NBER WORKING PAPER SERIES

HOW DOES COST-SHARING IMPACT SPENDING GROWTH AND COST-EFFECTIVE TREATMENTS? EVIDENCE FROM DEDUCTIBLES

Claudio Lucarelli
Molly Frean
Aliza S. Gordon
Lynn M. Hua
Mark Pauly

Working Paper 28155
http://www.nber.org/papers/w28155

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 2020

We thank Sarah Dykstra and Sean Kelly for excellent research assistance and HealthCore for help interpreting data. We thank Andrea DeVries, Geoff Crawford, Matthew Benko, Zarek Brot-Goldberg, and seminar participants at the ASHEcon Conference for excellent comments. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

How Does Cost-Sharing Impact Spending Growth and Cost-Effective Treatments? Evidence from Deductibles
Claudio Lucarelli, Molly Frean, Aliza S. Gordon, Lynn M. Hua, and Mark Pauly
NBER Working Paper No. 28155
November 2020
JEL No. I11,I13

ABSTRACT

The growth of health care spending has been a longstanding policy concern. Over the years, several innovations have been proposed to lower levels of health care spending; however, their impact has been limited and not sustained over time. Costly new technology, while often an improvement to existing care, has been identified as a principal driver of health care spending growth. Recent literature has shown that high deductible health plans (HDHP) can have an immediate impact on *levels* of health care spending, but their medium- and long-run effects on spending *growth* remain unknown. In this paper, we use multiple-employer-group claims data from a large national insurer to (i) study whether HDHPs reduce the growth in spending over four years compared to lower deductible alternatives; and (ii) explore the mechanisms behind any reductions in growth by looking at whether HDHPs reduce the use of low- vs. high-value treatments. We find that HDHPs have a limited effect on spending growth, with a statistically significant reduction observed only for prescription drugs. HDHPs are not associated with significantly lower growth in spending on highly cost-effective medicines in a sample of drugs but do reduce spending growth for less cost-effective drugs.

Claudio Lucarelli
The Wharton School
University of Pennsylvania
3641 Locust Walk
Philadelphia, PA 19104
clucarel@wharton.upenn.edu

Molly Frean
The Wharton School
University of Pennsylvania
3641 Locust Walk
Philadelphia, PA 19104
mfrean@wharton.upenn.edu

Aliza S. Gordon
HealthCore, Inc.
123 Justison St, Ste 200
Wilmington, DE 19801
agordon@healthcore.com

Lynn M. Hua
The Wharton School
University of Pennsylvania
3641 Locust Walk
Philadelphia, PA 19104
lynnhua@wharton.upenn.edu

Mark Pauly
The Wharton School
University of Pennsylvania
3641 Locust Walk
Philadelphia, PA 19104
and NBER
pauly@wharton.upenn.edu

1 Introduction

Health care spending per capita for the privately insured population in the United States has grown rapidly for many decades, exceeding growth in wages, consumer prices, and GDP. According to the Centers for Medicare and Medicaid Services, national health spending was projected (before the COVID pandemic) to grow at an annual rate of 5.4% starting in 2019, reaching $6.2 trillion by 2028 (Keehan et al., 2020). There has been ongoing interest in how insurance coverage can be reformed to reduce this growth, ideally limiting it to an amount commensurate with national income and improvements in quality and health outcomes. As noted by Brot-Goldberg et al. (2017), a necessary piece of evidence for that change in spending growth is understanding "how consumers respond to cost-sharing" in behaviors that affect it.

Managed care, changes in provider payment methods, and increasing patient cost-sharing have all been shown to have some effect on lowering the *level* of spending as they are phased in, but, after they have been adopted and diffused, there is strong evidence that spending growth tends to resume its former path (Chernew and Newhouse, 2012; Cutler, McClellan and Newhouse, 2000; McWilliams et al., 2016; Manning et al., 1987). The best example of this process was the managed care transformation of the 1990s, which lowered national spending growth as more of the private sector and Medicaid converted to managed care, but thenceforth resumed their traditional growth rates (Glied, 2003). Studies of the immediate effect of placing individuals in insurance plans with varying levels of cost-sharing have shown statistically significant and economically large estimates of impact. The famous RAND Health Insurance Experiment estimated that the elasticity of medical spending with respect to its out-of-pocket price is -0.2 (Manning et al., 1987). More recent studies have generally found effects of larger magnitude (Eichner, 1998; Finkelstein, 2007; Kowalski, 2016). However, these studies have not looked at spending growth.

Why does growth seem to return close to its former rate? The primary reason, and the one that motivates this study, is that spending growth is thought to be largely driven by continuous incremental spending on better but more costly new technology, for which the rates of introduction and diffusion have proven resistant to change (Smith, Newhouse and Freeland, 2009). Newhouse and Chernew (2012) made the point that changes in levels of cost-sharing should only affect spending growth as they are being phased in, and that changes in cost-sharing levels over time have not been sufficiently large to explain more than a small fraction of spending growth. There are certainly other drivers of spending growth, such as changes in population demographics, higher prices resulting from supplier consolidation, and changes in the incidence of illness. However, none of these factors are sufficiently large nor consistent to explain persistent spending growth.

In addition to decreasing spending *levels*, however, higher cost-sharing has the potential to reduce spending *growth* if it can affect what drives spending growth and limit the adoption and diffusion of new and costly (but potentially beneficial) technologies (Chandra and Skinner, 2012; Weisbrod, 1991). Paradoxically, however, there has been very little investigation of whether and how the level of cost-sharing affects the *growth* of health care spending. Early work by Peden and Freeland (1998) using national health expenditure data found a (time series) estimate of a significant impact of the proportion paid out-of-pocket on the growth of spending, but no evidence of an impact of *changes* in this share on contemporaneous changes in spending. Golberstein et al. (2013) examined the impact of private Medigap insurance on the level and growth of Medicare spending, and found that supplemental coverage raised both. However, the effect of cost-sharing on privately insured spending growth has been understudied, despite the serious policy concern about spending growth and the potential for increasingly common high deductibles to curb that growth.

High deductible health plans (HDHPs) have become increasingly popular in the employment-based market and a key object of policy interest; HDHPs have been promoted to reduce healthcare spending. “Bronze” plans on the Affordable Care Act’s individual insurance exchanges are also characterized by high deductibles and are the second-most popular type of plan. In a review of the effects of consumer-directed health plans (CDHPs), high-deductible health plans coupled with tax-favored health savings accounts (HSAs), healthcare expenditures were reported to have decreased between 5% and 14%, depending on the study, with greater reductions in healthcare spending for plans with larger deductibles (Bundorf, 2016). Empirical evidence has demonstrated that HDHPs may lead to significant spending reductions in the short term as consumers are exposed to more of the cost of current types of care, however, their potential net benefit to buyers after any initial impact is unknown. Do they in fact encourage more thoughtful use of the new but more expensive types of care that arrive every year?

