1.040)	0.755 (0.666 - 0.856)
Age 18-35	Platinum	1.453 (1.181 -1.787)	1.997 (1.629 – 2.448)
Age 18-35	Gold	1.273 (1.038 -1.562)	1.419 (1.211 – 1.662)
Age 18-35	Bronze	0.842 (0.621-1.139)	1.070 (0.922-1.243)
Age 36-50	Platinum	REF	REF
Age 36-50	Gold	REF	REF
Age 36-50	Bronze	REF	REF
Age 51+	Platinum	0.321 (0.268-0.385)	0.029 (0.017-0.049)
Age 51+	Gold	0.475 (0.402-0.561)	0.129 (0.096-0.174)
Age 51+	Bronze	1.221 (0.991-1.506)	0.707 (0.579-0.863)
APTC (binary)	Platinum	0.254 (0.194 -0.333)	0.436 (0.303 - 0.627)
APTC (binary)	Gold	0.449 (0.354 – 0.570)	0.984 (0.767 – 1.264)
APTC (binary)	Bronze	0.403 (0.296 – 0.548)	1.345 (1.088 – 1.664)
APTC amount	Platinum	1.006 (1.005 - 1.007)	1.010 (1.009 - 1.012)
APTC amount	Gold	1.004 (1.004 - 1.005)	1.006 (1.005 - 1.007)
APTC amount	Bronze	1.003 (1.002 – 1.004)	1.004 (1.004 - 1.005)
N	Platinum	374	176
N	Gold	482	352
N	Bronze	258	603
APTC = Applied Premium Tax Credit			
REF = Referent Category			

CHAPTER 4: INTRA-YEAR VARIATION IN THE MARGINAL COST OF CARE AND ITS EFFECT ON UTILIZATION

Introduction

Health insurance plans use beneficiary cost-sharing to reduce moral hazard in the health insurance market. Moral hazard assumes that when individuals are shielded from the full costs of healthcare services, they exhibit less discretion in their demand for care, resulting in overconsumption (Aron-Dine et al., 2013; Arrow, 1963). Cost-sharing through deductibles, coinsurance, copayments, or annual spending caps refers to the portion of healthcare costs for which the beneficiary is responsible. Traditional health plans, such as preferred provider organizations (PPOs) and point of service (POS) plans, often use copayments to encourage routine outpatient visits instead of more costly inpatient admissions when possible. Increasingly, high deductible health plans (HDHP) are being offered. HDHPs encourage individuals to take more responsibility for healthcare by imposing larger deductibles (>\$1,250) before plans help pay for services (Buntin et al., 2006; Internal Revenue Service, 2015). Past studies suggest that utilization increases when patients have lower out-of-pocket costs. Notably, the RAND health insurance experiment found beneficiaries with zero cost-sharing had a higher outpatient utilization rate than those responsible for 95% of the cost of outpatient services (Manning et al., 1987). From the beneficiary perspective, cost-sharing can lead to nonlinearities in the price of care. As beneficiaries consume more care and incur costs, they may reach their deductible or annual spending limits, after which the price of an additional unit of care changes. In this study we utilize a large dataset containing the costs of services and a monthly indicator of health status to examine the intra-year effect of nonlinearities in cost-sharing from the perspective of a beneficiary in the non-group market.

We focused on ambulatory care sensitive conditions (ACSCs), conditions for which timely access to quality outpatient care can often prevent emergency room (ER) and inpatient visits. Specifically, we examined how a change in the marginal out-of-pocket cost, due to nonlinearities in plan benefits, would affect utilization of outpatient services for ACSCs. Additionally, controlling for the marginal out-of-pocket cost, we explored the effect of recent outpatient services on potentially avoidable ER and inpatient visits.

We hypothesized that: (1) individuals would be more likely to receive outpatient care when their marginal out-of-pocket cost was lower, and (2) controlling for the beneficiary's cost responsibilities, individuals with a recent outpatient visit would have fewer ER and inpatient visits.

Data and Methods

Data and Sample

The data for this study come from a large insurer in the southeastern United States. Typically, insurers do not release contractually-negotiated reimbursement rates, but this dataset included the price of care for all services, including the cost of care to the beneficiary and to the plan. Using 2014 claims data, we analyzed all utilization and costs attributable to each beneficiary in our sample.

The analytical sample included individuals who were: (1) enrolled in the non-group market for at least six months of 2014 (to ensure they were enrolled long enough to observe use of care); (2) between the ages of 18 and 64 as of January 1, 2014 (working age adults who do not transition to Medicare); and (3) diagnosed with asthma, chronic obstructive pulmonary disease (COPD), diabetes, hypertension, heart failure, and/or coronary heart disease. We excluded individuals on: (1) plans exclusively serving American Indians or Alaskan Natives as those plans frequently have zero-cost-sharing arrangements, and (2) family plans or plans with a dependent or spouse, as they have family deductibles and annual spending maximums that may change the effect of cost-sharing. Plans in the non-group market include those that were compliant with the requirements of the Affordable Care Act (ACA), and grandfathered or transitional plans, which did not adhere to ACA regulations.

Measures

Outcome Variables

Three outcome variables were used to capture healthcare utilization related to ACSCs. Outpatient visits for ACSCs were used as a measure of access to routine care, whereas ER and inpatient visits were used as indicators of potentially preventable utilization. Outpatient visits included wellness visits, office visits for evaluation and management (E&M), and imaging and lab tests by a primary care provider or specialist. Also included were office visits not directly coded as E&M but related to asthma, COPD, diabetes, hypertension, and/or heart disease identified by ICD-9 codes (International Classification of Diseases, 9th revision, Clinical Modification, (Agency for Health Research and Quality, 2015)). ER visits

were defined by claims filed for visits to the ER that did not result in an inpatient stay; ER visits resulting in an admission were considered inpatient visits. Both ER and inpatient visits of interest were identified using the Agency for Healthcare Research and Quality (AHRQ) Prevention Quality Indicators (PQIs). PQIs have been used to indicate the adequacy of access to outpatient care in communities (Agency for Healthcare Research and Quality, 2001). We focused on nine PQIs representing the focal chronic conditions of the analytic sample: asthma/COPD, diabetes, hypertension, heart failure, and coronary heart disease. Each outcome was dichotomized (1= presence of ≥ 1 visit in any given month and 0=absence of visit in a given month).

Key Independent Variables

Marginal Out-of-Pocket Cost

The key explanatory variable was the marginal out-of-pocket cost, defined as the proportion of the total payment to the provider borne by the beneficiary at the beginning of each month. Specifically, it was operationalized by comparing cumulative beneficiary liability to-date to the beneficiary's plan benefits. To calculate the monthly marginal out-of-pocket cost, we determined whether a beneficiary's annual deductible had been met at the end of the month. Until that point, a beneficiary would face the full cost of care (marginal out-of-pocket cost=1). Once the deductible was met, the marginal out-of-pocket cost changed to a fraction reflecting the level of coinsurance defined by the plan benefits (in this sample: 0.00, 0.20, 0.30, 0.40, or 0.50). When a member's total in-network liability reached or surpassed the annual spending limit (if it existed), the marginal out-of-pocket cost dropped to "0" for the remainder of the year (i.e., individual was not responsible for any costs of additional care). While the marginal out-of-pocket cost for out-of-network care may be different, less than 5% of all visits in this sample were out-of-network. As such, we assumed the marginal out-of-pocket cost aligned with in-network deductibles, coinsurance, copayments, and maximum annual limits. Because of delays between utilization and claims filing, individuals may not immediately have been aware of their current liability so a one month lag was introduced to the marginal out-of-pocket cost variable. For example, if an individual reached their deductible anytime in May, the variable recognized this milestone July 1.

Health Status

Risk scores have been used to reflect health status (Albert, 2006; Thomas, 2006). We used an episode-based health risk score generated by an Ingenix Symmetry® algorithm accounting for age, gender, and healthcare claims from the previous twelve months (Symmetry® Episode Treatment Groups®, 2012). The score represents the risk that an individual will be less or more costly than the rest of the sample due to being more or less healthy. The score was standardized across the sample to an annual mean and standard deviation of 1. A score of 1 indicated an average health risk; scores above 1 suggested that an individual was at higher risk of being more costly (less healthy) than the rest of the sample. The health risk score for each individual was updated in every month of enrollment to reflect changes in health status throughout the year.

Months Enrolled

The marginal out-of-pocket cost variable was a function of the cost of care used to-date, namely individuals who were enrolled on a plan for a longer amount of time most likely would have utilized more care to-date. We controlled for length of enrollment over the year by creating a binary indicator, updated monthly, for whether or not an individual had been enrolled for less than seven months (e.g. in July, individuals who enrolled in January had a value of 1, while individuals who enrolled in February or March had a value of 0). By decoupling the effects of time from cost, we are better able to isolate the effect of changes in the marginal out-of-pocket cost on utilization throughout the year.

Analysis

The Model

The general form of the model is the same across all outcome variables. There are four main input variables, each defined at the person-month level: (1) the marginal out-of-pocket cost (operationalized as three binary indicators for whether the marginal out-of-pocket cost was zero, one, or equal to the coinsurance); (2) health risk, updated monthly, operationalized as both a continuous variable and quadratic term, (3) a binary indicator for whether the observation occurred in the first six months of enrollment, and (4) (when the outcome was ER or inpatient visits) an indicator of whether or not an individual had an outpatient visit in the previous three months.

$$Y_{im} = \beta_1(\text{marginal out-of-pocket cost}=0; \text{REF})_{im} + \beta_2(\text{marginal out-of-pocket cost}=\text{other})_{im} + \beta_3(\text{marginal out-of-pocket cost}=1)_{im} + \beta_4(\text{health risk})_{im} + \beta_5(\text{health risk})^2_{im} + \beta_6(\text{first six months of enrollment})_{im} + \beta_7(\text{outpatient visit in the past three months})_{im} + \alpha_i + \varepsilon$$

* REF = referent group

We estimated a series of fixed effects models with binary outcome variables. Because time-invariant, unobserved factors (such as risk aversion or care-seeking tendencies) may influence utilization, we included individual-specific fixed effects that control for these characteristics. Fixed effects models only estimate the effects of variables that have within-person variation or which change over time for an individual; because there is no (or limited) variation in traditional explanatory variables (e.g., age, gender), these variables are not needed in the model. Using only within-person variation effectively controls for these traditional explanatory variables by allowing individuals to serve as their own control over the time period while their marginal cost of care varies (Thiebaud, Patel, & Nichol, 2008). The model was estimated in SAS Enterprise Guide 6.1 (SAS Institute, 2011). Following Zou (2013), we estimated the models using a Poisson distribution with a log link to allow the coefficient to be interpreted as *risk ratios* (RR) rather than *odds ratios* (G. Zou, 2004; G. Y. Zou & Donner, 2013). This distinction is most relevant for outpatient events; when events are rare (such as emergency room and inpatient visits) odds ratios will approximate RRs; however, when events are more common the odds tends to overestimate the risk.

Subgroup analysis

We conducted a subgroup analysis stratified by whether or not an individual had a copayment for outpatient or ER visits. No plans had copayments for inpatient admissions. Most PPO and POS plans had copayments for outpatient care, meaning beneficiaries paid only a pre-specified amount for that visit; occasionally services rendered in this setting were not eligible for the copayment and therefore subject to the deductible. Most beneficiaries (94.4%) with outpatient copayments also had ER copayments. Copayments for outpatient visits ranged from \$5 to \$45 and ER visits from \$100 to \$250. Twelve percent of beneficiaries in the sample had no copayments for any services and all services were subject to the deductible; 90% of individuals with no copayments had HDHPs, meaning deductibles above \$1,250 and the ability to save money in a health savings account (Internal Revenue Service, 2015).

Results

The analytical sample included 59,583 beneficiaries with 632,722 person-months (Table 5). Approximately 65% of the sample was new to this insurer in 2014. The sample was slightly more female (56%) with a mean age of 51; 76% never reached their deductible within the year. The health risk score was skewed to the right; the median health risk was 0.82. The risk scores in this sample ranged from 0.31 to 30.06.

Outpatient Visits

When the marginal out-of-pocket cost was 1, 36% of the sample had at least one outpatient visit (Table 6). When an individual reached their annual spending limit and the marginal out-of-pocket cost of accessing an additional service was 0, the likelihood of an outpatient visit increased (RR: 1.104, CI: 1.088-1.119; Table 7), controlling for health status and the duration of policy enrollment. Compared to individuals for whom all outpatient visits were subject to the deductible, a higher percentage of beneficiaries with copayments for most outpatient services had >1 outpatient visits when the marginal out-of-pocket cost was 0 (37% versus 29%, Table 6). The effect of reaching the annual spending limit was smaller for individuals with copayments for most outpatient services (RR=1.095, CI: 1.079-1.111 versus RR=1.265, CI: 1.204-1.328; Table 7).

Emergency Room Visits

ER visits attributed to ACSCs were rare: when the marginal out-of-pocket cost was 1, 1.07% of individuals had an ER visit (Table 6). Having had a recent outpatient visit was associated with an increased likelihood of an ER visit (RR=1.377, CI: 1.285-1.475; Table 8). Compared to individuals for whom all ER costs were subject to the deductible, a higher percentage of individuals with ER copayments had >1 ER visits when the marginal out-of-pocket cost was 1 (1.1%, versus 0.7%; Table 6). Reaching the annual spending limit increased the risk of ER visits for individuals with ER copayments (RR=1.124, CI: 1.027-1.423; Table 8) but not for individuals for whom all ER visits were subject to the deductible.

Inpatient Visits

The percentage of individuals with an inpatient admission attributed to an ACSC was 0.3% (Table 6). Overall, having reached annual spending limits was associated with a decrease in the likelihood of an inpatient visit (RR=0.799, CI: 0.702-0.909; Table 9). Having a recent outpatient visit was associated with

an increased likelihood of an inpatient admission (RR=1.303, CI: 1.144-1.484; Table 9). The marginal out-of-pocket cost had a similar effect on inpatient admissions for individuals with and without outpatient copayments; however, having had a recent outpatient visit is only statistically significant for individuals with outpatient copayments (RR=1.374, CI: 1.195-1.581; Table 9).

Discussion and Policy Implications

Cost-sharing is intended to encourage individuals to be more deliberate in their utilization decisions – not to discourage them from obtaining needed care. This is critical because failing to obtain necessary care can lead to acute complications and costly ER visits and hospitalizations, especially for those with ACSCs (Bindman et al., 1995; Decker, Schappert, & Sisk, 2009). To-date, most studies on cost-sharing and utilization have examined differences across health plans or within an insurer across multiple years (Reddy et al., 2014; Borah, Burns, & Shah, 2011; Kephart, Skedgel, Sketris, Grootendorst, & Hoar, 2007; Maciejewski, Liu, Kavee, & Olsen, 2012; Trivedi, Moloo, & Mor, 2010). We extended previous research by capitalizing on a rich insurer dataset that included actual prices of services and monthly health risk. As hypothesized, decreases in marginal out-of-pocket cost were associated with increases in outpatient visits. Notably, we did not find the same effect on ER or inpatient visits. The findings of this study are consistent with prior work on the effect of cost on utilization; this study's focus on the growing non-group insurance market contributes new information to the literature.

High Deductible Health Plans

HDHPs have been referred to as a “blunt instrument” because they are associated with a decrease in utilization across all types of services without distinguishing between lower cost outpatient care and higher cost inpatient services (Department of Health and Human Services, 2014; Kozhimannil et al., 2013; Reddy et al., 2014; Reed et al., 2009; Wharam et al., 2013; Xin, 2015). We found that a lower percentage of individuals with HDHPs (deductibles over \$1,250, access to an HSA, and no copayments for outpatient care) use any services regardless of the marginal cost (Table 6).

Having a marginal out-of-pocket cost of 0 increased the likelihood of an ER visit for individuals with ER copayments but had no effect on ER visits for those without ER copayments. These findings could indicate that individuals without ER copayments are more conscious of the cost of ER visits and have an overall lower preference for care in this setting. It is important to note that individuals self-select

plans in the non-group market so it is likely that individuals who enrolled on a HDHP did so anticipating using less care.