There are some patterns in the differential impact of HDHPs on the *levels* of use of specific health care services. Past research has documented that when CDHPs reduce healthcare spending, a portion is usually driven by reductions in outpatient care and pharmaceutical spending, without a clear effect on inpatient admissions (Parente et al., 2008; Charlton et al., 2011; Buntin et al., 2011). There have been exceptions, such as one study where enrollment in an HDHP *increased* the utilization of drugs and had no effect on outpatient care relative to a PPO plan (Waters et al., 2011). The presence of high deductibles seems even to deter the use of care not subject to the deductible, such as some covered preventive services, though that effect may come from an impact on complementary physician services.

There have also been mixed results on the differential impacts of cost-sharing on the quality of care, typically measured by the appropriateness of services. For example, in the RAND Health Insurance Experiment (Manning et al., 1987; Newhouse et al., 1993), higher cost-sharing reduced care labeled both clinically necessary and unnecessary (though often with no effect on health outcomes). Some more recent studies (Wharam et al., 2007, 2011) suggest that consumers can differentiate between more or less clinically appropriate care, while others found that, with less insurance coverage, they nevertheless reduced the use of recommended preventive care (Buntin et al., 2011) and reduced the cervical and breast cancer screening rates (Charlton et al., 2011; Wharam et al., 2018).

These results raise the concern that HDHPs may have high adverse health consequences when patients delay, reduce, or forgo care to curb costs, even when costs are moderate compared to health benefits. Few researchers have investigated the concern that HDHPs may negatively impact vulnerable, disadvantaged populations such as those who are low-income and high risk (Davis, 2004; Woolhandler and Himmelstein, 2007) as individuals enrolled in HDHPs may report having financial strain (Gaffney et al., 2020; Rabin et al., 2020). While one study found little evidence of income-driven variation in the magnitude of spending reduction associated with HDHPs, with a reduction in total spending by 13% for both vulnerable and non-vulnerable families with HDHPs (Haviland et al., 2011), another found that the outpatient out-of-pocket spending difference between enrollees in HDHPs and traditional plans was almost twice as high for those with substance abuse and mental health disorders compared to those without these disorders (Eisenberg et al., 2020).

The two studies most related to our work are by Haviland et al. (2016) and Brot-Goldberg et al. (2017). In a large multi-employer study, Haviland et al. (2016) use a difference-in-differences approach to quantify an intent-to-treat effect of employer CDHP offer on spending growth for up to three years (the most which has been previously tracked). They find that in each of the three years after firms offer a CDHP, there was a 5% reduction in total health care spending relative to the baseline of firms only offering lower deductible health plans. They find that decreases in total spending are driven primarily by reductions in spending on outpatient care and prescription pharmaceuticals, and in the third year, there are no differences in spending for inpatient and emergency department care.

Brot-Goldberg et al. (2017) study a natural experiment where employees of a single large firm were mandated to switch from a generous zero-deductible plan that provided free in-network health care to a HDHP paired with a subsidized HSA. Access to the same providers remained post-switch to the HDHP plan. They estimate that the switch caused a spending reduction of approximately 12% of firm-wide spending using four years of pre-switch and two years of post-switch data in the time window 2006-2015. When decomposing this effect, they find no evidence of increased price shopping, but rather that consumers reduced quantities of both potentially low-value and higher-value care (though somewhat more for presumably low-value imaging). Their results are consistent with greater sensitivity to spot prices, incurred at the point of service, over true shadow prices, which take into consideration expected spending over the entire plan benefit year.

A key limitation of the prior literature is that the persistence of the impact of HDHPs on healthcare spending, specifically whether they lower growth over time, remains unclear. Our study provides the first large-sample investigation of the relationship between private insurance deductibles and the growth of privately insured spending over time, both in total and by individual components of that growth. We examine the fundamental question – can higher levels of cost-sharing generate a permanent reduction in the rate of growth of spending, or is any impact limited to a one-time reduction in the level of spending? We build upon past research and examine the effect of HDHPs on the growth of health care spending using a large national sample of claims and enrollment data from Anthem, a private national insurer. Our dataset spans a diverse set of employers over the four-year time period from 2015 to 2018 and allows us to describe and analyze patterns of spending growth for different types of covered services.

We initially focus on a large sample of members who were consistently insured with either high- or low-deductible coverage over the study period ("stayers"). Our results for this sample indicate that high deductibles are associated with mixed effects on spending growth. Relative to members enrolled in LDHPs, members enrolled in HDHPs do not experience lower dollar growth in total spending (and associated insurance claims). However, for prescription drugs, we do find significantly lower dollar growth in spending among HDHP members compared to LDHP members. Specifically, absolute growth in drug spending is about one fifth lower for HDHPs relative to LDHPs. For this more rapidly growing and more innovation-affected category of care, we hypothesize that high deductible plans slowed the diffusion of new drug technology.

Because individuals are not randomly assigned to a particular insurance plan, we exploit the variation in the employers' choice set to alleviate concerns about selection. Some employers in our sample exclusively offer a HDHP or LDHP, whereas others offer both high and low deductible options. We exploit this variation across employers, and also within employers over time to understand the effect of

HDHPs on spending levels and growth conditional on the ability to choose. Accounting for selection bias this way, we confirm that HDHPs affect spending levels but have no impact on total spending growth in our sample. We also find that adverse selection manifests itself on the levels of spending but not on its growth.

To further explore selection bias, we separately analyze a smaller sample of members who switched from LDHP to HDHP coverage during the study period. We find that such members experience lower growth relative to members continuously enrolled in either plan type around the time of the switch, however, this reduction does not persist and spending growth resembles that of stayers past one year. This result is robust to controlling for unobserved and permanent risk factors that could drive selection when accounting for within-employer variation in deductible choice over time.

Did the slowdown in drug spending growth we observed for individuals with higher cost sharing discriminate between high- and low-value drugs, or did it discourage needed and less needed drugs indiscriminately? To investigate this, we matched the majority of the highest selling drugs with their published cost-effectiveness ratios from the Tufts Cost-Effectiveness Analysis (CEA) Registry. We then found that the growth in spending and use was similar for LDHP and HDHP for the set of highly cost-effective drugs (cost saving or cost per QALY below $50,000) but was lower in HDHP for the set of less cost-effective drugs (cost per QALY above $50,000).

The overall pattern in our data therefore is one of no effect on aggregate spending growth for all insured care, and modest but potentially efficiency-improving effects on spending growth for drugs. High deductibles do not curb runaway medical spending, but may lead to more selective choices among drugs that better balance health benefits and cost. It appears that HDHPs do not have as much potential for long-term cost containment as their advocates contend, nor do they pose as much risk to the use of effective and cost-effective care as their detractors fear.

However, this work only compares spending growth between members of different plans from a single insurer. We cannot identify the impact of high deductibles on overall spending nor on health care utilization in markets where HDHPs offered by many insurers have had substantial penetration compared to markets where such plans are rare. As Finkelstein (2007) has noted, effects of cost-sharing estimated at the individual level may well understate those at the market level.

The next section offers a simple model of plan choice and spending conditional on plan, which helps to identify the main sources of selection and motivates our empirical analysis. Section 3 describes the data, Section 4 describes our estimation strategy, Section 5 presents our results, and Section 6 concludes.

2 Model

In this section, we develop a two-stage model that first describes the considerations behind a decision to enroll in either a HDHP or a LDHP (when such a choice exists in employer-sponsored coverage), and then describes the choice of medical care expenditure conditional on insurance choice. Consistent with individuals' dynamic optimization behavior within the insurance year, our exposition and solution of the model uses backward induction. Although most of the employers in our sample offer only one level of deductible in the plan administered by the insurer, about 35% of employers offered insurer-administered plans with different deductibles.

Conditional on the choice of insurance plan deductible, the insured person is assumed to choose medical care expenditure according to a simplified version of the Grossman (1972) model, where medical care expenditure is an input for the production of health. We consider expenditure on two medical inputs, x_1 and x_2, which differ on their health production ability (their marginal health product) and are translated into a utility flow of health through the function $f(.,.)$, which is assumed to be twice continuously differentiable and exhibit decreasing marginal returns. The insured's objective function depends on health and the residual consumption after paying for insurance premiums and medical care, with the function g(.) transforming dollars to utility units. We simplify the problem by summarizing the degree of coverage with the parameter α, where higher values of α can be interpreted as coverage with lower deductibles. The maximization problem is as follows, where W represents income and π the insurance premium:

$$\underset{x_1,x_2}{Max}\, f(x_1, x_2) + g\big(W - \pi - (1 - \alpha)(x_1 + x_2)\big)$$

The first order conditions are:

$$f_{x_1}(x_1, x_2) - g_{x_1}(1 - \alpha) = 0$$

$$f_{x_2}(x_1, x_2) - g_{x_2}(1 - \alpha) = 0$$

Both conditions show that with no coverage ($\alpha = 0$), marginal benefits as measured by marginal health product equal marginal costs. However, the presence of insurance ($\alpha > 0$) distorts the choice generating the problem of moral hazard.

To understand how the choice of expenditure on medical inputs varies with coverage, we differentiate the first order condition for x_1 and obtain:

$$\Big[\underbrace{f_{x_1x_1} + (1 - \alpha)g_{x_1x_1}}_{<0}\Big]dx_1 - \Big[\underbrace{(1 - \alpha)g_{x_1x_1} - g_{x_1}}_{<0}\Big]d\alpha = 0$$

Above, both terms in brackets are negative due to the decreasing marginal return assumptions ($f_{x_1x_1} < 0$, $g_{x_1x_1} < 0$), and increasing utility on consumption ($g_{x_1} > 0$) . The same applies for expenditure on x_2.

Therefore, expenditure on medical care is increasing in coverage as is shown in the following equations:

$$\frac{dx_1}{d\alpha} = \frac{(1 - \alpha)g_{x_1x_1} - g_{x_1}}{f_{x_1x_1} + (1 - \alpha)g_{x_1x_1}} > 0$$

$$\frac{dx_2}{d\alpha} = \frac{(1 - \alpha)g_{x_2x_2} - g_{x_2}}{f_{x_2x_2} + (1 - \alpha)g_{x_2x_2}} > 0$$

Given these observations, we obtain for each individual a demand curve for medical care – derived largely, as Grossman (1972) suggests, from the demand for health – which will depend on income, insurance coverage as measured by marginal user price, preferences for health versus other goods, market prices for health care goods and services, time cost associated with consuming health care goods and services and other desired consumption items, and provider advice.[1] All of the arguments except the last one would be present in any economic demand function where there is insurance that takes the form of health insurance. This demand function would be similar to others for a consumer's decision to initiate contact with the health care system (where there is no prior physician information).

As we stated above, the inputs to the production of health x_1 and x_2 differ in their marginal health product, which represents the difference in value to the consumer. Suppose the schedule of diminishing marginal product for x_2 is always above that for x_1, in the following way: $f_{x2}(x_1, x_2) = \beta f_{x_1}(x_1, x_2)$ for $\beta > 1$. In other words, x_2 exhibits larger marginal health product relative to x_1. If there are no differences in the marginal (dis)utility of a dollar spent on either input (i.e., if the individual does not derive utility for the identity of the inputs beyond their contribution to health), then the derivatives of the function g(.) are identical both inputs. Therefore,

$$\frac{dx_2}{d\alpha} = \frac{(1-\alpha)g_{x_2x_2} - g_{x_2}}{\beta f_{x_1x_1} + (1-\alpha)g_{x_2x_2}} \Rightarrow \frac{dx_2}{d\alpha} < \frac{dx_1}{d\alpha}$$

The expression above states that the coverage elasticity of expenditure on the more productive input x_2 is more inelastic than for the less productive input x_1. This implication of our model emphasizes different magnitudes of response to changes in coverage (e.g., through changes in deductibles) for high value vs. low value care, or old vs. new technology, which in turn, can generate different magnitudes of change in spending levels or spending growth. Our model predicts that if higher deductibles reduce expenditures on medical care, the percentage change will be more pronounced on low value care. This is a testable implication of our model that we contrast with our data in the empirical sections of the paper for

[1] Evidence has shown that physician practice style, as a proxy for advice, is often uniform across patients regardless of their particular insurance coverage or other demand parameters. If physician advice is tailored to the average or typical patient's insurance coverage, rather than to that of each individual patient, an individual patient's deductible may have an attenuated effect. Finkelstein (2007) demonstrated this kind of "norms" behavior exists and leads to impacts of market-level changes in insurance coverage on spending larger than what would be implied by studies of individual responses to cost-sharing. Hence, any impacts we detect that arise from variations in individual insurance coverage can be interpreted as a lower bound to the potential impacts of market-level changes.

prescription drugs, the category of medical care for which we can observe systematic measures of value as proxied by cost-effectiveness.