The Role of Outpatient Care

There is some debate over whether outpatient and inpatient visits are complements or substitutes (Kaestner & Lo Sasso, 2015; Manning et al., 1987). The former suggests that individuals who access any healthcare service will be more likely to access additional services due to provider preferences or supply-side demand (Fisher et al., 2003; Kaestner & Lo Sasso, 2015). The substitution perspective argues that individuals will use outpatient services to maintain chronic conditions, rather than waiting until an exacerbation requires costly ER or inpatient visits. Contrary to our hypothesis, having an outpatient visit within the prior three months was associated with an increased likelihood of an ACSC-related ER or inpatient visit, suggesting they are complements. These results suggest that utilizing outpatient care may increase, rather than decrease, healthcare costs over the year.

Limitations

There were several limitations of this study. We focused on ACSCs among beneficiaries of a single insurer. Moreover, we restricted our sample to individuals with certain chronic diseases, and our outcomes included only selected PQIs. For these reasons, generalizability is limited. Also, our study period was one year. Other studies have found that when individuals were assigned to a HDHP by their employer they initially reduced utilization across all types of care, but then increased ER and inpatient visits in subsequent years (Fronstin & Roebuck, 2013; Wharam et al., 2013). It is possible that study findings would be different over a longer time period.

If an individual received a health shock that affected both the marginal out-of-pocket cost and required additional services, receipt of that follow-up care may appear to be motivated by the change in the marginal out-of-pocket cost rather than by doctors' decisions. However, we controlled for health status with inclusion of the health risk score variable, which was updated in every month of enrollment. As expected, the health risk variable controlled for the effect of poor health on increased utilization (Tables 7-9).

Conclusions

Changes in the marginal out-of-pocket cost due to nonlinearities of plan benefit design affect how individuals with ACSCs utilize healthcare services. Although routine outpatient services may not decrease the likelihood of ER or inpatient visits within a year, maintenance of chronic conditions is still critical to prevent potentially avoidable, costly services in subsequent years. Understanding how individuals in the non-group market respond to nonlinearities resulting from cost-sharing arrangements is of growing importance with recent health reform efforts including the expansion of the health insurance marketplaces and the rising popularity of HDHPs.

Tables

Table 5: Aim 2 Summary Statistics

	Frequency	Percent
Under 50	20,739	35%
Female	33,566	56%
New to this insurers	38,554	65%
ACA compliant plan	38,454	65%
Disease Conditions (not mutually exclusive)		
Asthma / COPD	17,092	29%
Diabetes	18,370	31%
Heart Conditions	8,261	14%
Hypertension	32,910	55%
Plan Types		
Outpatient and ER Copayments	49,239	83%
Outpatient Copayments Only	3,344	6%
HDHP	6,271	11%
No Copayments (not HDHP)	729	1%
Coinsurance Level		
Coinsurance (20%)	10,997	18%
Coinsurance (30%)	39,196	66%
Coinsurance (40%)	1,005	2%
Coinsurance (50%)	1,575	3%
No Coinsurance	6,810	11%
Total	59,583	

ACA = Affordable Care Act

COPD = Chronic Obstructive Pulmonary Disease

ER = Emergency Room

HDHP = High Deductible Health Plan

Table 6: Aim 2 Key Independent Variables by Marginal Price

	Entire Sample			Plan has Copayments for OP Visits*			Plan has No Copayments for OP Visits (High Deductible Health Plans)		
Marginal Cost of Care	1	Other	0	1	Other	0	1	Other	0
Had Outpatient Visit in the month? (percent)	36.11%	51.35%	58.83%	37.15%	52.16%	59.67%	28.57%	43.13%	55.02%
Emergency Room Visits (percent)	1.07%	1.28%	2.22%	1.13%	1.30%	2.42%	0.66%	1.08%	1.29%
Inpatient Visits (percent)	0.30%	0.60%	1.11%	0.31%	0.63%	1.17%	0.26%	0.35%	0.87%
Health Risk (mean)	0.86	1.66	2.1	0.88	1.71	2.13	0.76	1.12	1.97
Health Risk (median)	0.66	1.23	1.5	0.68	1.28	1.52	0.57	0.83	1.42
Enrolled more than six months (mean)	40%	64%	70%	39%	66%	69%	42%	48%	76%
Sample Size	N = 59,583			N = 52,583			N = 7,000		

*Generally on PPO and POS plans, copayments are the only charges associated with outpatient services, however because some services, or portions of those services, might not be eligible for copayments, individuals with copayments have a marginal cost of 1 until they meet their deductible.

Table 7: Risk Ratios for Receipt of At Least One Outpatient Visit in a Month

	Entire Sample	Plan has Copayments for OP Visits*	Plan has No Copayments for OP Visits (High Deductible Health Plans)
	Risk Ratio (95% CI)	Risk Ratio (95% CI)	Risk Ratio (95% CI)
Marginal Cost of Care (1)	REF	REF	REF
Marginal Cost of Care (Other)	1.063 (1.046 - 1.080)	1.044 (1.027 - 1.061)	1.290 (1.209 - 1.377)
Marginal Cost of Care (0)	1.104 (1.088 - 1.119)	1.095 (1.079 - 1.111)	1.265 (1.204 - 1.328)
Health Risk	1.756 (1.711 - 1.802)	1.752 (1.709 - 1.796)	1.680 (1.498 - 1.884)
Health Risk (squared)	0.949 (0.945 - 0.954)	0.949 (0.945 - 0.953)	0.957 (0.939 - 0.975)
Enrolled more than six months	0.967 (0.961 - 0.973)	0.965 (0.958 - 0.971)	0.996 (0.975 - 1.017)
Sample Size	N = 59, 583	N = 52,583	N = 7,000

OP = Outpatient

All models include individual fixed effects

95% confidence intervals (CI) in parenthesis

*Generally on PPO and POS plans, copayments are the only charges associated with outpatient services, however because some services, or portions of those services, might not be eligible for copayments, individuals with copayments have a marginal cost of 1 until they meet their deductible.

Table 8: Risk Ratios for Receipt of Emergency Room Visits in a Month

	Overall	Plan has Copayments for ER Visits	Plan has No Copayments for ER Visits (High Deductible Health Plans)
	Risk Ratio (95% CI)	Risk Ratio (95% CI)	Risk Ratio (95% CI)
Marginal Cost of Care (1)	REF	REF	REF
Marginal Cost of Care (Other)	0.740 (0.659 - 0.831)	0.706 (0.626 - 0.796)	1.246 (0.820 - 1.893)
Marginal Cost of Care (0)	1.080 (0.990 - 1.178)	1.124 (1.027 - 1.230)	1.004 (0.749 - 1.346)
Had an OP visit in the past three months	1.377 (1.285 - 1.475)	1.326 (1.237 - 1.423)	1.610 (1.281 - 2.023)
Health Risk	2.000 (1.819 - 2.198)	2.080 (1.914 - 2.260)	1.554 (1.312 - 1.841)
Health Risk (squared)	0.952 (0.940 - 0.965)	0.947 (0.935 - 0.958)	0.984 (0.968 - 1.000)
Enrolled more than six months	0.812 (0.773 - 0.852)	0.812 (0.772 - 0.855)	0.856 (0.724 - 1.012)
Sample Size	N = 59, 583	N = 49,239	N = 10,344

ER = Emergency Room

OP = Outpatient

All models include individual fixed effects

95% confidence intervals (CI) in parenthesis

Table 9: Risk Ratios for Receipt of Inpatient Visits in a Month

	Entire Sample	Plan has Copayments for OP Visits*	Plan has No Copayments for OP Visits (High Deductible Health Plans)
	Risk Ratio (95% CI)	Risk Ratio (95% CI)	Risk Ratio (95% CI)
Marginal Cost of Care (1)	REF	REF	REF
Marginal Cost of Care (Other)	0.635 (0.534 - 0.756)	0.638 (0.533 - 0.764)	0.613 (0.311 - 1.208)
Marginal Cost of Care (0)	0.799 (0.702 - 0.909)	0.825 (0.719 - 0.948)	0.642 (0.454 - 0.908)
Had an OP visit in the past three months	1.303 (1.144 - 1.484)	1.374 (1.195 - 1.581)	0.912 (0.626 - 1.327)
Health Risk	3.427 (3.064 - 3.834)	3.322 (2.968 - 3.718)	4.859 (2.854 - 8.272)
Health Risk (squared)	0.930 (0.918 - 0.942)	0.933 (0.921 - 0.945)	0.892 (0.832 - 0.958)
Enrolled more than six months	0.974 (0.892 - 1.064)	0.988 (0.900 - 1.085)	0.913 (0.699 - 1.193)
Sample Size	N = 59, 583	N = 52,583	N = 7,000

OP = outpatient.

All models include individual fixed effects

95% confidence intervals (CI) in parenthesis

*This group represents those individuals with copayments for outpatient services – there are no copayments for any inpatient visits in this sample

CHAPTER 5: THE EFFECT OF NARROW NETWORK PLAN SELECTION ON UTILIZATION AND COST

Introduction

The Affordable Care Act of 2010 (ACA) established Marketplaces for health insurance where individuals could access, and choose among, health plans from a variety of insurers. In 2014, the first year of Marketplace operation, plans with restricted provider networks, referred to as narrow network plans, were popular offerings, available to 92% of the population and comprising 48% of all ACA plans offered in the 2014 Marketplace (Bauman, Coe, Ogden, & Parikh, 2014). Narrow networks refer to health plans for which an insurer contracts with a limited group of providers in a range of specialties who accept lower reimbursement rates as a trade-off for higher patient volume (Kliff, 2014; Summer, 2015). With lower reimbursement rates to providers, insurers are able to offer lower premiums to beneficiaries choosing narrow network plans. In addition to the lower premiums, beneficiaries in narrow network plans have lower out-of-pocket costs for services offered by contracted providers compared to individuals in broad network plans – even when they see the same provider. In return for lower costs, beneficiaries' choice of providers is restricted; if beneficiaries in narrow network plans access services from providers not contracted to participate in the narrow network plan they could face higher out-of-pocket costs than if they had the same service performed by a participating provider.

Consumer interest in lower priced products in the Marketplace drove the creation of the narrow network products by the insurance industry. Individuals were attracted to the lower premiums; a 2014 survey of individuals enrolled on an ACA-compliant plan found that individuals on narrow network plans were more likely to report they chose one of the lowest priced products in the Marketplace (Bauman et al., 2014). While the lower costs enticed many individuals to sign up for narrow network plans in 2014, anecdotal reports and news stories indicated some individuals did not fully understand the incentives embedded in the structure of the narrow network plans (Polsky, 2015; Corlette, 2014). In this study we focus on individuals in the 2014 non-group market who had a choice to select a narrow network plan or a broad network plan. Using those in broad networks as a control group, we used statistical modeling to

determine the effect of narrow network plans on the number of outpatient visits, percent of visits with providers participating in the narrow network, and out-of-pocket costs to the beneficiary.

Background

ACA regulations limited insurers' traditional avenues to lower premiums by not allowing medical underwriting (calculating premiums based on an individual's risk and expected costs) and by requiring plans to cover a more substantial minimum level services (Polsky, 2015). Through contracting, insurers were able negotiate lower reimbursement costs with groups of providers and pass some of those savings along to beneficiaries in the form of lower premiums. On average, 2014 narrow network products had premiums 13%-17% lower than products with similar levels of cost-sharing (Bauman et al., 2014). Individuals were attracted to the lower premiums; a 2014 survey of individuals enrolled on an ACA-compliant plan found that individuals on narrow network plans were more likely to report they chose one of the lowest priced products in the Marketplace (Bauman et al., 2014).

Lowering insurance costs by restricting provider choice is not a new concept in health insurance. In the 1990s, managed care organizations experimented with narrow network plans and found some evidence of cost containment (Corlette, 2014; Hancock, 2013). Unlike traditional managed care plans such as Health Maintenance Organizations (HMOs), the narrow network plans in this study do not require permission from a primary care provider to see a specialist; and narrow network plans do provide coverage for out-of-network services. Narrow network plans are often preferred provider organizations (PPOs), which contract with groups of providers and facilities to offer in-network services to beneficiaries at reduced rates (Department of Health and Human Services, 2014). PPO beneficiaries pay more for care delivered by out-of-network providers and facilities. Typically out-of-network care is subject to higher out-of-network copayments, deductible limits, and coinsurance rate, and can have higher, or no, out-of-pocket maximum.

Narrow network PPOs are like broad network PPOs except insurers establish in-network contracts with a smaller number of providers. McKinsey and Company define network size by the percent of all hospitals in the rating area participating in the network; networks in which 31% - 70% of hospitals participate are called narrow and network with participation rates of 70% or more are deemed to be broad (Bauman et al., 2014). Many insurers offer similar cost-sharing structures (i.e. deductible, coinsurance,

and copayment combinations) on narrow network and broad network PPOs with the only difference being network breadth (J. Gruber, & McKnight, R., 2014). In terms of quality, there were no discernible difference in quality metrics between hospitals included in and excluded from narrow networks nationwide (Bauman et al., 2014).

Proponents of narrow network plans have postulated that they can facilitate better coordination of care by ensuring that patients receive more care from providers within a certain community or hospital group, making it more likely that providers have working relationships and / or compatible electronic medical records systems (Hancock, 2013). In addition to better care coordination, narrow network beneficiaries should benefit from lower premiums and lower cost of services. In practice, taking advantage of cost reductions can be challenging. First, not all individuals in a narrow network were aware of the plan restrictions on providers and facilities. A 2014 survey found that 26% of individuals enrolled on an ACA-compliant health plan were unaware of their plan's network size (Bauman et al., 2014; Polsky, 2015). Second, even if beneficiaries were aware of the restricted network, they still may have had problems identifying participating providers and facilities.

Using out-of-network services can have real consequences on the price of care to the beneficiary. Out-of-network care is subject to its own deductible, coinsurance, and copayments and, although there is variation in narrow network plans across the country, coinsurance, deductibles, and copayments can be two or three times larger for individuals seeking care out-of-network (Polsky, 2015). A national 2003 study found that, on average, the cost of out-of-network care was 7% higher than in-network care. The same study found that if high-cost PPO beneficiaries had accessed only in-network care, out-of-pocket costs would have been \$4,000 lower on average (McDevitt, Gabel, Gandolfo, Lore, & Pickreign, 2007).

Insurers introduced additional narrow network plans to the market in the second year of the Marketplace (2015) yet few studies of the effect of restricted provider networks have been conducted in the non-group market (Bauman, Bello, Coe, & Lamb, 2015; J. Gruber, & McKnight, R., 2014). In this paper we examined the extent to which narrow networks affected the number of outpatient visits, the percentage of visits with providers participating in the narrow network, and total out-of-pocket costs to the beneficiary, for individuals who chose a narrow network plan in 2014. We used a difference-in-difference model to control for (1) any differences in the year prior to the introduction of narrow networks between

individuals enrolled in a narrow network plans in 2014 and those not on a narrow network plan, and (2) any other exogenous occurrences that could have affected the outcome variables over the time of the study. We hypothesize that enrollment in a narrow network plan would not affect the number of outpatient visits but would increase the percentage of visits with providers participating in the narrow network and decrease total out-of-pocket costs. If this study finds individuals in narrow network plans did not change their behavior to visit a greater percent of participating providers, their health expenditures would be higher and enrollment in a narrow network plan could increase total out-of-pocket costs.

Methods

Data

The data for this study come from a large insurer in the southeastern United States. In 2014, this insurer was one of only two companies offering plans in the state Marketplace and in 2013, it had 86% of the non-group market (The Kaiser Family Foundation State Health Facts, 2013). We used 2013 and 2014 claims data to analyze utilization by each beneficiary in our sample. Typically, insurers do not release contractually-negotiated reimbursement rates, but this dataset included the price of care for all services, including the cost of care to the beneficiary.

Sample

The analytical sample included individuals who were: (1) enrolled on an ACA-compliant, non-group health plan for 12 months of 2014; (2) between the ages of 18 and 64 as of January 1, 2014 (working age adults who do not transition to Medicare); (3) in a 2014 narrow or broad network PPO plan; (4) lived in a county where narrow network plans were offered in the Marketplace; and (5) had 12 months of 2013 enrollment on a plan with the same insurer.

Outcome Variables

We have three main outcome variables: (1) outpatient visits, (2) the percentage of visits with participating providers, and (3) total out-of-pocket costs. Visits were identified using 2013 and 2014 claims and the year of the visit was assigned by the date the service began. We included both professional and facility claims but limited them to those where the provider designated for reimbursement was a physician or mid-level provider. We also excluded inpatient and emergency room

visits because we wanted visits to represent care which was more likely to have been planned in advance and for which individuals had more control over location and provider selection.

The provider or facility eligible for reimbursement on the first line of the claim was identified as the provider affiliated with that claim. Narrow network affiliation was a stable trait for providers, in that providers were identified as “participating” based on whether or not they were contracted to participate in the 2014 narrow network; however the distinction was used in the pre-period as well. The outcome variable, visits with a participating provider as a percentage of all outpatient visits, was continuous, and inclusive between 0 and 100%.

Total costs have two components: (1) all healthcare expenditures for which the beneficiary was responsible in each year of the study, and (2) annualized monthly premiums less any tax credits received (tax credits were relevant only in 2014). Costs were logged and capped at the 99th percentile to minimize the influence of outliers (Wooldridge, 2009).

Statistical Approach

In 2013, this insurer did not offer narrow network plans in the non-group market. In 2014, narrow network plans were introduced as an option in the Marketplace, along with broad network PPOs. We take advantage of this quasi-experimental situation by using a series of random-effect, difference-in-difference models to examine the effect of narrow networks on the number of outpatient visits, percent of visits with participating providers, and total out-of-pocket costs for individuals who chose a narrow network plan in 2014. A difference-in-difference model controls for observed differences between the treatment and control groups as well controlling for any extemporaneous changes to the outcome variable over the time period.

To ensure the control group will provide a satisfactory counterfactual, we examined pre-intervention trends in the outcome variables. If pre-intervention trends are not parallel than we would not have been able to confidently differentiate between the effect of the intervention and the natural progression of differences between the two groups (Ryan, Burgess, & Dimick, 2015). We examined average visits, percentage of visits with participating providers, and expenditures on outpatient visits in years 2011, 2012, and 2013 and found parallel trends between the two groups (not shown).

$$Outcome = \alpha + \delta(Narrow\ Network) + \rho Post + \gamma(Narrow\ Network * Post) + \beta X + \varepsilon$$

The key independent variable in this model was membership in a 2014 narrow network plan in the non-group market. Like identification of provider participation, narrow network affiliation was a stable trait for beneficiaries. The label of narrow network beneficiaries defines our groups in 2013 and 2014, even though the plans were only available in 2014. Those in the sample who did not enroll in a 2014 narrow network plan were referred to as broad network beneficiaries. In the model above, α was the intercept representing the pre-period (2013) for broad network beneficiaries. δ was the effect of the narrow network in the pre-period (2013); this is also the pre-period difference between the narrow and broad network groups.

This study spans two years: 2013 and 2014. In 2013 (pre-period), no members of the sample were enrolled in narrow network plans. In 2014 (post-period), narrow networks were introduced to the non-group market and all individuals in the sample had the choice to enroll in one of these plans or remain in a broad network PPO. ρ is the effect of the post-period (2014) on the outcome for the broad network beneficiaries, this also represents any changes in the outcome variable over the time period that were not a result of the introduction of the narrow networks.

γ , the effect of the narrow networks in the post-period, is the main effect of the model. This is the effect of the narrow network plan on the outcomes for those who selected a 2014 narrow network plan, controlling for extemporaneous changes and observable characteristics.

X represents other variables in the model. Health status, represented by the risk score, is included as a time varying control. Risk scores have been used in previous studies to represent health status (Albert, 2006; Thomas, 2006). We used an episode-based health risk score generated by an Ingenix Symmetry® algorithm accounting for age, sex, and healthcare claims from the previous 12 months (Symmetry® Episode Treatment Groups®, 2012). Our model utilized the prospective risk score, which combines demographics and claims data from the past 12 months to calculate a risk score that predicts the risk of an individual being high cost in the subsequent year (Symmetry® Episode Treatment Groups®, 2012). Two risk scores were generated for each individual in the sample – one created on January 31, 2013 to predict risk of high health expenditures in 2013 and the other created on January 31, 2014 for 2014 risk. In the pre-period the risk variable is the risk from 2013 and in the post-period it is the risk variable from

2014. When the outcome was the percentage of visits with a participating provider we also controlled for the number of visits in each year.

We ran fixed effect and random effects models and compared the coefficients on our main variables. We found no difference in the estimates and, since fixed effects methods are less efficient and, in this case, random effects methods were unbiased, we used random effects in our difference-in-difference models. Because we are using a random effects model we are able include additional time invariant controls. In these models we control for age, gender, and presence of chronic conditions (asthma/ COPD, health failure, hypertension, or diabetes). We also controlled for ACA specific factors such as an indicator for each rating regions in this state and any applied premium tax credits (APTCs) received by the beneficiary. Standard errors in the difference-in-difference models were obtained by bootstrapping over 1,000 replications (Ryan et al., 2015). All analyses were done in SAS (SAS Institute, 2011).

Results

The analytical sample contained 12,332 individuals, 37.5% of whom were in a narrow network health plan in 2014 (Table 10). There was no statistically significant difference between the mean age of the treatment and control groups (mean age 45) but females were less likely to choose a narrow network plan (55.6% vs. 59.1 %, $P<0.0001$). Individuals on narrow network plans were at a lower risk of having high healthcare expenditures ($P<0.0001$). Only 27.8% of individuals who enrolled on a narrow network plan had at least one of the following conditions: asthma/ COPD, diabetes, heart failure, and / or hypertension, while slightly more (29.9%) individuals on a broad network plan had one of such conditions ($P=0.012$). Individuals who joined narrow network plans had lower 2013 monthly premiums (\$282 vs. \$387, $P<0.0001$) and higher applied premium tax credits in 2014 (\$261 vs. \$203, $P<0.0001$) (Table 10).

Unadjusted Results

In Table 11, we present the unadjusted means for our three main outcome variables: (1) outpatient visits, (2) the percentage of visits with participating providers, and (3) total out-of-pocket costs. We calculated 95% confidence intervals (CI) around the means and we present the percentage change between years and groups.

Individuals both in narrow and broad networks saw increases in the mean number of visits with physicians or mid-level providers in between 2013 and 2014 (7% and 9% respectively) (Table 11). In both

2013 and 2014 mean number of visits for the narrow network group was 25%-27% lower than for the broad network group (Table 11).

In the pre-period, individuals in the narrow network group had a higher percentage of their outpatient visits with providers who participated in the narrow network compared to individuals not in the narrow network (2013 mean for individuals in narrow networks: 48.9% CI: 47.7%-50.1% vs. 2013 mean for individuals in broad networks: 44.2% CI: 43.3%-45.1%) (Table 11). While individuals in broad network plans had no significant change in the mean percentage of visits with participating providers, individuals in narrow networks had a 16% (unadjusted) increase in the percentage of visits with participating providers between 2013 to 2014 (Table 11).

The unadjusted results show that individuals in narrow network plans had lower mean total costs in both the pre-period (24.6% lower) and the post-period (28.9% lower). While total costs decreased between 2013 and 2014 for both groups, the mean unadjusted total cost for individuals in narrow network plans decreased more than for individuals in broad network plans (24.5% vs. 20.0%) (Table 11). Compared to premiums for broad network beneficiaries, premiums (which account for 77% of total costs) were 31% lower for individuals who selected a 2014 narrow network plan (they were 25.9% lower in 2013). Relative to 2013 premiums, individuals who selected a 2014 narrow network plan had a larger decrease in their 2014 premiums (25.3% vs. 19.8%) (Table 11). The difference in 2014 premiums was likely due to uneven receipt of APTCs between the narrow and broad network groups. Individuals in narrow network plans were more likely to have received an APTC, which were available to qualifying individuals in ACA-compliant plans only in 2014, than individuals on broad network plans (58% vs. 41%) (Table 10).

Difference-in-Difference Results

In Table 12 we present difference-in-difference model results with 95% CIs. Although the mean number of visits for individuals on narrow network plans was significantly higher in 2014 compared to 2013, controlling for pre-period differences and adjusting for risk and other variables make the effect of enrolling on a narrow network plan on outpatient visits statistically insignificant (Table 12). Controlling for observable characteristics and any extemporaneous changes, individuals who self-selected narrow network plans had an increase in the percent of outpatient visits with participating providers of 9.40

percentage points (CI: 7.24-11.55) and a decrease in total costs of 32.89% (CI: -41.36%- -24.41%) (Table 12).

Discussion

Narrow network plans were pervasive and popular choices for consumers in the first year of the health insurance Marketplaces. Although nationally there was much heterogeneity in the creation and execution of narrow network plans, the underlying concept was for insurers to offer a lower premium to individuals and, in return, beneficiaries were incentivized to visit a particular set of contracted providers, or face a penalty through a higher cost of services. To-date, very few studies have been conducted on the effect of narrow network plans on costs and utilization in the non-group market (J. Gruber, & McKnight, R., 2014). The results from our study support the idea that individuals who select narrow network plans can save money overall without reducing the number of outpatient visits. Moreover, consistent with incentives, these beneficiaries increased the percentage of visits with providers participating in the narrow network.

Reports of narrow networks stated that individuals chose narrow network plans because of the lower costs, specifically the plan premiums (Kliff, 2014; Summer, 2015). Our results provide direct empirical support for this finding. We found that the 2013 unadjusted, average monthly premium for the narrow network group was 21.9% lower than the average for the broad network group. 2013 premiums were medically underwritten, which means that lower premiums may have been a function of a healthier population. However, a higher percentage of individuals in narrow networks had deductibles over \$5,000 in 2013 (34.3% v. 26.6%). Individuals with higher deductibles would have had lower premiums as well providing evidence that individuals who selected 2014 narrow network plans had a preference for lower premiums over higher cost-sharing.

In the unadjusted results, individuals who selected narrow network plans were more likely to have been visiting participating providers in the pre-period. Compared to individuals who did not switch networks, individuals who joined narrow network plans in 2014 were more likely to see participating providers (48.9% vs. 44.2%). This is consistent with plan incentives which are, not to decrease utilization, but to steer individuals to participating, and therefore lower cost, providers. Individuals who chose to join

a narrow network in 2014 who were already seeing a participating provider would not have had a disruption to continuity of care.

We found support that the narrow networks do not decrease overall utilization. Individuals in the narrow network group had fewer outpatient visits in both 2013 and 2014, although care rose slightly for both groups in 2014. This is notable for two reasons: (1) individuals in the narrow networks were not deterred from accessing care; and (2) the observed decrease in out-of-pocket costs did not result from less outpatient care, but rather of a combination of lower premiums and lower cost of care.

We found evidence that narrow network enrollment was associated with an increased percentage of visits with participating providers. Narrow network plan beneficiaries were more likely to increase the percentage of visits they had with participating providers after joining the narrow network plan. These results suggest that, at least for individuals renewing health plans, beneficiaries were able to understand and follow the incentives of the narrow network plan to steer them to participating providers.

Individuals who selected a narrow network plan were generally at lower risk of being high cost compared to individuals on a broad network plan (risk scores for individuals on narrow network plans were 20% lower than risk scores for individuals on broad network plans), which could have implications for the percentage of visits an individual has with participating providers. Individuals who are less healthy or use more care may have established relationships with providers and those existing relationships might be difficult to break. Additionally, less healthy individuals may have more need for certain specialists and, although the networks should have a full range of providers in terms of number and type, individuals with special needs may have preferences that draw them out-of-network (Corlette, 2014).

Beneficiaries in broad network plans had only a very slight decrease in the unadjusted percentage of visits they had with participating providers. Since the overall number of outpatient provider visits increased in 2014, we can surmise that participating providers were seeing more patients because of the narrow networks. This is supported by evidence in other studies that found cost-sharing swayed visits to new providers but did not have an effect on existing provider relationships (Sinaiko & Rosenthal, 2014). Whether or not this increase in patients is enough to cover the decrease in the amount of reimbursement is outside the scope of this paper.

Results show that for this sample, enrollment in a 2014 narrow network plan was associated with a decrease in total out-of-pocket costs to the beneficiary. A large percentage of total costs (77%) were lower premiums associated with narrow network plans (premiums adjusted for APTCs), and the remainder of out-of-pocket costs were healthcare expenditures. Expenditures decreased between 2013 and 2014 for both narrow and broad network beneficiaries, but the decreases was 2 percentage points greater for narrow network beneficiaries, partially due to the lower cost of services resulting from the increase the percentage of visits with participating providers.

Limitations

There were several limitations to this study. Our study was conducted with one insurer, which limits generalizability. This is important because of the wide heterogeneity in narrow network plans nationally and the variation in implementation by state and by insurer (Schultz, 2014); (Giovannelli, 2015). However, the insurer in this study had a significantly large market share of the state's non-group health insurance beneficiaries, which makes this study generalizable within the state (The Kaiser Family Foundation State Health Facts, 2013). Second, we focus only on outpatient provider-based visits because they are more actionable, in that people have more ability to make decisions about where to go. Thus, we do not know the effect of narrow networks on unplanned emergency room and inpatient visits. Third, the sample for this study was composed of individuals who were continuously enrolled with this same insurer in 2013 and 2014. Due to the inclusion criteria of 12 months of 2013 enrollment, the average income level of the sample was higher than the average income of the total population of individuals enrolled on ACA-compliant plans in 2014. The higher income is evidenced by the lower percentage of individuals in our sample with an APTC (41.2%-58.3%) compared to the national average (86%) (Table 10) (Office of the Assistant Secretary for Planning and Evaluation, 2014). The results of this study may not apply to individuals who were new to health insurance in 2014 or to all low-income individuals.

Finally, our model may exhibit heterogeneous treatment effects. Individuals who self-select into a narrow network plan may differ from individuals who do not in unmeasured ways (e.g., they may be less prepared for, or aware of, narrow network plan guidelines) and as such they might not respond to plan incentives in the same way as those who purposively selected a narrow network plan. In 2014, enrollees in this study could choose to enroll in a narrow or broader network plan; all plans were self-selected and

not assigned. These findings could be different if individuals were forced into narrow network plans, for example if, in the future, health plans limit the availability of broader network plans.

Conclusions

Health insurance premiums and healthcare expenditures are projected to rise and health plans with narrow networks are one mechanism insurers are using to control costs (CBO, 2015). Narrow network plans offer individuals lower premiums and, in return, individuals are encouraged through cost-sharing to visit certain providers and facilities. Narrow network implementation was heterogeneous throughout the country with varied levels of success but the rising popularity of these products suggests more health plans may be trending towards restricted provider networks.

In this study, we found individuals who self-selected to enroll in a narrow network health plan had no effective change in the number of outpatient visits but higher proportion of their visits with participating providers. Utilizing in-network care is imperative for lowering out-of-pocket costs on a PPO. Individuals on narrow network plans under this particular insurer were able to adhere to plan incentives and therefore were able to enjoy lower total out-of-pocket costs compared to individuals who did not choose 2014 narrow network plans.

This study shows an example of one insurer under which the narrow network plans succeeded in lowering costs and steering individuals towards participating providers. It appears that individuals on narrow network plans responded to incentives on where to seek care. To ensure individuals in narrow network plans continue to comply with plan incentives and visit participating provider, more transparency may be needed on provider and facility participation in narrow networks (Corlette, 2014).