In the first stage of the model, the individual decides to enroll in either type of plan, high or low deductible. We do not consider the possibility of someone choosing an outside option or to be uninsured if offered insurance. In the simple case in which an employee is offered only one coverage option, we assume the employee takes it. The expected utility of a worker holding an insurance policy with a deductible is given by equation (1), where a contract is described by the premium π, the deductible D (which could be low or high), and a cost sharing rate *c*. The expected utility maximizer faces a probability p of experiencing a loss in wealth equal to L.

$$U(\pi, D, c) = (1-p)\,U(W - \pi) + p\,U(W - \pi - D - c(L-D)) \qquad (1)$$

To simplify the problem further and to emphasize the role of the deductible, we initially assume the coverage after the deductible is the same for both plans, and it is very generous. A worker facing the choice of HDHP or LDHP will be indifferent between the two choices if:

$$U(\pi^H, D^H) = U(\pi^L, D^L)$$

which by the definition of expected utility provided in (1) becomes:

$$(1-p)\,U(W-\pi^H) + pU(W-\pi^H-D^H) = (1-p)\,U(W-\pi^L) + p(W-\pi^L-D^L) \qquad (2)$$

Rearranging the above equation and collecting terms, we get the following expression

$$p\big[U(W-\pi^H-D^H) - U(W-\pi^H) - \big(U(W-\pi^L-D^L) - U(W-\pi^L)\big)\big] = U(W-\pi^L) - U(W-\pi^H)$$

Performing a Taylor expansion around W, the utilities above can be approximated by: $U(W - A) \approx U(W) - A\,u'(W) + \frac{1}{2}A^2u"(W)$, which after some algebra can be written as:

$$p[(D^H - D^L)\,U'(W)] \approx -U'(W)\,(\pi^L - \pi^H) + U"(W)\frac{(\pi^L - \pi^H)\,(\pi^L + \pi^H)}{2} \qquad (3)$$

Defining $\overline{\pi} = \frac{\pi^L + \pi^H}{2}$, Equation (3) can be expressed as a compact expression that describes the indifference between an HDHP and a LDHP as a function of the differences in premia and deductibles, the probability of a loss, and the coefficient of risk aversion. This expression resembles analogous expressions derived by Chiappori and Salanie (2000) and Cohen and Einav (2007) in the context of car insurance. Less risk averse individuals and those with a lower probability of experiencing a loss (which could be interpreted either as pure selection or selection on moral hazard) will prefer HDHPs.

$$\frac{\frac{p(D^H - D^L)}{\pi^L - \pi^H} - 1}{\overline{\pi}} \approx \frac{-U''(W)}{U'(W)}$$

The above expression captures the sources of selection bias, which are addressed in our empirical analysis, and motivate our identification strategy. Exploiting individuals who switch plan types allows us to control for unobserved risk aversion, which is assumed constant within individuals. By exploiting variation in deductible choice both across workers and over time, we are able to study situations in which there is a single choice of premium and deductible.

All else equal, higher patient cost-sharing will reduce moral hazard, which in turn will offer stronger incentives to reduce the use of beneficial medical care with low marginal benefit relative to its cost or price, as is shown in the first order conditions of our model as α decreases. It will also offer incentives to search more aggressively for lower unit prices if they vary in the market, if expected annual spending falls between the low and high deductible, and if the cost (and effectiveness) of search is moderate. Our focus is on the growth in spending over time, for which a wide range of literature suggests three correlates: (1) the discovery and diffusion of new beneficial technology which increases total spending; (2) other changes in demand for existing types of care related to changes in population level illness levels and other demand determinants; and (3) increases in unit prices for existing care arising from supply side influences such as changes in market competition or exogenous changes in input prices.

Our focus in this paper is primarily on the use of care, especially care which is associated with the supply (broadly defined) of new technology that can improve survival, quality of life, and patient comfort. If the demand for improved health is relatively unresponsive to changes in the shadow price of health arising from new technology, such innovation could lower spending holding the level of health approximately constant. But empirically it appears that, for as far back as we have data, higher medical spending has been associated with new technology, either because new treatments are added onto existing treatment or, if they substitute, the improved quality combined with patent protection or other sources of innovator market power is associated with a higher price per treatment. The data we use are from a population and time period characterized by little change in overall health risk and demographic characteristics. As a result, we abstract from any effect of changes in health or in the demand for health in our analysis.

The relevance of price changes to our analysis is more complex. There is no a priori reason to imagine that the change in average market prices for medical services received by providers should be related to an individual's type of insurance coverage; it should be experienced similarly by people regardless of the type of coverage. However, because health care markets are not perfectly competitive, there is usually a range of prices a buyer could face in a market, and it has been suggested that higher cost-sharing may prompt more intensive search for lower prices. Brot-Goldberg et al. (2017) found no evidence of such shopping behavior in a static setting. However, it is plausible that insureds with higher deductibles will have more of an incentive to search for lower prices if overall prices in their area increase but the distribution of selling prices from which they must search remains the same. Hence, an effect of deductible levels on spending growth may reflect a combination of both changes in quantities and insurance-influenced changes in prices. As our data do not permit precise measurement of unit price changes, especially for new technology, we do not separate spending growth into these two components.

3 Data

We use data from the HealthCore Integrated Research Database (HIRD^{SM}), a large administrative claims database containing medical and pharmacy claims for members in commercial health plans administered by Anthem, Inc. Anthem is the country's second largest private insurer, with employer plans offered in 14 US states. The claims data contain fields common to most administrative claims datasets, including diagnosis and procedure codes (medical claims) and national drug codes (NDCs; pharmacy claims). Cost data contained in the claims include member out-of-pocket payments (from deductibles or coinsurance/copayments), payments by the plan and total allowed amounts. Unless otherwise indicated, results presented in this paper regarding spending are based on total allowed amounts and therefore include payments made by both members and Anthem. We separately analyze spending for medical care and prescription drugs. Medical spending includes spending in the inpatient, outpatient, emergency room and skilled nursing facility settings, while drug spending includes outpatient prescription drugs.

The study sample includes adult members aged 18-64 enrolled in Anthem plans designated as preferred provider organization (PPO) products through a sponsoring employer. All plans are fully-insured by Anthem; our sample does not include plans administered by Anthem on behalf of employers who choose to self-insure. Each member had continuous medical and pharmacy coverage for the calendar years 2015-2018 (the study period). While Anthem also offers insurance products on the non-group (individual) market, such members were excluded in an effort to reduce selection bias. Precise plan benefit design data, also available from Anthem but separate from the HIRD^{SM}, were used to classify plans according to the level of their individual and/or family deductibles.[2]

We defined HDHPs as plans with an individual deductible of at least $1,250 or a family deductible of $2,500. If a member's plan was described with both an individual and family deductible, we required that

[2] A minority of members had missing benefit design data at the beginning, middle or end of the study period. For such members, we imputed benefits based on benefits observed closest to the missing time period. In sensitivity analyses not shown but available upon request, we verify that this procedure does not affect our main findings.

both deductibles exceed the threshold for the plan to be classified as a HDHP. All other plans were considered low deductible health plans (LDHP). Such criteria are consistent with IRS regulations for minimum annual deductibles for health plans with paired tax-advantaged savings accounts during this time period and are similar to other thresholds used in industry reports (KFF, 2018). As we do not precisely observe the start and end of each plan's benefit year and cannot link members in the same family, we are unable to analyze spending or utilization patterns before and after a deductible is fulfilled.

Among members in our sample, we analyze two cohorts. The first cohort ("stayers") includes members who either had a low deductible during the entire study period (hereafter, "LDHP") or who had a high deductible during the entire study period ("HDHP"). The second cohort ("switchers") includes a smaller sample of members who switched from a low to high deductible plan over the course of the study period.

In addition to the primary definition of a high deductible described above, we also completed a secondary analysis of members in the first cohort who were enrolled in plans with more extreme deductible levels. Specifically, we considered members exclusively enrolled in three types of plans: (1) those with "very high" deductibles, defined as an individual/family deductible ≥ $3,000/$6,000; (2) those with "very low" deductibles, defined as an individual/family deductible ≤ $250/$500; and (3) those with no (i.e., $0) deductibles. The first group represents a subgroup of the overall HDHP group, the second group represents a subgroup of the overall LDHP group, and the third group represents a subgroup of both (2) and the overall LDHP group.

Within commercial insurance, the scope of care to which a deductible applies varies, plans may have a single deductible that applies only to medical care, separate deductibles for medical and pharmacy care, or an integrated deductible that applies to both medical and pharmacy care. All three of these plan types exist at Anthem. In the plan benefit design data, we observe individual and/or family deductibles for each plan. We know with certainty that the deductibles apply to medical care; however, we cannot precisely identify whether the same deductibles also apply to pharmacy care. However, high deductible health plans offered in combination with a tax-advantaged health savings account (HSA) are required by law to apply the plan deductible to all services, including prescription drugs.[3] As we are able to observe the presence of a paired HSA for some members in our overall HDHP group, we conducted an additional subgroup analysis of cost growth for such members. For those high deductible plans where the deductible only applies to medical care, the deductible may still reduce drug spending by deterring patients from seeking medical care that results in the prescribing of pharmaceuticals.

4 Estimation

4.1 Addressing Plan Selection

In any setting in which people are not randomly assigned to a particular insurance plan, selection bias will frustrate attempts to make causal inferences. Observed relationships between plan-level cost-sharing and total costs may be affected by choices of employers to attract and retain workers in competitive labor markets, choices of workers to accept jobs based on different benefits packages, or choices of workers to enroll in one of several plans offered by a given employer. If individuals are risk neutral but incremental premiums for plans with lower cost-sharing are not risk-rated, adverse selection is possible. In contrast, there may be favorable or advantageous selection if people who are more risk averse take precautions against risky behavior but attach high value to financial protection.

Our data from Anthem employer plans permits selection of some type to occur for some individuals in the sample. A possible outcome is adverse selection based on levels of health risk. Those who are at higher risk at the time when their employment and/or insurance is chosen will tend to choose plans with lower cost-sharing, all else equal. These individuals will then be observed to have higher spending *levels* relative to those lower-risk individuals who elected to enroll in plans with higher cost-sharing. However, if relative risks, expected benefits and insurance loading (difference between expected benefits and incremental premium) are constant over time, there should be no relationship between coverage chosen and *growth* in spending, assuming the expected benefits from new technology (the reason for spending

[3] Exceptions are permitted for preventive medications.

growth) are distributed independently of risk. In other words, individuals of different risk levels should have the same growth in spending or benefits. Conversely, risk will be related to benefits growth to the extent that new technology is biased towards individuals with relatively higher or lower risk. New vaccines will appeal to low risks, while new cancer treatments will appeal to high risks.

We explore the potential role of selection in our data by analyzing members within our overall LDHP and HDHP groups for which we observe a choice of deductible level (high or low) at their employer. As we do not directly observe the plan menu at each employer, we infer annual choice of deductible based on observed simultaneous uptake of both high and low-deductible Anthem plans among employees of a given employer in the data. We do not classify members from firms for which we only observe fewer than 25 associated members, as the probability of observing take-up of multiple plans (if offered) is lower. Using this approach, we find that 53% of members across the two plan types (HDHP) never have a choice of deductible during the study period and 26% always have a choice of deductible. The remaining 21% of members have choice during some but not all years.

This approach has two qualifications. First, it is possible that a firm offers multiple Anthem plans but not all plans are available to all employees (e.g. if certain business units or salary levels within the firm are offered different options than others). Second, it is possible that a firm offers insurance products from a non-Anthem insurer in addition to Anthem. In the first case, we may incorrectly infer that choice was present, while in the second case, we may incorrectly infer that choice was absent. While we expect the degree of misclassification resulting from these two cases to be minimal, we cannot rule it out entirely.

In addition to exploiting the presence or absence of choice, we further correct for the bias introduced by selection on unobserved risk components by including in the analysis the cohort of members who switch from low to high deductible plans. For this group, we observe the distribution of spending before and after the switch, which if constant over time, or shifts according to time-variant observables, allows us to estimate the change in spending due to switching plans with different levels of deductible, while also controlling for time-invariant unobservable characteristics. Exploiting the panel structure of our data, we therefore use a difference-in-difference approach to identify any differences in spending levels or growth that are attributable to plan type (HDHP or LDHP).

4.2 Empirical model

In the equation below, y_{ijt} denotes individual i's spending while holding plan *j* at time t , α_i is an individual fixed effect that captures time invariant differences across individuals, δ_t is a vector of time dummies, and $I\{\}$ are indicator functions that take the value 1 if the expression within the braces is true. These indicator functions allow for different intercepts and slopes for those holding high or low deductible plans when choice of deductible is present or absent. We allow this choice to be time variant, and therefore, *J* is subscripted by *t*. In addition to the choice and type of plan dummies, we include variables that denote whether an individual has just switched to a HDHP (at $t_s = 0$) or if he has *k* periods prior to sign up, or q periods after sign up. The vector X_{it} contains observable individual characteristics (e.g., age, sex, region, Charlson comorbidity score). Finally, u_{it} contains all unobservable characteristics, which are assumed to be mean independent of plan type after controlling for time invariant individual-specific unobservables, time trends and relevant individual observables.

$$y_{ijt} = \alpha_i + \delta_t + \sum_{j}^{J_t} \delta_j * I\{j = HDHP\} I\{J_t > 1\} + \sum_{t}^{T} \sum_{j}^{J_t} \delta_{jt} * I\{j = HDHP\} I\{J_t > 1\}$$
$$+ \sum_{t_s=-k}^{q} \sum_{j_s}^{J_t} \delta_{j_s t_s} * I\{switch_{t_s}\} I\{J_t > 1\} + \gamma X_{it} + u_{it}$$

The model above allows to quantify the effect of plan type (HDHP vs. LDHP) on spending levels, including how those effects vary depending on the choice environment. We estimate the model using the full extent of variation in our data – including variation in plan types within and across individuals and variation in plan offerings of their associated employers. The variation in plan offerings by employers provides us a way to distinguish between voluntary switches and forced switching, similar to Brot-Goldberg et al. (2017)'s experiment. Parameters of interest include: (i) δ_j , which measure the difference in spending levels between individuals in HDHP vs. LDHP, taking into account the fact that people might be able to select or not into different types of plans, in addition to controlling for observable differences X_{it}, and unobservable risk factors α_i , (ii) δ_{jt} , which measure differences in spensding growth between HDHP and LDHP, again considering the selection possibilities, and (iii) $\delta_{j_s t_s}$, which identify differences in spending growth before and after switching from LDHP to HDHP.