Tables

Table 10: Aim 3 Summary Statistics

Mean (unless indicated otherwise)	Narrow Network	Broad Network
N (12,332)	4,621 (37.5%)	7,711 (62.5%)
Female	55.6%	59.1%***
Age	45.4	45.3
On a family policy	71.3%	75.3%***
Health Status		
Presence Any Chronic Condition	27.8%	29.9%*
Health Risk Score (2013)	1.275	1.573 ***
Health Risk Score (2014)	1.366	1.687 ***
2013 Plan Information		
Low 2013 Deductible (below \$3,000)	43.3%	31.7%***
Medium 2013 Deductible (between \$3,000 - \$5,000)	30.1%	34.0%***
High 2013 Deductible (\$5,000 and higher)	26.6%	34.3%***
2013 Monthly Premium	\$ 281.52	\$ 386.94 ***
2014 Tax Credits		
Percent with applied premium tax credit	58.3%	41.2%***
Amount of applied premium tax credit (monthly)	\$ 261.21	\$ 203.39 ***

*, **, *** significantly difference from narrow network at $p < 0.01$, $p < 0.001$, and $p < 0.0001$ respectively

Table 11: Unadjusted Means (with 95% Confidence Intervals (CI)) and Percentage Change for Three Outcomes by Network and Year

	2013 Mean (95% CI)	2014 Mean (95% CI)	Percentage change from 2013 to 2014
Mean Visits			
Broad Network	7.28 (7.10- 7.46)	7.95 (7.76-8.13)	9.2%
Narrow Network	5.43 (5.25- 5.61)	5.80 (5.60- 5.99)	6.7%
Percent difference between narrow and broad networks	-25.4%	-27.0%	
Percent of Visits with Participating Providers			
Broad Network	44.2% (43.3%- 45.1%)	43.0% (42.1%- 43.9%)	-2.8%
Narrow Network	48.9% (47.7%- 50.1%)	56.7% (55.5%- 57.9%)	16.0%
Percent difference between narrow and broad networks	10.6%	32.0%	
Mean Total Costs to Beneficiary			
Broad Network	\$ 5,886 (\$ 5,792 - \$ 5,980)	\$ 4,704 (\$ 4,628 - \$ 4,781)	-20.0%
Narrow Network	\$ 4,432 (\$ 4,338 - \$ 4,526)	\$ 3,343 (\$ 3,259 - \$ 3,427)	-24.5%
Percent difference between narrow and broad networks	-24.6%	-28.9%	
Mean Adjusted Premiums (77% of 2014 Total Costs)			
Broad Network	\$ 4,514 (\$ 4,437 - \$ 4,591)	\$ 3,621 (\$ 3,559 - \$ 3,683)	-19.8%
Narrow Network	\$ 3,346 (\$ 3,275 - \$ 3,417)	\$ 2,498 (\$ 2,431 - \$ 2,566)	-25.3%
Percent difference between narrow and broad networks	-25.9%	-31.0%	
Mean Healthcare Expenditures (23% of 2014 Total Costs)			
Broad Network	\$ 1,327 (\$ 1,285 - \$ 1,368)	\$ 1,071 (\$ 1,036 - \$ 1,105)	-19.3%
Narrow Network	\$ 1,054 (\$ 1,005 - \$ 1,103)	\$ 828 (\$ 789 - \$ 868)	-21.4%
Percent difference between narrow and broad networks	-20.6%	-22.6%	

Table 12: Difference-in-Difference Model Results: Estimates and 95% Confidences Intervals (CI) for Three Outcomes

		Pre-period Non- Narrow Network	Pre-period Narrow Network	Post-period Non- Narrow Network	Post-period Narrow Network
Outpatient Visits	REF		-0.20 (-0.24 - -0.16)	0.08 (0.02 - 0.14)	-0.03 (-0.09 - 0.03)
Percent of Visits with Participating Providers (Percentage point change)	REF		5.42 (3.90 - 6.94)	-1.95 (-3.50 - -0.39)	9.40 (7.24 – 11.55)
Total Out-of-Pocket Costs (Percent change)	REF		-2.33% (-7.55% - 2.90%)	-50.65% (-58.70% - -42.59%)	-32.89% (-41.36% - -24.41%)

CHAPTER 6. DISCUSSION

Conclusions

Historically, the majority of studies on health insurance plan selection and the effect of insurance on healthcare utilization have been conducted in the public or employer-sponsored insurance markets, with few studies being conducted in the non-group market (Nadash & Day, 2014; M. V. Pauly & Nichols, 2002; Sommers, 2014). However, the non-group health insurance market operates differently than the market for public insurance or employer-sponsored insurance, offering individuals more choices of plans and requiring consumers to compare multiple plan options (Jost, 2014). Enactment of the ACA and the creation of the Marketplaces expanded the non-group health insurance market over 200% between 2013 and 2015 (Carman et al., 2015a). To ensure that consumers in this new and expanding market are able to make informed decisions when choosing a health insurance plan and using that plan to access healthcare services, policymakers and industry leaders need to understand the behavior of non-group health insurance beneficiaries. This dissertation focused specifically on plan selection, and the effect of plan selection on healthcare utilization, for individuals in the non-group health insurance market in the first year of ACA Marketplace operation.

Using data from a single insurer, I conducted analyses on the first year of Marketplace operation in a Federally-Facilitated Marketplace (a Marketplace in a state that opted to allow the Federal Government to manage Marketplace operations). This dissertation examined the range of health insurance related decisions that beneficiaries made, from choosing a plan to using that plan to access healthcare services. I focused on individuals who were not new to health insurance in 2014, but had the decision whether to enroll in a QHP through the ACA-established Marketplace or to re-enroll on a Grandfathered / Transitional plan. In separate analyses, I analyzed the effect of two aspects of health plans, network breadth and cost-sharing, on the utilization of healthcare services.

Summary of Findings

In analyzing plan selection and utilization I uncovered some common themes, namely the pervasive effects of health status and cost. First, I found evidence that less healthy individuals chose more generous plans; however, for some individuals, the cost of the monthly premium was the main determinant of plan selection. Plan generosity and premium price influenced the plan's cost-sharing structure, and I found evidence that cost-sharing impacted the number of outpatient visits and the choice of providers. Lastly, cost-sharing was not the only factor driving utilization; in addition to the effect of health status on plan selection, I found that less healthy individuals used exponentially more of all types of services (more outpatient, emergency room, and inpatient visits).

Plan Selection: The Influence of Health Status

In this dissertation, I found individuals who were at high-risk for high healthcare expenditures were more likely to enroll in a plan with greater actuarial value (aim 1) and less likely to enroll in a plan with a restricted provider network (aim 3). In aim 1, I examined characteristics associated with switching from a Grandfathered or Transitional plan to a QHP and, conditional on switching, the characteristics associated with selecting a metal level. I found that individuals at high-risk for high healthcare expenditures who had APTCs had lower odds of choosing a less generous plan compared to high-risk individuals without APTCs (odds of selecting a bronze plan over a silver plan: 0.40, CI: 0.30- 0.55) but found the opposite to be true for low-risk individuals with APTCs (odds of selecting a bronze plan over a silver plan compared to low-risk individuals without APTCs 1.35, CI: 1.09- 1.66). APTCs are available to low income individuals and can be applied to any metal level; the fact that high-risk individuals had lower odds of selecting a less generous plan with their APTCs demonstrates that they value more generous health insurance, prioritizing health insurance within limited budgets. These findings support the necessity of the APTCs in providing access to more generous health plans for low-income, high-risk individuals.

Choosing between plans with different breadths of provider networks is different than choosing between plans with different actuarial values; many narrow network plans have the same actuarial value as their broad network PPO counterparts. Although actuarial value could be the same, narrow network plans restrict the choice of provider which could disrupt continuity of care. In aim 3, we found that high-risk individuals, who are more likely to be obtaining care, were less likely to select a narrow network plan.

Plan Selection: The Influence of Premiums

Comparing unadjusted average premiums for individuals who chose to enroll in a narrow network QHP and those who also switched to a 2014 QHP but enrolled in a broad network PPO, I found those who selected a narrow network plan in 2014 had lower premiums in 2013. In 2013 the unadjusted, average monthly premium for individuals who were to self-select a narrow network plan in 2014 was 21.9% lower than those who joined a broad network PPO. Also, a higher percentage of individuals in 2014 narrow network plans had 2013 deductibles over \$5,000 (34.3% v. 26.6%, $P < 0.0001$) which also demonstrates their preference for lower premiums over other plan characteristics.

Aim 1 also provided evidence of the importance of lower premiums for some individuals. Individuals who had APTCs and were at low-risk of being high cost were more likely to select a plan with a lower premium (odds of selecting a bronze plan over a silver plan 1.35, CI: 1.09- 1.66). This finding suggests low-risk individuals were more likely to apply tax credits towards the purchase of less generous plans and save money on health insurance and thereby increasing their budget for other goods.

Overall, I found that some individuals value lower premiums over more generous plans and more provider options. Health insurance, even less generous health plans, provides a backstop against the potential of financial catastrophe resulting from a medical emergency. For some individuals who anticipate using fewer healthcare services, choosing less generous plans can be a reasonable option. Aim 2 shows that individuals who choose HDHPs, with lower premiums and higher cost-sharing, use less care overall. If using less care does not impact long term health (i.e., avoiding needed care) than low premium, high cost-sharing plans could be rational choices for individuals who do not prioritize health insurance.

Healthcare Utilization: The Influence of Cost-Sharing and Provider Networks

In aim 2, I used 2014 claims to assess the effect of intra-year variation in the marginal cost of care on outpatient and inpatient utilization by individuals in the non-group health insurance market. I concentrated on services for ACSCs, for which inpatient visits should be avoidable with access to quality and timely outpatient care. After controlling for health status and length of enrollment, I found that a decrease in the marginal cost of care was associated with an increased likelihood of an outpatient visit (RR = 1.104, CI: 1.088-1.119), but not emergency room visits (RR=1.080, CI: 0.990-1.178) or inpatient

admissions (RR=0.799, CI: 0.702-0.909). These findings support previous studies of cost-sharing on utilization, such as the RAND HIE which found a decrease in cost-sharing to be associated with increased outpatient utilization (Manning et al., 1987).

Individuals who self-selected HDHPs and therefore were responsible for 100% of costs until they reached the deductible (HDHPs provided no copayments for services) were less likely to have any healthcare visits regardless of the marginal cost of care compared to individuals who were only responsible for a copayment. However, when the marginal cost of accessing another unit of care was 0, individuals on HDHPs had a greater likelihood of using outpatient services (RR=1.265, CI: 1.204 - 1.328).

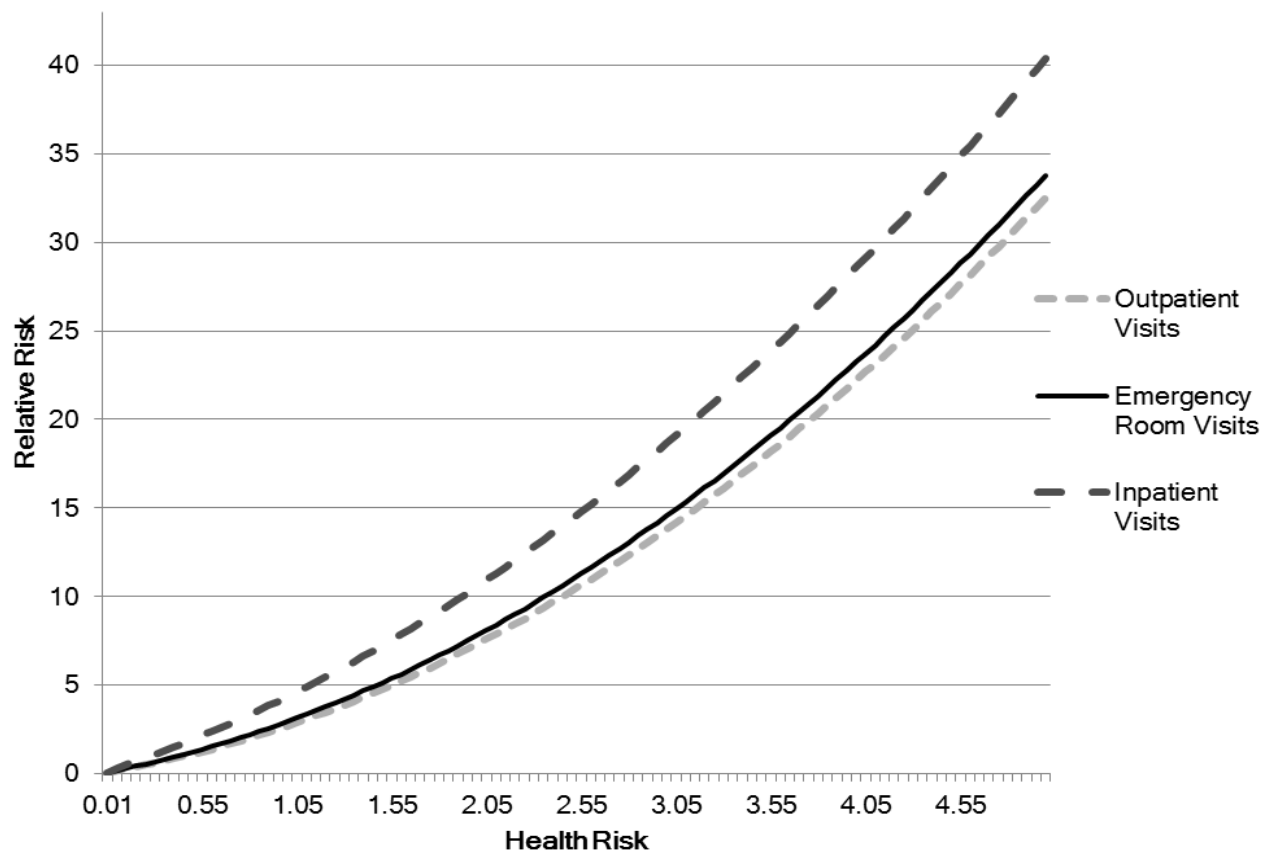
We found that although narrow networks did not change utilization of outpatient services in terms of quantity, they did have an effect on behavior with regards to provider selection. Individuals in narrow network plans who saw participating providers incurred lower costs than: (1) individuals in broad network plans who saw the same providers; and (2) lower costs than if they had the same services with non-participating providers. In aim 3 I examined the effect of narrow networks on outpatient visits, percent of visits with providers participating in the narrow network, and out-of-pocket costs to the beneficiary for individuals continuously enrolled in 2013 and 2014. Enrollment in the narrow network plan increased the percentage of visits individuals had with participating providers and, because individuals were able to adhere to provider steerage incentives, narrow network plan enrollment was associated with a decrease (32.89%) in total out-of-pocket costs to the beneficiary (however, a large portion of the savings was due to lower premiums associated with narrow network plans).

Findings from this dissertation suggest that selection of a healthcare plan can have real effects on utilization of care. As mentioned above, high-risk individuals tend to choose more generous plans, which is an encouraging sign for market operations. Since cost-sharing does impact utilization it is important that individuals who need more care enroll on more generous plans with lower cost-sharing. The Marketplace provides lots of plan options and, while over-insuring would also be a suboptimal outcome, it is important that individuals who anticipate high utilization are not putting too much weight on premiums and under-insuring on plans with low actuarial value.

Healthcare Utilization: The Influence of Health Status

In aim 2, we found an association between health status and utilization. Health status was operationalized as the risk that an individual will be less or more costly than the rest of the sample due to being more or less healthy (Symmetry® Episode Treatment Groups®, 2012). As health risk increases (indicating a decrease in health status), we see the relative risk of outpatient, emergency room, and inpatient services increase exponentially (Figure 3). Less healthy individuals have higher likelihood of accessing care, controlling for marginal cost of care. These results suggest that less healthy individuals are more likely to access care than healthier individuals; this is an indication that cost-sharing incentives are working as designed by neither preventing people from getting care they need nor incentivizing healthy individuals to get care they do not need.

Figure 2: Relative Risk of Utilization by Health Risk and Type of Visit



Policy Implications

The first year of the ACA provided a quasi-experimental situation which we were able to use to our advantage. ACA-compliant QHPs, with community rated premiums, minimum benefit requirements, and the option for restricted network plans, were introduced to the non-group market for the first time and individuals in this market had the option to switch to one of these QHPs or remain on their Grandfathered or Transitional plan. This dissertation adds an important contribution to the literature through the analysis of claims data from a large insurer with regards to the first year of operation in the Marketplace. This unique dataset, which included all services, costs, and plan benefits for beneficiaries in the non-group market, allowed me to conduct a thorough analysis of the response of beneficiaries to costs and benefits of health insurance. The results of these timely studies of an actively changing program have implications for future policies; this dissertation provides evidence of the importance of the APTCs in providing access to affordable insurance plans and the necessity of ensuring individuals have a solid understanding of the complicated details of health insurance benefits when selecting a plan.

The Importance of APTCs

This study provided support for the importance of the APTCs in ensuring access to affordable healthcare for consumers in the Marketplaces and provides positive indications of tax credit application. Through the APTCs, low-income individuals who anticipate high healthcare expenditures were able to purchase health plans with relatively high actuarial values. And, while APTCs were necessary for allowing individuals who need more generous health plans to purchase those plans, they did not encourage healthier individuals to over-insure. Although APTCs are important, their generosity might not go far enough; individuals with APTCs who were at high-risk for high healthcare expenditures had higher odds of selecting silver plans over bronze plans, but lower odds of selecting gold or platinum plans over silver plans compared to other high-risk but wealthier beneficiaries.

Understanding QHPs

The ACA required QHPs to set premiums using modified community ratings and to adhere to minimum benefit standards. I found evidence that individuals most likely to benefit from these requirements were more likely to have switched to a QHP in 2014. This suggests that, even in the first year of operation, individuals understood what made QHPs an attractive option over Grandfathered and

Transitional plans. The first year of the Marketplace was fraught with additional hardships from website failures, court challenges, negative press, and conflicting or inaccurate information, however, open enrollment in 2015 was smoother than 2014 and mistakes of the first year have been studied and absorbed, providing reason to think that the process will only improve in the future (Office of the Inspector General, 2014) (Grob, 2014).

Understanding Health Benefits

The non-group market requires individuals to self-select health plans from a large set of options. In this dissertation, I found evidence that individuals who selected a HDHP had a lower risk of an outpatient visit, emergency room visit, or an inpatient admission and used less care in 2014 and that individuals who selected a narrow network plan increased the percentage of visits with participating providers. These examples provide evidence that individuals understood the incentives of the plan structures they selected. While purposeful self-selection of health plans in year one is a positive sign for Marketplace operations, this study focused mainly on individuals who were enrolled in health plans in 2013, future policies need to ensure that individuals who are new to the market are also able to make informed decisions about plan selection. Additionally, as premiums continue to rise, policymakers need to revisit the question of purposeful selection to ensure that individuals continue to select plans based on a range of criteria and not just price (CBO, 2015).

Limitations

This study has several limitations. First of all, generalizability is limited because I used data from only one insurer. At the time of this study, this particular state was fairly unique in its lack of competition and dominance from one insurer. Although this particular insurer represented a large percentage of the non-group market in the state, every state had different experiences with implementation of the ACA and the execution of the Marketplaces. Also, the focus of this study (aims 1 and 3) was on individuals who were enrolled in health insurance plans in 2013 as well as 2014. Individuals on 2014 QHPs who had insurance prior to implementation of the ACA and the establishment of the Marketplaces were generally higher income and lower health risk than individuals who were new to health insurance in 2014. Both income and health risk have effects on outcome variables suggesting that results from this study might not hold for individuals new to insurance in 2014.

Secondly, each aim would have benefited had I controlled for income, however no accurate variable for income was available. Income plays a large role in which health insurance plans individuals choose and how they utilize healthcare. Health insurance is not the only good individuals purchase and as such premium payments are a trade-off for other goods and services. Also, health insurance is not the only cost involved in accessing care; healthcare services cost money even with health insurance and as such income also plays a role in how individuals with insurance access care.

Aim 3 results only apply to individuals who self-selected into a narrow network plan and the results may not be transferable to individuals who were forced into a narrow network plan, as is sometimes the case in the employer-sponsored health insurance market. However, in 2014 everyone in this sample was given the choice to enroll in a narrow or broad network plan. These findings could be different if individuals were forced into narrow network plans, for example if, in the future, health plans limit the availability of broader network plans.

Additionally, this study was conducted only on data from one year of Marketplace operation. Data from previous years of enrollment was used as a control but the focus was on experiences in the first year of the Marketplace. Studies of the first year of implementation of the major ACA provisions affecting the non-group market (guaranteed issue, the individual mandate, and the Marketplaces) are important because they provide early results from which policymakers and industry leaders can examine policy impacts and make adjustments to ensure the market is operating as desired. However, year one of Marketplace operations may not be indicative of future years as individuals, industry leaders, and policymakers learn more about the market and the market adapts to policy changes.

Future Directions

This dissertation used secondary data to provide a comprehensive snapshot of decision making regarding selection of health plans and utilization of insurance in the first year of the non-group health insurance Marketplace. The work conducted in this dissertation provided a foundation for future longitudinal studies and research involving primary data collection.

Longitudinal Studies

Individuals who are new to health insurance

Previously uninsured individuals who signed up in 2014 after having been closed out of the non-group market had higher utilization in the first few months of Marketplace operations, some of that might have been pent-up demand but it also could be a difference in proclivities towards healthcare utilization (Owen, 2015). Future studies should examine whether these higher rates of utilization retreat to the rate of the underlying population or whether individuals who were new to insurance in 2014 continue to behave differently than other health insurance beneficiaries.

More follow up / longer time periods

A full analysis of this population and the effect of QHP selection on health outcomes will require long-term studies. Future studies should examine the cumulative effect of years of enrollment in HDHPs, narrow network plans, and bronze metal level plans on health outcomes, especially for individuals with chronic conditions.

Primary Data Collection

Focus groups and surveys

Because individuals in the non-group market self-select health plans, it is important to know how much they understood about their choices and the extent to which their decision making was purposeful. Focus groups and surveys could be conducted to elicit opinions on market operations and the content, level and format of guidance that would be useful in informing future decisions.

Conjoint Analysis

Some individuals chose plans with low premiums because they expected to use less care; other individuals might have actually valued more generous plans and expected to use healthcare services but myopic preference led them to select a plan with a lower premium. Conjoint analysis and discrete choice models can be used to tease apart the health insurance attributes most important to individuals and help guide them to the plan that truly best fits their particular preferences.

Selection Tool

A useful future project would be the creation of a health plan selection tool that would incorporate past utilization, expected healthcare needs, risk tolerance, budgetary limitations, and provider

preferences in a way that would aid in consumer decision making. A benefit of this tool would be to help individuals better understand the trade-offs between lower premiums, cost-sharing, restricted provider networks, and plan generosity.

Conclusion

Unlike the public or employer-sponsored health insurance markets, in the non-group market individuals are offered a myriad of health plan options and must choose a plan in which to enroll. The ability to self-select a specific plan can be beneficial as long as individuals are knowledgeable about their choices and purposeful in their selection. Overall, the healthcare industry is experiencing a shift to a more consumer driven market. Through consumer driven health plans, increases in transparency and price tools, and the shift away from paternalistic care, individuals are becoming more engaged in all aspects of the healthcare system. The ACA Marketplaces increased the consumer-focused nature of the health insurance market through the individual mandate, minimum benefit requirements, and uniformity of metal levels.

The ACA has changed the non-group health insurance market. Although the majority of Americans still purchase health insurance through their employer, the non-group market for health insurance has been expanding while the percentage of individuals with employer-sponsored insurance has been in decline over the past decade (Blavin, Holahan, Kenney, & Chen, 2012; Carman, Eibner, & Paddock, 2015b; Gould, 2009). The mandate that US citizens have adequate health insurance coverage requires a functional and robust Marketplace. Industry leaders and policymakers need to understand behavior in this new Marketplace in order to both provide individuals with appropriate and useful information to aid in plan selection and to understand how future policy changes will affect behavior in this market. As ACA regulations and Marketplaces become more engrained in the health insurance system, we may see a wider expansion of the non-group market, or at least an expansion of the consumer driven aspects of this market. The ACA has fundamentally changed the health insurance industry, while exact details of how the system will look in the future are not certain, early analyses of ACA implementation can help industry leaders, policymakers, and consumer better navigate the market.

APPENDIX 1: SENSITIVITY ANALYSES FOR AIM 2

Dichotomized Risk

I tested model formation by operationalizing the risk score in different ways. One version of the model utilized two indicator variables for risk score: one to indicate a likelihood of high healthcare costs (top 75th percentile) and another to indicate a likelihood of lower healthcare costs (lower 25th percentile). These variables were created for ease of interpretation and to clearly capture the non-linear relationship between health and utilization. Another way to model non-linearity in an explanatory variable is with a quadratic (or squared) term. I compared the quasiliikelihood under the independence model information criterion (QIC) from the model run with the two indicator variables to the QIC for the model with a continuous and quadratic term for health risk. The QIC, similar to Akaike's information criterion (AIC) is a measure of goodness of fit for non-nested maximum likelihood estimation model. The AIC is a function of the number of parameters in the model and the log likelihood and the QIC is similar to the AIC except that quasiliikelihood instead of the log likelihood to better represent generalized estimation models (Hardin & Hilbe, 2003). With both the QIC and the AIC, the smallest value indicates the model with the best fit. QIC values for the model as run with continuous and quadratic risk versus the model with categorical risk are shown below for all three outcome measures (outpatient, emergency room visits, and inpatient admission) (Appendix 2 Table 1).

In addition to QIC, theory supports representing risk score as a continuous and quadratic term as we would expect the probability of higher utilization to increase exponentially with increased risk. The estimates on the continuous risk variables are positive and between 0 and 1 and the estimates on the quadratic terms are negative and between 0.001 and 0.1 - creating a graph that is concave upward with a positive slope.

Changing the formation of the risk score in the model altered the effect of some of the other variables in the model, with the largest effects on the risk ratios in the model where inpatient admission is the outcome variable (Appendix 2 Table 2). There was no statistically significant difference in the estimates in the model when outpatient visits is the outcome variable. For the models of emergency room (ER) visits, the effect of a marginal cost of care (MCC) of 0 is statistically significant different when the risk score is represented as a continuous / quadratic variable rather than a categorical variable. When the risk score

was operationalized as two categorical variables, having a marginal cost of zero was statistically significantly associated with an increase in ER visits; when the risk score was continuous the effect of a marginal cost of zero on ER visits was not significant (RR = 1.24, CI 1.15-1.35 versus RR = 1.08, CI: 0.99-1.18). Changing the health risk variable from two indicators to a continuous and quadratic variable had the largest impact on the risk ratios when the outcome was inpatient visits. When the risk score was operationalized as two categorical variables, having a marginal cost of zero was statistically significantly associated with an increase in inpatient admissions; when the risk score was continuous and quadratic the effect of a marginal cost of zero was not a statistically significant (RR = 1.24, CI 1.15-1.35 versus RR = 1.08, CI: 0.99-1.18). When the risk score was operationalized as two categorical variables, having a had an outpatient visits in the past three months was not statistically significantly but when the risk score was continuous and quadratic having a had an outpatient visits in the past three months was statistically significantly associated with an increase in inpatient admissions (RR = 0.93, CI 0.82-1.06 versus RR = 1.30, CI 1.114-1.48). The variable transformation likely has such a significant effect when the outcome was inpatient admissions because of the because of the strong association between health risk and inpatient visits.

Individuals Who Met Their Deductible / Out-of-Pocket Maximum

Over 50% of individuals in the sample were enrolled for twelve months of 2014 and 80% were enrolled for nine or more months. Only 23% of individuals in the sample reached their deductible limit and even fewer (16%) reached their annual spending maximum over the course of 2014. Five percent of the sample (3,000) had no PQI-related visits in 2014; however, 3% of these people reached their deductible limit (presumably using other services unmeasured in this study). 80% of the sample (48,000) had at least one outpatient visit but had no emergency room or inpatient visits and only 20% of these individuals (9,600) reached their deductible limit. Appendix 2 Table 3 presents the marginal cost of care for an individual in their final month of enrollment in the sample (the final enrollment month was between 6 and 12, as inclusion criteria required individuals to have been enrolled for at least six months in 2014).

Out-of-Network Visits and Costs

Networks are groups of providers and facilities who have contracted with insurers to provide services to beneficiaries of particular plans (Department of Health and Human Services, 2014). To the beneficiary, the cost of care differs depending on whether the provider and / or the facility are in- or out-of-network. Out-of-network care is generally more expensive for the beneficiary and subject to different plan benefits; plans have separate in- and out-of-network deductibles, coinsurances, and annual maximum spending limits. In this study I considered only in-network deductibles, coinsurances, and annual maximum spending limits when creating the marginal cost of care variable.

Only 15% of this sample was on a narrow network plan and, for beneficiaries of this particular insurer, beneficiaries not enrolled on a narrow network plan have fairly low probability of accessing out-of-network care. Approximately 5% of PQI-related outpatient visits attributable to this sample were out-of-network and only 2% of PQI-related emergency room visits and 3% of inpatient visits were out-of-network. Total spending by this sample on PQI-related out-of-network care in 2014 was only 4%-5% of the total costs incurred on in-network care.

Defining Chronic Conditions

The objective of this study was to quantify the effect of the marginal cost of care on receipt of different types of healthcare services. In addition to controlling for cost, health status, and time, the models for emergency room and inpatient services controlled for receipt of recent outpatient visits; the hypothesis was that a lower marginal cost of care would be associated with a higher likelihood that individuals would seek outpatient services and that, for individuals with certain chronic conditions, outpatient care could potentially reduce the likelihood of an emergency room or inpatient visit.

Cost-sharing can have different effects on utilization depending on the reason for accessing services (Newhouse, 2006; Basu et al., 2002). Utilization is commonly defined four ways. Marker conditions are events that requires emergency care and are generally not preventable through standard outpatient care, such as appendectomies or fractures (Basu et al., 2002; Billings et al., 1993; Holmes, 2014). Preventive care services include screening for disease, routine care for chronic conditions, and wellness visits (U.S. Preventive Services Task Force (USPSTF), 2015). Referral sensitive care includes services that are often elective, such as joint replacements and coronary angioplasty (Basu et al., 2002). Finally, services for

ambulatory care sensitive conditions (ACSC) are generally considered to be preventable through access to outpatient care (Basu et al., 2002).

ACSCs are featured in the Prevention Quality Indicators (PQIs), a tool created by the Agency for Healthcare Research and Quality (AHRQ) to measure adequacy of services throughout the healthcare continuum in a community. When applied to claims data, the PQIs can be used to identify potentially avoidable inpatient procedures (Agency for Healthcare Research and Quality, 2001). To quantify the effect of the marginal price on care received for ACSCs, the sample was restricted to individuals with: (1) Chronic Obstructive Pulmonary Disease (COPD) or Asthma, (2) Diabetes, (3) Heart Failure, (4) Hypertension, and / or (5) Coronary Heart Disease.

Nine PQIs related to these conditions were used to define outcome variables. Related to COPD and asthma were PQI 15 - Asthma in Younger Adults Admission Rate (18 -39 years old), and PQI 05 - Chronic Obstructive Pulmonary Disease (COPD) or Asthma in Older Adults Admission Rate (40 and older); related to diabetes were PQI 01 - Diabetes Short-Term Complications Admission Rate, PQI 03 - Diabetes Long-term Complications Admission Rate, PQI 14 - Uncontrolled Diabetes Admission Rate, and PQI 16 - Rate of Lower-Extremity Amputation Among Patients With Diabetes; related to Hypertension was PQI 07 - Hypertension Admission Rate, and related to Congestive Heart Failure (CHF) and Coronary Heart Disease were PQI 08 CHF Admission Rate and PQI 13 Angina without Procedure Admission Rate. Outcome variables were identified for inclusion using the International Classification of Diseases, 9th revision, Clinical Modification codes (ICD-9 codes) listed in the PQI documentation (Agency for Health Research and Quality, 2015).

Outcome Variables

Outpatient Visits

Outpatient visits were identified in the 2014 claims of a large commercial insurer. Outpatient visits were identified using ICD-9 codes listed in the PQIs as well as annual wellness visits, initial or period comprehensive preventive and physical examinations, or other valuation and management visits. Both professional and facility charges were used to identify outpatient visits. Professional claims were identified mainly by date and type of visit; any outpatient claims with place of service as “emergency room” were excluded. The facility claims are rolled up into cases (or events) with all the information for one visit

linked at the case level; any cases that included a claim with place of service as “emergency room” were excluded. Also included were visits specifically for imaging or lab tests. The rationale for including imaging and lab tests was that outpatient visits were used to represent maintenance for chronic conditions and a lab test (such as an A1C test for diabetes) or imaging (such as an electrocardiogram for a heart condition) can be viewed as routine care (e.g. HBA1C testing for diabetes).