5 Results

5.1. Sample

Our final study sample consists of 159,917 HDHP stayers, 164,574 LDHP stayers, and 12,888 switchers. Basic demographic characteristics are summarized in Table 1. Just under half of each cohort is female, with an average age of 42 years (stayers in HDHP and LDHP) and 43 years (switchers). While all cohorts include members across the country, a larger share of HDHP members reside in the Midwest region and a larger share of LDHP members reside in the West region. While the age distribution is similar in HDHP and LDHP, HDHP members are slightly healthier as judged by Charlson comorbidity scores (p < 0.001).

Figure 1 illustrates the distribution of individual and family deductibles for members in the HDHP and LDHP stayer groups. As members in each group may multiple low or multiple high deductibles during the study period, this figure uses an enrollment-weighted average for each member. Approximately 20% of LDHP members have $0 deductibles and very few have individual deductibles over $1,000 (but below the $1,250 threshold). Deductibles in the HDHP group exhibit more variation across a wider range, with individual deductibles ranging from $1,250 to $7,350, and family deductibles ranging anywhere from $2,500 to $15,000. Median individual deductibles are $500 (LDHP) and $2,700 (HDHP), while corresponding median family deductibles are $1,150 and $5,700 [not shown].

Consistent with the patterns in deductibles above, Table 2 shows that the average share of spending paid out-of-pocket is lower among members of the HDHP group relative to the LDHP group. For medical spending, the HDHP and LDHP out-of-pocket shares were 24% and 14% respectively in 2015, and for pharmacy spending they were 22% and 12%. The similar differences in out-of-pocket shares is consistent with most plans having integrated deductibles that apply to both medical and pharmacy spending. Increases in spending in either category over the four-year period were associated with increases in out-of-pocket payments [not shown], however, the share of the increase paid out-of-pocket was relatively low, resulting in a 2-4 percentage point decline in out-of-pocket shares over the 4-year period in both groups. To the extent that the share of total expenses paid out-of-pocket is decreasing in total costs, this suggests that spending growth was associated with larger spending per episode of illness rather than more frequent spending of small amounts. This result is consistent with the hypothesis that spending growth was associated with more costly technologies as substitutes for less costly ones.

5.2. Spending Growth

5.2.1 Descriptive Analysis

Figure 2 displays trends in average per-member medical and pharmacy spending for each year in the study period. Consistent with both adverse selection and moral hazard, both medical and pharmacy spending levels are approximately 20% lower in the HDHP group relative to the LDHP group. Both groups experienced growth in both types of spending over the study period as well. Figure 3 shows average 3-year cost growth in the two groups in absolute terms, unadjusted for any observable individual characteristics. Total spending growth is remarkably similar between the two groups, as judged by both measures. While growth in medical spending is also non-significantly different, pharmacy spending growth is significantly lower among HDHP members ($570 vs. $694 [3Y growth]; $p < 0.01$). It is worth noting that within medical spending, episodes of care with new technology might more commonly have costs well above the deductible. HDHPs may be less effective in slowing the growth of spending on hospital and physician care unless higher deductibles can discourage episodes of care entirely.

Tables 3a and 3b show spending levels and average growth for selected subgroups of our overall LDHP (Table 3a) and HDHP (Table 3b) groups. Relative to the overall group, average cost levels are higher among LDHP members with observed choice of deductible and lower among HDHP members with observed choice, consistent with some degree of adverse selection. Interestingly, members with "very low" and no deductibles have slightly *lower* spending levels but *higher* spending growth relative to the overall LDHP group. In contrast, members with "very high" deductibles have both lower spending levels and lower spending growth, relative to the overall HDHP group. HDHP members with HSAs, on the other hand, have higher baseline spending levels as well as higher growth in total spending. This higher growth results from higher growth in medical spending, and average growth in pharmacy spending is actually slightly lower relative to the overall HDHP group. Comparing means across the two tables, differences in spending levels and growth rates between LDHP and HDHP members are generally greater among members with observed choice, suggesting that significant differences in pharmacy spending growth in the aggregate analysis may be driven in part by selection. However, while lower in magnitude, the difference in average annual growth in pharmacy spending among LDHP and HDHP members for which choice is *never* observed (and selection effects therefore minimized) remains statistically significant ($212 versus $181 per year; $p = 0.019$).

Table 4 shows summary statistics for the 12,888 members who switched from a LDHP to an HDHP over the study period. In the table, we compare mean and median spending levels in the year before switch to the year after switch. As expected, out-of-pocket spending increases considerably between the two years, with mean and median out-of-pocket spending per member increasing by 45% and 49% respectively. Conversely, both mean and median spending by Anthem ("plan" spending) decreased after the switch. Together, these effects led to a decrease of about 10% in median total allowed spending per member, but a slight increase in *mean* total spending per member. Figure 4 plots the trends in mean allowed costs per member including up to two years before and two years after the switch. The trends suggest that the decline in spending growth associated with switching from LDHP to HDHP is temporary, with spending growth returning to the pre-switch trend beyond 1 year.

5.2.2 Multivariate Analysis

The descriptive results above suggest that while spending levels differ between HDHP and LDHP, spending growth does not. We further explore whether these results are robust to efforts to control for selection and conditioning on both observable and unobservable risk factors. In Table 5, we present the results from our regression analyses, in which combine the two cohorts of members (members exclusively enrolled in HDHP or LDHP and members who switched from HDHP to LDHP). The first three columns show results for total spending, medical and pharmacy, interacting both intercepts and slopes with the availability of choice for the individual, but no controls for observable and unobservable risk factors.

The basic time trend points towards increasing spending for all categories of care over time, with changes in the intercept depending both on type of plan and the availability of choice. Individuals that chose HDHPs spent on average $1,348 less relative to those who were offered only a LDHP. Individuals who chose LDHP with the option to have chosen a HDHP spent $575 more relative to the baseline of LHDP holders without choice. The shifts in the intercepts go in the expected direction of selection, and for those individuals without choice, the shift in the spending levels are consistent with the higher price of medical care individuals with HDHPs face at least over the deductible portion of their plan. Looking at slopes, there is no evidence of differences in total nor medical spending growth across HDHP and LDHP individuals, regardless of whether the plan was offered alone or with a choice of the other. As we found in our unconditional analysis of means, statistically significant differences in spending growth are observed for pharmacy benefits. For switchers, we observe a significant decrease in spending after switching, especially for “voluntary” switchers that did so while offered a choice of deductible. However, consistent with the unconditional evidence provided before, switching to a HDHP is associated with a one-time decrease in levels after which spending growth continues its previous path. The absence of an effect on spending growth is evidenced by the fact the post switching coefficients are not significantly different from each other. The results from this test are reported at the bottom of the table, and in all cases we cannot reject the null of equality of the post switch coefficients.