Outpatient visits (and all outcomes in this study) were coded as binary variables; in any given month an individual either had one of the identified outpatient visits, or did not. Because of the way outpatient visits were operationalized in the model, not all of these visits are distinctly represented (e.g. if an individual had an imaging visits and a CHF-related visit and an E&M visit all in one month, the outcome variable was “1” indicating that that individual received routine outpatient care in that month).

Defining Emergency Room and Inpatient Visits

Similar to outpatient visits, emergency room visits are identified at the case level; in a case all claims relevant to an event are linked. If any claim associated with a case (care event) was identified as having occurred in the emergency room then that case was coded as an emergency room visit. Identifying visits at the case level has the added advantage of removing duplicate “visits” which are really only one visit with claims spanning multiple days. Emergency room visits exclude cases in which an individual was admitted through the emergency room; these are coded as inpatient visits. Inpatient visits are also defined at the case level and identified using facility charges.

Both emergency room and inpatient visits were identified using ICD-9 codes provided by AHRQ for identifying PQIs in claims data. The diagnosis and procedure codes included in the PQIs are specifically designed to identify events in an inpatient setting. The same set of ICD-9 diagnosis codes were used for outpatient, emergency room, and inpatient visits, however the procedure codes were only used to identify inpatient care. Procedure codes were relevant for hypertension, amputation due to diabetes, and all the heart conditions (Agency for Health Research and Quality, 2015).

Accounting for Duplicate or Overlapping Visits

Outpatient visits were intended to represent routine care and maintenance for chronic conditions. One objective of this study was to model the effect of the marginal cost of care and recent outpatient care on potentially avoidable inpatient visits. In practice, individuals may visit their primary care provider or

specialist for a concern they have regarding a chronic condition but, if the condition has not been properly cared for or has already worsened, the provider may suggest the individual be admitted for an emergency procedure or inpatient stay. For example, if a diabetic patient visits their provider in an outpatient setting for swollen feet and the doctor admits them that day or the next day there may be an outpatient visit and inpatient admission but they would both be related to the same event. Most likely, the individual intended to have an outpatient visit by seeing their provider in an office setting, however, their condition had already worsened to the point where they will now have an inpatient visit which potentially could have been avoided had they seen their provider earlier when the problem would still have been manageable in an outpatient setting. To systematically categorize overlapping (or nearly overlapping) outpatient and inpatient visits I adopted Medicare's 3-day payment window for reimbursement.

Medicare's 3-day payment window for reimbursement was established under a provision in law passed in 2010 regarding Medicare beneficiaries and pension relief (Centers for Medicare & Medicaid, 2014). The provision required that claims for inpatient visits must include "the diagnoses, procedures, and charges for all outpatient diagnostic services and admission-related outpatient nondiagnostic services that are furnished to the beneficiary during the 3-day (or 1-day) payment window," meaning that all outpatient charges were included in reimbursement for the inpatient visit. In our model, the rule was applied so that any outpatient visits that occurred within the three days prior to an inpatient admission were not classified as outpatient visits, but the inpatient admission did count towards that measured outcome.

Chronological proximity of Outpatient Visits

AHRQ defines ACSCs as "conditions for which good outpatient care can potentially prevent the need for hospitalization, or for which early intervention can prevent complications or more severe disease," (Agency for Healthcare Research and Quality, 2001). The documentation on the PQIs makes it clear that the tool is best used in terms of population health and, as such, the documentation does not make recommendations for specific individuals. Although the PQIs represent potentially avoidable conditions, not all events noted in the PQIs could have been avoided. Because each individual is unique and the severity of their condition is a function of genetics, ability to maintain the condition, comorbidities, socio-economic conditions, and a host of other factors, "good outpatient care" may differ from one individual to

the next. In this study, I am assuming that many of the individuals in my sample should expect to see an outpatient provider for their conditions at least once during the year – at the least, maintenance of these conditions may require medications with prescriptions requiring annual fills. Considering the timeframe for this study was one year, I defined a “recent” outpatient visit as one that occurred within the past three months. I created a variable with memory to indicate if an individual had at least one outpatient visit in the past three months or not.

I conducted a sensitivity analysis around the three month definition of recent outpatient care by broadening the definition to six months prior to an inpatient visit. Many of the results are robust to this definition change but not all (Appendix 2 Table 4, subgroup results not shown). When recent outpatient care was defined as three months a marginal cost of care of zero has no statistically significant effect on the likelihood of having an emergency room but, when the definition of recent was increased to six months, a marginal cost of care of zero does cross the threshold for statistical significance. In terms of clinical significance there was not much difference in the risk ratio for the marginal cost of care being zero between the three month and six months definitions (RR=1.08, CI:0.99-1.18 vs. RR=1.09, CI: 1.00-1.19).

Regardless of whether it was defined as three or six months, the effect of a recent outpatient visit on emergency room visits was positive; however, the impact of a recent outpatient visit has a greater impact on the probability of having an emergency room visit when the outpatient visit occurred in the past three months (RR= 1.38, CI = 1.29-1.48 vs. RR=1.24, CI: 1.15-1.34). All results for the two subgroups were robust to a change in the definition for recent outpatient visits with one exception in the subgroup of individuals with copayments for emergency room services; the impact of having had a recent outpatient visit was positive but the effect on the likelihood of an emergency room visit was larger when the outpatient visit occurred in the three months prior (RR=1.33, CI: 1.24-1.42 vs. RR=1.20, CI: 1.11-1.29).

When the outcome variable was inpatient admissions, all results for the entire sample and the two subgroups were robust to a change in the definition for recent outpatient visits with two exceptions. The impact of a recent outpatient visit has a statistically significant impact on the probability of having an inpatient admission when the outpatient visit occurred in the past three months, however when recent was defined as six months, the effect of an outpatient visit on the probability of an inpatient admission was no longer statistically significant (RR= 1.30, CI = 1.14-1.48 vs. RR=1.11, CI: 0.96-1.27). For the

subgroup of individuals with copayments for outpatient services, the impact of having had a recent outpatient visit was positive, but the effect on the likelihood of an inpatient admission was larger when the outpatient visit occurred in the three months prior (RR=1.37, CI: 1.19-1.58 vs. RR=1.18, CI: 1.01-1.37).

Types of Plans

The type of plan in which an individual was enrolled could impact the effect of the marginal cost of care on utilization. Individuals whose plans offer copayments for outpatient or emergency services, in general, pay an upfront amount for that visit, however not all outpatient visits, and not all services provided during those visits, are eligible for copayments (Department of Health and Human Services, 2014). Individuals with copayments may still receive a bill for outpatient visits or portions of outpatient visits. Alternatively, for individuals in the “no copayments” subgroups, individuals pay the entirety of all portions of all outpatient visits until the deductible is met.

The sample for this study was stratified into two subgroups: individuals with copayments for certain services and individuals for whom the outcome was always subject to the deductible. Ninety percent of individuals in the “no copayments” subgroup were on high deductible health plans (HDHPs). The US Government defines high deductible as any plan with a deductible of \$1,250 or higher, this distinction is used to qualify individuals for health savings accounts (HSAs) (Internal Revenue Service, 2015). HSAs are accounts where qualified individuals can save pre-tax dollars to use tax-free on healthcare expenses, the money is invested by the individual and belongs to the individual (i.e. the money rolls over from year-to-year) (Department of Health and Human Services, 2014). 729 people who had no copayments for any services (1.2% percent of the full sample) were ineligible for an HSA. 238 of these individuals had no copayments but were not on a HDHP. These individuals were on a qualified health plan (QHP; ACA-compliant plan) with \$0 deductibles; no other individuals in the sample had \$0 deductible. 446 individuals had in-network, individual deductibles of either \$10,000 or \$20,000; these plans are not ACA-compliant; the out-of-pocket maximum for in-network care in 2014 was \$6,350 for an individual.

I conducted a sensitivity analysis for including the 729 individuals without copayments or HSAs with the individuals on HDHPs in the no copayments subgroup. The results were robust to the inclusion of individuals without HSAs, no risk ratios were statistically significantly different (Appendix 2 Table 5). Since these individuals met the inclusion criteria, they were included in the sample.

Enrolled Months

The marginal price variable was a function of care used to-date. Individuals who were less healthy and individuals enrolled on a plan for a longer amount of time were likely to have utilized more care by a given month in the year than individuals who were healthier or had been enrolled on a plan for less time. To obtain a more pure effect of the marginal price on utilization, I controlled for health risk in every month (see Section: Risk Score Distribution and Table 1) and well as length of time on a plan. I operationalized length of enrollment as a binary indicator for whether or not an individual was enrolled on a plan for more than six months in any given month.

I conducted a sensitivity analysis using indicators for the number of months enrolled to date in the given month (up to twelve indicators for individuals enrolled the full twelve months). The results were robust to representing length of enrollment as monthly indicators. There were no statistically significant changes in the risk ratios (Appendix 2 Table 6)

Variance Inflation Factor

Because the marginal cost of care variable partially reflects health status and amount of time on a plan, I checked the variance inflation factor (VIF) score to determine if the model was violating the principle of multicollinariaty, correlation among the explanatory variables are correlated (Wooldridge, 2009). There is no defined cut-off for VIF scores (some researchers claims 10 is valid others use a cut-off of 2). In this model, all VIF scores were below 2 suggesting multicollinariaty is not a problem (Appendix 2 Table 7).

Marginal Cost of Care Indicators

The marginal cost of care variable could take on a value of 0, 1, or a percent equal to the coinsurance (if applicable). The variable was calculated on a monthly basis and changes in the variable are reflected in the subsequent month. A one month lag was introduced to the marginal cost of care variable. For example, if an individual reached their deductible during the month of May, the marginal price variable recognized this milestone in June. The lag was included to better represent real world behavior; because of claims delays, individuals may not immediately respond to changes in the marginal price.

The values of the marginal cost of care variable are mutually exclusive in any given month. The marginal price variable was operationalized as three mutually exclusive binary variables for whether or not an individual's marginal cost of care was (1) 0, (2) 1, or (3) "other," with the "other" variable including any values of the marginal price between 0 and 1. Not every subgroup has beneficiaries with all five coinsurance levels in the sample. Appendix 2 Table 8 displays the number of individuals in each subgroup by level of coinsurance.

I conducted a sensitivity analysis where, instead of operationalizing the marginal cost of care as three binary indicators, I operationalized care as six binary indicators for each of the possible levels of the marginal cost of care variable (Appendix Table 9). While some of the risk ratios on the individual marginal cost of care variables are significant, the other risk ratios of the other variables in the model are all robust to changes in the formation of the marginal cost of care variable. Because some of the marginal cost of care variables have small numbers of beneficiaries (especially in the subsections, see Table 8) I opted to include only three indicator variables for the marginal cost of care rather than six variables, one for each level of coinsurance.

Because I am using a Fixed Effects model, each individual is their own control. In any given month for a single individual, the marginal cost of care variable associated with an individual can only take on one of three possible levels (0,1, or a pre-defined percentage). The marginal price care variable is capturing the risk ratio for having a marginal cost of care equal to the coinsurance rather than the marginal cost of care being 100% for a particular individual. Because each person serves as their own control, there is less benefit in comparing the effect of a decrease in the marginal cost of care from 100% to 40% for individual 1 and the effect of a decrease in the marginal cost of care from 100% to 20% for individual 2.

Alternative Pathways

This model estimates the effects on receipt of emergency room and inpatient care of both receipt of recent outpatient care and the marginal cost of care. I conducted two separate sensitivity analyses capture the direct effect of receipt of outpatient care and marginal price. In sensitivity analysis 1, I looked at the direct pathway of the marginal cost of care on receipt of emergency room visits and inpatient visits (not controlling for recent outpatient visits). In sensitivity analysis 2, I checked the direct pathway of

outpatient care on receipt of emergency room visits and inpatient visits (not controlling for the marginal cost of care).

Figure 1: Conceptual Model

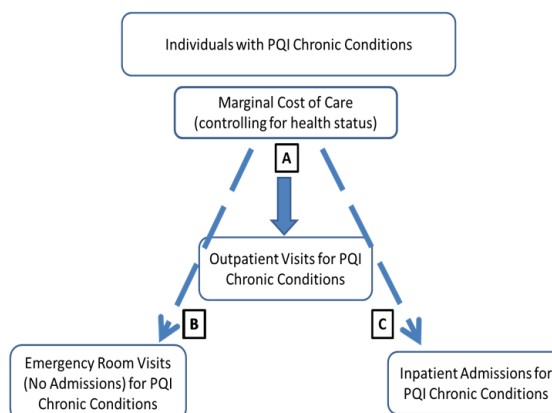


Figure 2: Sensitivity Analysis 1 (Direct Effect of Marginal Cost on ER and IP)

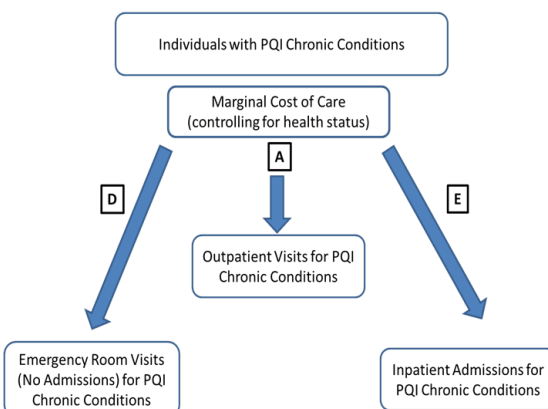


Figure 3: Sensitivity Analysis 2 (Direct Effect of Recent Outpatient Visits on ER and IP)

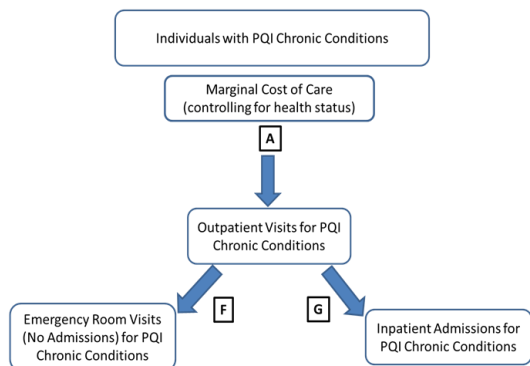
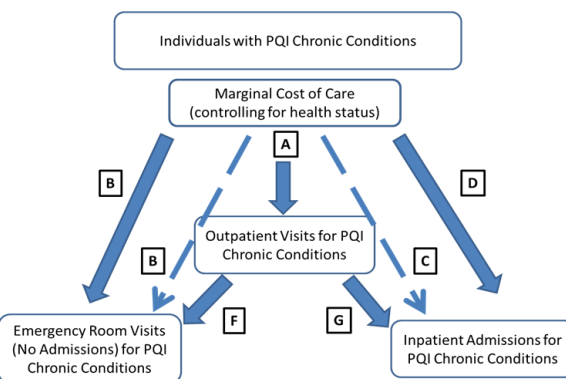


Figure 4: Aim 2 Conceptual Model (All Pathways)



The results are robust to receipt of recent outpatient care; controlling for outpatient visits does not significantly change the effect of the marginal cost of care on the likelihood of an emergency room or inpatient visit (Appendix Table 10). Only results for the entire sample are shown; results were similarly robust for subgroups (subgroup result tables available upon request).

The results are also robust to the inclusion of the marginal cost of care variable. There is no statistically significant change in effect of outpatient visits on likelihood of emergency room or inpatient when I do not control for the marginal cost of care in the model (Appendix 2 Table 11). Only results for the entire sample are shown; results were similarly robust for subgroups (subgroup result tables available upon request).

Individuals New to Insurance

An additional subgroup analysis was conducted in which I stratified by whether or not a beneficiary had a 2013 health plan with the same insurer as in 2014. Individuals were considered “renewing” if they had been insured with this insurer in previous year, even if they switched plans. Individuals were classified as “new” if they had not previously had an insurance plan with this particular insurer. The dataset did not allow for identification of whether individuals classified as “new” ever had insurance prior to 2014 or just switched from another insurer.

Individuals who were new to this particular insurer in 2014 had a higher baseline risk of an outpatient visit (41% versus 29%); however, reaching the annual spending limit had a smaller effect the likelihood of an outpatient visit (RR: 1.02, CI: 1.00-1.03 versus RR: 1.20, CI: 1.15-1.24) (Appendix 2 Table 12). Individuals who were new had a higher baseline risk of an emergency room visit before reaching their deductible (1.5% versus 0.5%) and a higher baseline risk of an inpatient admission compared to renewing individuals (0.4% versus 0.1%). Reaching annual spending limits reduced the risk of an inpatient admission for new individuals but had no significant effect on the risk of an inpatient admission for renewing individuals (RR=0.69 CI: 0.60-0.79 versus RR=1.02, CI: 0.71-1.47).

The effect of the marginal cost of care on outpatient visits and inpatient admissions is statistically significantly different for people who were new to this insurer in 2014 versus those who were renewing. People who were new did have a greater probability of an outpatient visit after reaching their annual limit but the risk ratio is significantly smaller than the effect of the change in the marginal care for renewing beneficiaries (RR = 1.02, CI: 1.00-1.03 versus RR = 1.20, CI: 1.15-1.24). For renewing individuals, having reaching annual spending limits does not significantly change the likelihood of inpatient admissions; for these individuals inpatient admissions are more significantly influenced by health risk (RR = 6.48, CI: 5.04-8.33). Although health risk has a large influence on receipt of inpatient admissions for both subgroups, the effect is significantly smaller for new individuals (RR =3.24, CI: 2.89-3.63, Appendix 2 Table 13). New individuals are less likely to have an inpatient admission when the marginal cost of care is 0 than when it is 1 (RR = 0.69, CI: 0.60-0.79). Having had an outpatient visit in the past three months has no significant effect on emergency room or inpatient admissions for new individuals, while having a recent outpatient visit increases the likelihood of both emergency room and inpatient admissions for renewing

individuals (RR =2.16, CI: 1.84-2.52 and RR = 1.68, CI: 1.29-2.19). These differences suggest that individuals who are new to this insurer (or to insurance in general) may use coverage differently than individuals who are familiar with their insurer. For renewing individuals with chronic conditions who are perhaps more familiar with how health insurance works or have an established relationship with their provider, these results suggest complementary care between outpatient and inpatient services.

Appendix 1: Tables

Table 13: QIC Comparison with Different Interpretations of Risk Score for all Three Outcomes

Outcome	Outpatient	Emergency Room	Inpatient
Categorical Risk	1,487,216.2317	78,696.6710	27,151.8614
Continuous / Quadratic Risk	0.0088	11,936.8348	5,486.2661
QICu			
Outcome	Outpatient	Emergency Room	Inpatient
Categorical Risk	1,487,211.2413	78,693.8104	27,150.5295
Continuous / Quadratic Risk	12.0088	11,946.1329	5,494.8650

Table 14: Sensitivity Analysis for Operationalizing the Risk Score Variable

Risk as Categorical				Risk as Continuous and Quadratic			
Outpatient Model (full sample)	RR	95%	CI	Outpatient Model (full sample)	95%	CI	95%
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	1.16	1.15	1.18	MCC = Other	1.10	1.09	1.12
MCC = 0	1.07	1.06	1.09	MCC = 0	1.06	1.05	1.08
Top 75 th of risk score	1.51	1.49	1.52	Risk Score (continuous)	1.76	1.71	1.80
Bottom 25th of risk score	0.43	0.42	0.43	Risk Score (quadratic)	0.95	0.94	0.95
Enrolled more than 6 months	0.93	0.93	0.94	Enrolled more than 6 months	0.97	0.96	0.97
Emergency Room Model (full sample)	RR	95%	CI	Emergency Room Model (full sample)	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.79	0.70	0.88	MCC = Other	0.74	0.66	0.83
MCC = 0	1.24	1.15	1.35	MCC = 0	1.08	0.99	1.18
Had an outpatient visit in the past 3 months	1.16	1.08	1.24	Had an outpatient visit in the past 3 months	1.38	1.29	1.47
Top 75 th of risk score	2.36	2.23	2.50	Risk Score (continuous)	2.00	1.82	2.20
Bottom 25th of risk score	0.42	0.39	0.46	Risk Score (quadratic)	0.95	0.94	0.97
Enrolled more than 6 months	0.78	0.74	0.82	Enrolled more than 6 months	0.81	0.77	0.85
Inpatient Model (full sample)	RR	95%	CI	Inpatient Model (full sample)	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.86	0.74	1.01	MCC = Other	0.64	0.53	0.76
MCC = 0	1.35	1.21	1.51	MCC = 0	0.80	0.70	0.91
Had an outpatient visit in the past 3 months	0.93	0.82	1.06	Had an outpatient visit in the past 3 months	1.30	1.14	1.48
Top 75 th of risk score	11.98	10.57	13.58	Risk Score (continuous)	3.43	3.06	3.83
Bottom 25th of risk score	0.06	0.03	0.12	Risk Score (quadratic)	0.93	0.92	0.94
Enrolled more than 6 months	0.79	0.72	0.86	Enrolled more than 6 months	0.97	0.89	1.06
MCC = Marginal Cost of Care RR = Risk Ratio CI = Confidence Interval							

Table 15: Marginal Cost of Care by Maximum Enrolled Month

	MCC = 1 (Never Reached Deductible)		MCC = Other (Paying Coinsurance)		MCC = 0 (Reached OOP Max)		Total (Maximum Number of Months Enrolled)	
	N	Percent of Total Sample	N	Percent of Total Sample	N	Percent of Total Sample	N	Percent of Total Sample
Month 6	1,290	2%	94	0%	166	0%	1,550	3%
Month 7	1,493	3%	118	0%	281	0%	1,892	3%
Month 8	5,914	10%	424	1%	1,432	2%	7,770	13%
Month 9	5,112	9%	401	1%	1,435	2%	6,948	12%
Month 10	3,554	6%	294	0%	1,044	2%	4,892	8%
Month 11	3,501	6%	340	1%	1,103	2%	4,944	8%
Month 12	24,692	41%	2,991	5%	3,905	7%	31,588	53%
Total	45,556	76%	4,662	8%	9,366	16%	59,584	100%

MCC = Marginal Cost of Care
OOP Max = Out-of-Pocket Maximum

Table 16: Sensitivity Analysis for Definition of “Recent” Outpatient Visit

Full Sample – 3Month Definition				Full Sample – 6 Month Definition			
Emergency Room Visits with Outpatient Visits	RR	95%	CI	Emergency Room Visits with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.74	0.66	0.83	MCC = Other	0.75	0.66	0.84
MCC = 0	1.08	0.99	1.18	MCC = 0	1.09	1.00	1.19
Had an outpatient visit in the past 3 months	1.38	1.29	1.48	Had an outpatient visit in the past 6 months	1.24	1.15	1.34
Risk Score (continuous)	2.00	1.81	2.20	Risk Score (continuous)	2.04	1.86	2.25
Risk Score (quadratic)	0.95	0.94	0.97	Risk Score (quadratic)	0.95	0.94	0.96
Enrolled more than 6 months	0.81	0.77	0.85	Enrolled more than 6 months	0.81	0.77	0.85
Inpatient Admissions with Outpatient Visits	RR	95%	CI	Inpatient Admissions with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.64	0.53	0.76	MCC = Other	0.64	0.54	0.76
MCC = 0	0.80	0.70	0.91	MCC = 0	0.81	0.71	0.92
Had an outpatient visit in the past 3 months	1.30	1.14	1.48	Had an outpatient visit in the past 6 months	1.11	0.96	1.27
Risk Score (continuous)	3.43	3.06	3.83	Risk Score (continuous)	3.47	3.10	3.88
Risk Score (quadratic)	0.93	0.92	0.94	Risk Score (quadratic)	0.93	0.92	0.94
Enrolled more than 6 months	0.97	0.89	1.06	Enrolled more than 6 months	0.98	0.90	1.07

MCC = Marginal Cost of Care
 RR = Risk Ratio
 CI = Confidence Interval

Table 17: Sensitivity Analysis for Inclusion of Individuals with No Copayments and No HSA

All individuals without copayments for outpatient services				High Deductible Health Plan Only			
Outpatient Model	RR	95%	CI	Outpatient Model	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	1.27	1.20	1.32	MCC = Other	1.31	1.17	1.48
MCC = 0	1.29	1.21	1.37	MCC = 0	1.23	1.17	1.29
Risk Score (continuous)	1.68	1.50	1.88	Risk Score (continuous)	1.66	1.48	1.86
Risk Score (quadratic)	0.96	0.94	0.98	Risk Score (quadratic)	0.96	0.94	0.98
Enrolled more than 6 months	0.10	0.98	1.02	Enrolled more than 6 months	1.01	0.99	1.04
Emergency Room with Outpatient Visits	RR	95%	CI	Emergency Room with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	1.25	0.82	1.89	MCC = Other	0.79	0.33	1.92
MCC = 0	1.00	0.75	1.35	MCC = 0	0.87	0.64	1.16
Had an outpatient visit in the past 3 months	1.61	1.28	2.02	Had an outpatient visit in the past 3 months	1.36	1.06	1.74
Risk Score (continuous)	1.55	1.31	1.84	Risk Score (continuous)	1.57	1.35	1.83
Risk Score (quadratic)	0.98	0.97	1.00	Risk Score (quadratic)	0.98	0.97	0.10
Enrolled more than 6 months	0.86	0.72	1.01	Enrolled more than 6 months	0.93	0.77	1.11
Inpatient Model with Outpatient Visits	RR	95%	CI	Inpatient Model with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.61	0.31	1.21	MCC = Other	1.27	0.49	3.30
MCC = 0	0.64	0.45	0.91	MCC = 0	0.65	0.45	0.93
Had an outpatient visit in the past 3 months	0.91	0.62	1.33	Had an outpatient visit in the past 3 months	0.75	0.49	1.14
Risk Score (continuous)	4.86	2.85	8.27	Risk Score (continuous)	4.73	2.76	8.12
Risk Score (quadratic)	0.89	0.83	0.96	Risk Score (quadratic)	0.90	0.83	0.96
Enrolled more than 6 months	0.91	0.70	1.19	Enrolled more than 6 months	0.94	0.70	1.25

MCC = Marginal Cost of Care
 RR = Risk Ratio
 CI = Confidence Interval

Table 18: Sensitivity Analysis of Operationalization of Time Enrolled

Full Sample– 6 month Binary Indicator for Time				Full Sample – 12 Indicators for Months			
Outpatient Visits	RR	95%	CI	Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	1.06	1.05	1.08	MCC = Other	1.06	1.05	1.08
MCC = 0	1.10	1.09	1.12	MCC = 0	1.11	1.09	1.12
Risk Score (continuous)	1.76	1.71	1.80	Risk Score (continuous)	1.75	1.71	1.80
Risk Score (quadratic)	0.95	0.95	0.95	Risk Score (quadratic)	0.95	0.95	0.95
Emergency Room with Outpatient Visits	RR	95%	CI	Emergency Room with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.74	0.66	0.83	MCC = Other	0.76	0.68	0.86
MCC = 0	1.08	0.99	1.18	MCC = 0	1.10	1.01	1.21
Had an outpatient visit in the past 3 months	1.38	1.29	1.48	Had an outpatient visit in the past 3 months	1.42	1.32	1.53
Risk Score (continuous)	2.00	1.82	2.20	Risk Score (continuous)	1.99	1.81	2.19
Risk Score (quadratic)	0.95	0.94	0.97	Risk Score (quadratic)	0.95	0.94	0.97
Inpatient Admissions with Outpatient Visits	RR	95%	CI	Inpatient Admissions with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.64	0.53	0.76	MCC = Other	0.64	0.54	0.77
MCC = 0	0.80	0.70	0.91	MCC = 0	0.80	0.70	0.92
Had an outpatient visit in the past 3 months	1.30	1.14	1.48	Had an outpatient visit in the past 3 months	1.37	1.19	1.57
Risk Score (continuous)	3.43	3.06	3.83	Risk Score (continuous)	3.41	3.05	3.82
Risk Score (quadratic)	0.93	0.92	0.94	Risk Score (quadratic)	0.93	0.92	0.94
MCC = Marginal Cost of Care RR = Risk Ratio CI = Confidence Interval							

Table 19: Variance Inflation Factor Scores

Variable	Parameter Estimate	Standard Error	t Value	Pr > t	Variance Inflation Factor
Intercept	0.3807	0.00276	138.04	<.0001	0
Marginal Cost of Care	-0.10159	0.00217	-46.89	<.0001	1.21366
Retrospective Risk	0.10551	0.000638	165.38	<.0001	1.15556
Indicator of 6 Months Enrolled	-0.00154	0.000187	-8.26	<.0001	1.05444

Table 20: Coinsurance Size by Subgroup

Coinsurance	HDHP N = 6,271	OP and ER Copay N = 49,239	OP Copay Only (no ER Copay) N = 3,344	No Copays N = 729	Total N = 59,583
0	5,569	594	239	408	6,810
20%	99	10,163	697	38	10,997
30%		37,721	1,403	72	39,196
40%			1,005		1,005
50%	603	761		211	1,575

OP = Outpatient
ER = Emergency Room

Table 21: Sensitivity Analysis for Operationalizing Marginal Cost of Care Indicators

Full Sample - 3 MCC Indicator Variables				Full Sample - 6 MCC Indicator Variables			
Outpatient Visits	RR	95%	CI	Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	1.06	1.05	1.08	MCC = 20	1.08	1.05	1.10
				MCC = 30	1.06	1.04	1.08
				MCC = 40	0.88	0.77	1.00
				MCC = 50	1.06	1.00	1.14
MCC = 0	1.10	1.09	1.12	MCC = 0	1.11	1.09	1.12
Risk Score (continuous)	1.76	1.71	1.80	Risk Score (continuous)	1.75	1.71	1.80
Risk Score (quadratic)	0.95	0.95	0.95	Risk Score (quadratic)	0.95	0.95	0.95
Enrolled more than 6 months	0.97	0.96	0.97	Enrolled more than 6 months	0.97	0.96	0.98
ER Visits with Outpatient Visits	RR	95%	CI	ER Visits with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.74	0.66	0.83	MCC = 20	0.67	0.56	0.81
				MCC = 30	0.81	0.70	0.94
				MCC = 40	0.31	0.12	0.81
				MCC = 50	0.75	0.48	1.17
MCC = 0	1.08	0.99	1.18	MCC = 0	1.08	0.99	1.18
Had an outpatient visit in the past 3 months	1.38	1.29	1.48	Had an outpatient visit in the past 3 months	1.38	1.29	1.48
Risk Score (continuous)	2.00	1.82	2.20	Risk Score (continuous)	2.00	1.82	2.20
Risk Score (quadratic)	0.95	0.94	0.97	Risk Score (quadratic)	0.95	0.94	0.96
Enrolled more than 6 months	0.81	0.77	0.85	Enrolled more than 6 months	0.81	0.78	0.86

Table 21: Sensitivity Analysis for operationalizing Marginal Cost of Care Indicators (continued...)