The next three columns of Table 5, Columns (4)-(6), present similar analyses, adding observable risk factors. The coefficients for those observables (not shown) have the expected signs, with spending levels increasing with the Charlson index, age, and for women. The significant results on spending levels and the insignificant results on spending growth are robust to the addition of observable risk factors. The final three columns of Table 5 show similar results for specifications with individual fixed effects. Results are also robust to the inclusion of individual fixed effects, with even stronger evidence on the decrease in spending growth for pharmaceutical products.

5.3 Prescription Drug Spending and Cost-Effectiveness

One of the most contentious issues in studies of how cost-sharing affects spending is its effect on use of necessary and beneficial care. Patients who are able to make fully-informed decisions about seeking different types of health care will only use services with net benefits (positive improvements to health less side effects), measured in money terms, that exceed the amount of cost-sharing. Care will be utilized up to the point at which marginal net benefit equals marginal incremental cost-sharing. Since incremental cost sharing is always less than or equal to the incremental total cost, the care that is not used will be care not worth its cost and not cost effective (ignoring potential cost offsets). However, if patients are imperfectly informed or if physicians can control their use of care, these conditions may not be satisfied. Deductibles as a form of cost-sharing (compared to proportional coinsurance) add complexity because the marginal expected user price of care changes once a deductible is expected to be satisfied.

For all of these reasons, researchers have sought to understand whether cost-sharing discourages the use of "needed" or "high-value" care from the perspective of added health benefits. This was a major part of the RAND HIE (Lohr et al., 1986) which looked at a sample of episodes of treatment classified based on clinical effectiveness; however, the HIE did not consider effectiveness relative to cost. The potential for adverse effects on health from discouraging effective care and the potential for adverse effects on efficiency from discouraging cost-effective care remain open questions. This is owed to the difficulty of labeling different types of care or use of a given type of care by patients with different illness levels as effective and also the difficulty of determining the cost. The HIE found that higher levels of cost-sharing affected (in similar proportions) care that medical experts thought was needed and that which was not, while at the same time finding little effect on a wide range of indicators for health outcomes for all but a minority of subjects with low-income and high risk. Brot-Goldberg et al. (2017) similarly found that high deductibles reduce utilization of services considered to be both high- and low-value. The concern is that a uniform deductible may be a "blunt instrument" because patients and their physicians do not distinguish between care of high and low marginal value (Wharam et al., 2007, 2011, 2018; Fendrick et al., 2019). However, some more recent studies suggest this is not always the case. One study found that switching to an HDHP was associated with higher discontinuation of branded diabetes medications but not diabetes medications generally (Fendrick et al., 2019). Another study of members with bipolar disorder found that high deductibles reduce visits to non-psychiatrist mental health providers but do not affect the number of psychiatrist visits, ED visits, nor hospitalizations (Wharam et al., 2020).

Given our significant finding that deductibles slow pharmacy spending growth, we sought to disaggregate that growth into that on relatively high- and low-value drugs. As our measure of "value" we used data on incremental cost-effectiveness ratios (ICERs) from publications included in the Tufts Cost-Effectiveness Analysis (CEA) Registry. The ICER measures the cost-effectiveness of a given drug relative to an appropriate comparator. We then tested two complementary hypotheses: (1) relative to LDHPs, HDHPs did *not* slow the growth in spending on highly cost-effective drugs; and (2) relative to LDHPs, HDHPs *did* slow the growth in spending on less cost-effective drugs.

For this exercise, we selected a sample of drugs for which spending growth reductions would be meaningful to total spending growth. We therefore selected those 100 drugs with the highest total spending over the study period, which includes drugs with high spending attributable to either high volume (number of claims billed for that drug), high unit prices (measured by average total amount paid per claim), or both. We calculated average spending per member on this set of drugs in the first and final years of our study period (2015 and 2018, respectively) and measured growth as the difference between these two estimates. Calculating the average spending per person allows us to measure the effects that the size of the deductible has on discouraging any use (extensive margin) as well as possible reductions in spending among those who use the drug (intensive margin).

We classified each drug as high- or low-value based on their ICERs relative to usual care or some other alternative, as summarized in the Tufts CEA Registry. The measures of cost effectiveness from the Registry use a variety of comparators and are over somewhat different time periods. As drugs with ICERs below $50,000 per quality-adjusted life year (QALY) are typically considered cost-effective, we use this threshold to classify our top 100 drugs as high-value (ICER ≤ $50,000/QALY, including dominating usual care) or low-value (ICER > $50,000). Drugs without any cost-effectiveness analyses in the Tufts CEA Registry and drugs with an insufficient sample size were excluded. Table 6 shows that the 100 selected drugs comprised about half of all drug spending in the study period. The subset of drugs with cost-effectiveness data available represented 48% of all drug spending.

Among the top 100 prescription pharmaceuticals with the highest spending, we identified 41 “high-value” drugs with ICERs ≤ $50,000 and 16 “low-value” drugs with ICERs > $50,000 that had positive spending growth from 2015 – 2018. An additional 16 “high-value” drugs and 13 “low-value” drugs had negative spending growth from 2015 – 2018. Spending on a cost-effective drug might decline over time if a newer drug or a generic substitute is introduced and “replaces” to some extent the spending on the existing drug. In addition to analyzing all low-value and all high-value drugs, we also analyzed the smaller sample of that had positive spending growth during this period since deductibles could slow the use of new technology. This subset would include more novel drugs. There were 3 drugs that had an insufficiently small sample size in 2015 for the analysis and 11 drugs that had no cost-effectiveness study found in the Tufts registry that were excluded.

Table 7 reports average values of spending and change in spending in each category of drugs separately for our HDHP and LDHP stayer samples. The top panel shows that while baseline spending was lower among HDHP stayers than for LDHP stayers (consistent with the aggregate data on all drugs), there was not a statistically significant difference in the three-year growth for the sample of high value drugs. However, for the low value sample of drugs, spending growth was significantly lower for HDHP relative to LDHP.

In the bottom panel of Table 4, we exclude those drugs with declining spending over the study period. In this subset we observe significantly lower growth in HDHP for both high- and low-value drugs. However, the shortfall in growth is larger for low value drugs.

Using the largest sample of drugs for which we have cost-effectiveness data we find results suggesting that high deductibles have an effect on spending growth for low value drugs but not on high value drugs. This is qualitatively different from the HIE which found no difference in the effect of cost sharing on levels of episodes of care characterized by expert judgment of clinical value. However, the smaller subsample of drugs including only those with growing spending generated a similar result to the HIE of higher cost sharing indiscriminately reducing high- and low-value care.

6 Conclusion

Our results imply that the impact of high deductible health plans (compared to low deductible plans) on growth in spending and use of new technology in the period 2015-2018 was modest at most. However, it does seem that high deductible plans did reduce spending growth on prescription drugs and did so in a way that may have impacted lower value technologies more than high value technologies.