Inpatient Admissions with Outpatient Visits	RR	95%	CI	Inpatient Admissions with Outpatient Visits	95%	CI	RR
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.64	0.53	0.76	MCC = 20	0.64	0.51	0.81
				MCC = 30	0.61	0.48	0.78
				MCC = 40	0.57	0.16	2.01
				MCC = 50	0.92	0.50	1.69
MCC = 0	0.80	0.70	0.91	MCC = 0	0.80	0.71	0.91
Had an outpatient visit in the past 3 months	1.30	1.14	1.48	Had an outpatient visit in the past 3 months	1.31	1.15	1.49
Risk Score (continuous)	3.43	3.06	3.83	Risk Score (continuous)	3.42	3.06	3.82
Risk Score (quadratic)	0.93	0.92	0.94	Risk Score (quadratic)	0.93	0.92	0.94
Enrolled more than 6 months	0.97	0.89	1.06	Enrolled more than 6 months	0.98	0.90	1.07
MCC = Marginal Cost of Care RR = Risk Ratio CI = Confidence Interval ER = Emergency Room							

Table 22: Sensitivity Analysis 1 (Direct Effect of Marginal Cost on ER and IP)

Full Sample - With Outpatient Visits					Full Sample - No Controlling for Outpatient Visits			
Emergency Room Visits	RR	95%	CI		Emergency Room Visits	RR	95%	CI
MCC = 1	1.00	REF	REF		MCC = 1	1.00	REF	REF
MCC = Other	0.74	0.66	0.83		MCC = Other	0.76	0.67	0.85
MCC = 0	1.08	0.99	1.18		MCC = 0	1.10	1.01	1.20
Had an outpatient visit in the past 3 months	1.38	1.29	1.48					
Risk Score (continuous)	2.00	1.82	2.20		Risk Score (continuous)	2.11	1.91	2.32
Risk Score (quadratic)	0.95	0.94	0.97		Risk Score (quadratic)	0.95	0.93	0.96
Enrolled more than 6 months	0.81	0.77	0.85		Enrolled more than 6 months	0.83	0.79	0.87
Inpatient Admissions	RR	95%	CI		Inpatient Admissions	RR	95%	CI
MCC = 1	1.00	REF	REF		MCC = 1	1.00	REF	REF
MCC = Other	0.64	0.53	0.76		MCC = Other	0.64	0.54	0.77
MCC = 0	0.80	0.70	0.91		MCC = 0	0.81	0.71	0.92
Had an outpatient visit in the past 3 months	1.30	1.14	1.48					
Risk Score (continuous)	3.43	3.06	3.83		Risk Score (continuous)	3.51	3.14	3.92
Risk Score (quadratic)	0.93	0.92	0.94		Risk Score (quadratic)	0.93	0.92	0.94
Enrolled more than 6 months	0.97	0.89	1.06		Enrolled more than 6 months	0.99	0.90	1.08
MCC = Marginal Cost of Care RR = Risk Ratio CI = Confidence Interval								

Table 23: Sensitivity Analysis 2 (Direct Effect of Recent Outpatient Visit on ER and IP)

Full Sample - with Marginal Cost of Care					Full Sample – no Marginal Cost of Care			
Emergency Room Visits	RR	95%	CI		Emergency Room Visits	RR	95%	CI
MCC = 1								
MCC = Other	0.74	0.66	0.83					
MCC = 0	1.08	0.99	1.18					
Had an outpatient visit in the past 3 months	1.38	1.29	1.48		Had an outpatient visit in the past 3 months	1.38	1.29	1.48
Risk Score (continuous)	2.00	1.82	2.20		Risk Score (continuous)	1.99	1.82	2.18
Risk Score (quadratic)	0.95	0.94	0.97		Risk Score (quadratic)	0.95	0.94	0.97
Enrolled more than 6 months	0.81	0.77	0.85		Enrolled more than 6 months	0.81	0.77	0.85
Inpatient Admissions	RR	95%	CI		Inpatient Admissions	RR	95%	CI
MCC = 1								
MCC = Other	0.64	0.53	0.76					
MCC = 0	0.80	0.70	0.91					
Had an outpatient visit in the past 3 months	1.30	1.14	1.48		Had an outpatient visit in the past 3 months	1.28	1.12	1.46
Risk Score (continuous)	3.43	3.06	3.83		Risk Score (continuous)	3.26	2.93	3.61
Risk Score (quadratic)	0.93	0.92	0.94		Risk Score (quadratic)	0.93	0.92	0.94
Enrolled more than 6 months	0.97	0.89	1.06		Enrolled more than 6 months	0.91	0.84	0.99

MCC = Marginal Cost of Care
 RR = Risk Ratio
 CI = Confidence Interval

Table 24: Probabilities of Outcomes

New Subgroup	MCC = 1	MCC = Other	MCC = 0		Renewing subgroup	MCC = 1	MCC = Other	MCC = 0
OP Visits (percent)	41.0%	53.8%	59.8%		OP Visits (percent)	29.0%	48.5%	52.2%
ER Visits (percent)	1.5%	1.5%	2.4%		ER Visits (percent)	0.5%	1.0%	0.9%
IP Visits (percent)	0.4%	0.6%	1.2%		IP Visits (percent)	0.1%	0.6%	0.7%
Health Risk (mean)	0.90	1.48	2.15		Health Risk (mean)	0.81	1.87	1.76
Health Risk (median)	0.68	1.11	1.54		Health Risk (median)	0.64	1.37	1.30
Enrolled more than 6 months (mean)	35.3%	56.4%	68.7%		Enrolled more than 6 months (mean)	45.9%	73.8%	78.3%
OP = Outpatient ER = Emergency Room IP = Inpatient MCC = Marginal Cost of Care								

Table 25: Risk Ratios for Subgroup Analysis: New and Renewing

New Individuals				Renewing Individuals			
Outpatient Visits	RR	95%	CI	Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	1.08	1.06	1.10	MCC = Other	1.09	1.06	1.12
MCC = 0	1.02	1.00	1.03	MCC = 0	1.20	1.15	1.24
Risk Score (continuous)	1.66	1.62	1.70	Risk Score (continuous)	2.16	2.06	2.26
Risk Score (quadratic)	0.96	0.95	0.96	Risk Score (quadratic)	0.91	0.90	0.92
Enrolled more than 6 months	0.98	0.98	0.99	Enrolled more than 6 months	1.02	1.01	1.03
ER with Outpatient Visits	RR	95%	CI	ER with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.000	REF	REF
MCC = Other	0.78	0.68	0.89	MCC = Other	0.85	0.68	1.05
MCC = 0	0.93	0.85	1.02	MCC = 0	0.85	0.63	1.14
Had an outpatient visit in the past 3 months	1.04	0.96	1.13	Had an outpatient visit in the past 3 months	2.16	1.84	2.52
Risk Score (continuous)	1.94	1.75	2.15	Risk Score (continuous)	2.45	2.02	2.98
Risk Score (quadratic)	0.96	0.94	0.97	Risk Score (quadratic)	0.93	0.90	0.96
Enrolled more than 6 months	0.86	0.82	0.91	Enrolled more than 6 months	1.01	0.91	1.14
Inpatient Admissions with Outpatient Visits	RR	95%	CI	Inpatient Admissions with Outpatient Visits	RR	95%	CI
MCC = 1	1.00	REF	REF	MCC = 1	1.00	REF	REF
MCC = Other	0.72	0.58	0.89	MCC = Other	0.80	0.60	1.07
MCC = 0	0.69	0.60	0.79	MCC = 0	1.02	0.71	1.47
Had an outpatient visit in the past 3 months	1.02	0.88	1.18	Had an outpatient visit in the past 3 months	1.68	1.29	2.19
Risk Score (continuous)	3.24	2.89	3.63	Risk Score (continuous)	6.48	5.04	8.33
Risk Score (quadratic)	0.94	0.92	0.95	Risk Score (quadratic)	0.85	0.81	0.88
Enrolled more than 6 months	1.09	0.99	1.21	Enrolled more than 6 months	0.86	0.70	1.05
MCC = Marginal Cost of Care							
RR = Risk Ratio							
ER = Emergency Room							
CI = Confidence Interval							

APPENDIX 2: RANDOM EFFECTS AND TREND ANALYSIS FROM AIM 3

Fixed Effects and Random Effects

In a panel dataset with two or more time periods (each observation has two rows of data, one for each year), the error terms are therefore correlated (i.e., the error term for person A in time 1 is not independent from the error term for person A in time 2. However, the error term for person A in time 1 is independent from the error term for person B in time 1). In aim 3, I considered both Fixed Effect (FE) and Random Effect (RE) models for this dataset. When considering the options for modeling panel data it can be helpful to decompose the error term into two components: the time invariant error (μ_i) and the time variant error (v_{it}).

Models with individual level fixed effects effectively have a unique intercept for each individual. These models use only “within” variation and do not generate estimates for time invariant variables. FE models are not efficient (they have a large variance) because they lose many degrees of freedom from the estimation of an intercept for each observation. RE models are more efficient but could potentially be biased. For RE to not be biased, the time invariant error term must be uncorrelated with the independent variables. We also assume the mean of the error terms (both time variant and invariant) are zero and the errors are homoskedastic.

Both RE and FE are consistent (as N approaches infinity, the estimate approaches to the true parameter), so the choice depends on whether RE is biased. When the coefficients on variables from RE and FE models are the same, as they are here, that tells us RE is unbiased. Because RE is more efficient and allows us to generate estimates for time invariant controls, I decided to use RE for all models. Even though it appears as if RE for the outpatient visits outcome is biased I believe these results are misleading. The outpatient visits outcome is a count variable and the fixed effects model in SAS is not as flexible as random effects and does not allow specification of a distribution (such as Poisson), this is also why the estimates are different than the ones that appear in the results table in the paper.

Coefficient on the Interaction Term	Fixed Effects Model	Random Effects Model
Outpatient Visits	(0.425)	(0.242)
Outpatient Visits (exp(coefficient))	0.654	0.785
Percentage with Participating Providers	9.01%	9.37%
Total Costs	-33.01%	-32.07%

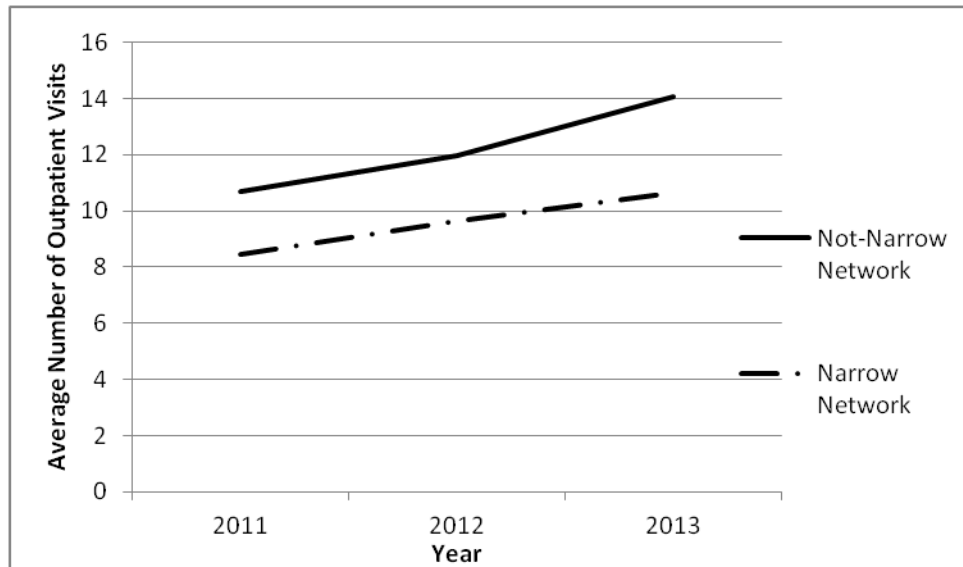
Trend Analysis

Difference-in-difference models control for pre-period differences between groups but, to ensure that the group not receiving the treatment provides a satisfactory comparison group, it is important to make sure that, absent the treatment, these two groups would behave similarly. One way to accomplish this is to examine the pre-intervention trends in the outcome variables. If the pre-intervention trends are not parallel then we will not be able to confidently differentiate between the effect of the intervention and the natural progression of differences between the two groups (Ryan et al., 2015).

In aim 3, I looked at average visits, percentage of visits with participating providers, and expenditures on outpatient visits in years 2011, 2012, and 2013 and found parallel trends between the two groups.

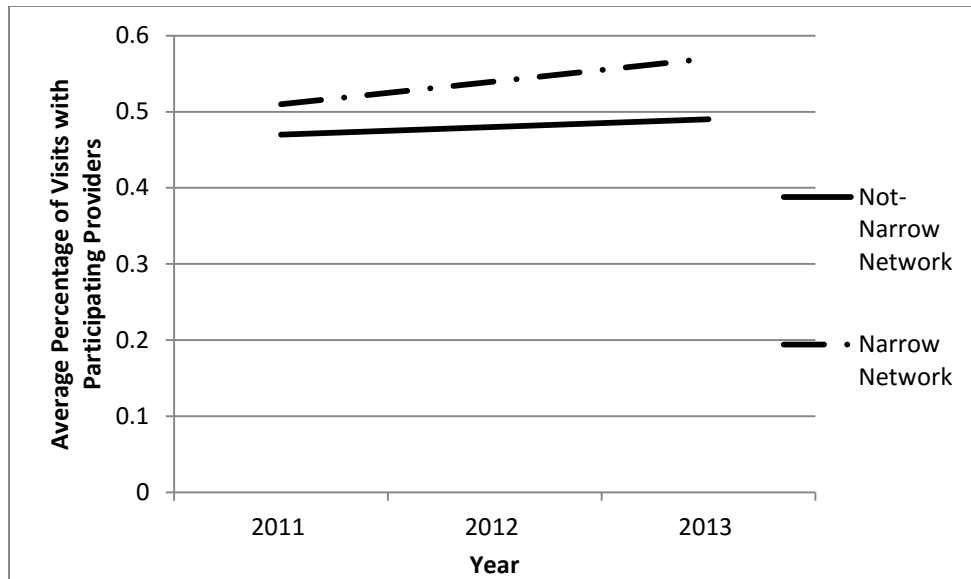
Appendix 2: Figures

Figure 3: Aim 3 Outpatient Visits (Professional and Facility Claims with Physicians or Mid-Level Providers - excluding inpatient and emergency room visits)



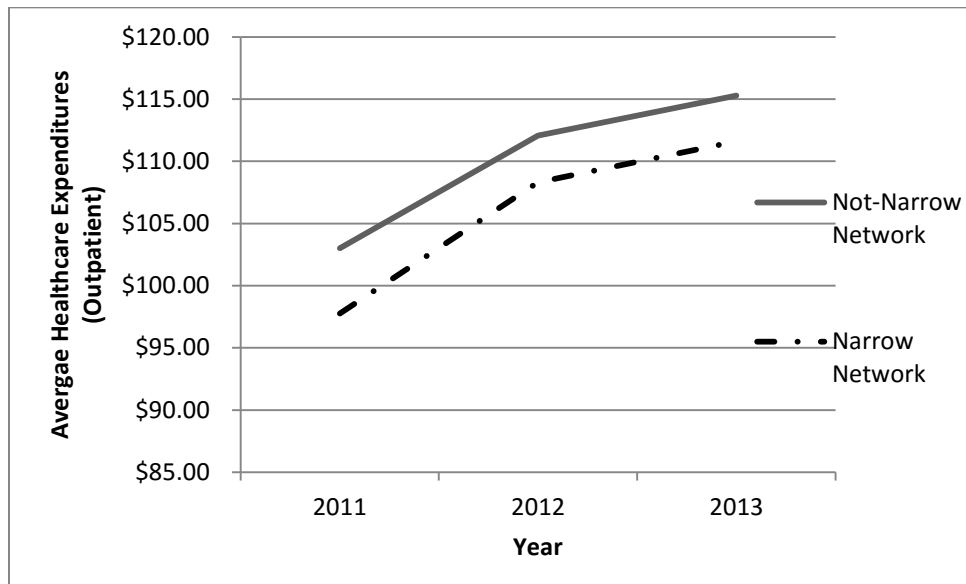
Year	Not-Narrow Network	Narrow Network	Ratio - Narrow : Not-Narrow
2011	10.69	8.45	0.790
2012	11.98	9.63	0.804
2013	14.08	10.65	0.756

Figure 4: Aim 3 Percent of Outpatient Visits with Physicians or Mid-Level Providers Participating in the Narrow Network



Year	Not-Narrow Network	Narrow Network	Ratio - Narrow : Not-Narrow
2011	0.47	0.51	0.92
2012	0.48	0.54	0.89
2013	0.49	0.57	0.86

Figure 5: Aim 3 Healthcare Expenditures (Member Liability on Outpatient Visits)



Year	Not-Narrow Network	Narrow Network	Ratio - Narrow : Not-Narrow
2011	\$ 103.01	\$ 97.77	0.949
2012	\$ 112.08	\$ 108.31	0.966
2013	\$ 115.29	\$ 111.61	0.968

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