As with any observational study attempting to identify the impacts of non-randomly assigned interventions in a real-world setting, there are some limitations to these conclusions. The time period of our data was not one in which there were major technological changes in most types of care. Nothing like the diffusion of MRI or of radiologic therapy for cancer was introduced, in contrast to earlier time periods. As a result, our setting may not be ideally suited to testing the hypothesis that higher deductibles slow spending growth by slowing the diffusion of new technology. In addition, any attempts to measure the anti-moral hazard effects of higher cost-sharing are always complicated by the possibility of selfselection into a high deductible plan by those with lower medical risks or propensity to seek care. While we attempt to account for such selection in multiple ways, we cannot disregard the possibility that some bias remains in our results. However, the likely direction of such bias is negative, and was not apparent in our results on spending growth for medical services or medical spending in the aggregate. Our measures of the impact of higher deductibles on the level of spending as people switch from low to high deductible plans are of the same order of magnitude as other estimates, suggesting little bias in the choice to switch or the timing of switch. More definitive welfare results than can be inferred from our results would require quantification of the cost-effectiveness of other new medical goods and services that are affected by coverage, along with measurement of the value of reduced risk protection (financial and health). In addition, the differences across plan type may well understate the impact of market wide shifts to higher or lower cost-sharing.

References

Brot-Goldberg, Z. C., Chandra, A., Handel, B. R., and Kolstad, J. T. (2017). What does a deductible do? The impact of cost-sharing on health care prices, quantities, and spending dynamics. *The Quarterly Journal of Economics*, *132*(3): 1261-1318.

Buntin, M. B., Haviland, A.M., McDevitt, R., and Sood, N. (2011). Healthcare spending and preventive care in high-deductible and consumer-directed health plans. *American Journal of Managed Care*, 17(3): 222-230.

Bundorf, M.K. (2016). Consumer-directed health plans: a review of the evidence. *The Journal of Risk and Insurance*, 83(1): 9-41.

Chandra, A., and Skinner, J. (2012). Technology growth and expenditure growth in health care. *Journal of Economic Literature,* 50(3): 645–80.

Chiappori, P.A. and Salanie, B. (2000). Testing for asymmetric information in insurance markets. *Journal of Political Economy*, 108(1): 56-78.

Charlton, M. E., Levy, B.T, High, R.R., Schneider, J.E., and Brooks, J.M. (2011). Effects of health savings account-eligible plans on utilization and expenditures. *American Journal of Managed Care*, 17(1): 79-86.

Cohen, A., and Einav, L. (2007). Estimating risk preferences from deductible choice. *American Economic Review*, 97(3): 745-788.

Cutler, D. M., McClellan, M., and Newhouse, J. P. (2000). How does managed care do it?. *The RAND Journal of Economics*, 31(3): 526-548.

Davis, K. (2004). Consumer-directed health care: will it improve health system performance?. *Health Services Research*, 39(4): 1219-1233.

Eichner, M. J. (1998). The demand for medical care: what people pay does matter. *American Economic Review: Papers and Proceedings*, 88(2): 117-121.

Eisenberg, M.D., Du, S., Sen, A.P., Kennedy-Hendricks, A., and Barry, C. L. (2020). Health care spending by enrollees with substance use and mental health disorders in high-deductible health plans vs. traditional plans. *JAMA Psychiatry*, 77(8): 872-875.

Fendrick, A.M., Buxbaum, J.D., Tang, Y., Vlahiotis, A., McMorrow, D., Rajpathak, S., and Chernew, M.E. (2019). Association between switching to a high-deductible health plan and discontinuation of type 2 diabetes treatment. *JAMA Network Open,* 2(11): e1914372.

Finkelstein, A. (2007). The aggregate effects of health insurance: evidence from the introduction of Medicare. *The Quarterly Journal of Economics*, 122(1): 1-37.

Gaffney, A., White, A., Hawks, L., Himmelstein, D., Woolhandler, S., Christiani, D.C., and McCormick, D. (2020). High-deductible health plans and healthcare access, use, and financial strain in those with chronic obstructive pulmonary disease. *Annals of the American Thoracic Society*, 17(1): 49-56.

Glied, S. (2003). Health care cost: on the rise again. *Journal of Economic Perspectives*. 17(2): 125-148.

Grossman, G. (1972). On the concept of health capital and the demand for health. *The Journal of Political Economy,* 80(2): 223-255.

Golberstein, E., Walsh, K., He, Y., and Chernew, M.E. (2013). Supplemental coverage associated with more rapid spending growth for Medicare beneficiaries. *Health Affairs,* 32(5): 873-881.

Haviland, A. M., Sood, N., McDevitt, R., and Marquis, M. S. (2011). How do consumer-directed health plans affect vulnerable populations?. *Forum for Health Economics and Policy*, 14(2): 3-3.

Haviland, A. M., Eisenberg, M.D., Mehrotra, A., Huckfeldt, P.J., and Sood, N. (2016). Do 'consumer-directed' health plans bend the cost curve over time?. *Journal of Health Economics,* 46: 33–51.

Keehan, S.P., Cuckler, G.A., Poisal, J.A., Sisko, A.M., Smith, S.D., Madison, A.J., Rennie, K.E., Fiore, J.A., and Hardesty, J.C. (2020). National health expenditure projections, 2019-28: expected rebound in prices drives rising spending growth. *Health Affairs*, 39(4): 10-377.

Kaiser Family Foundation. (2018). 2018 Employer health benefits survey. *Kaiser Family Foundation*. Available at: https://www.kff.org/health-costs/report/2018-employer-health-benefits-survey/, accessed on November 9, 2020.

Kowalski, A. (2016). Censored quantile instrumental variable estimates of the price elasticity of expenditure on medical care. *Journal of Business & Economic Statistics,* 34(1):107-117.

Lohr, K.N., Brook, R.H., Kamberg, C.J., Goldberg, G.A, Leibowitz, A., Kessey, J., Reboussin, D., and Newhouse, J.P. (1986). Use of medical care in the RAND Health Insurance Experiment: diagnosis and service-specific analyses in a randomized controlled trial. *RAND Corporation*. Available at: https://www.rand.org/pubs/reports/R3469.html, accessed on November 9, 2020.

Manning, W. G., Newhouse, J. P., Duan, N., Keeler, E. B., and Leibowitz, A. (1987). Health insurance and the demand for medical care: Evidence from a randomized experiment. *The American Economic Review*, 77(3): 251-277.

McWilliams, J. M., Hatfield, L. A., Chernew, M. E., Landon, B. E., and Schwartz, A. L. (2016). Early performance of accountable care organizations in Medicare. *New England Journal of Medicine*, *374*(24): 2357-2366.

Newhouse, J.P. and the Insurance Experiment Group (1993). Free for all?: Lessons from the RAND Health Insurance Experiment. *Harvard University Press*.

Parente, S. T., Feldman, R, and Chen, S. (2008). Effects of a consumer driven health plan on pharmaceutical spending and utilization. *Health Services Research*, 43(5): 1542-1556.

Peden, E. A., and Freeland, M.S. (1998). Insurance effects on US medical spending (1960–1993). *Health Economics*, 7(8): 671–687.

Rabin, D.L., Jetty, A., Petterson, S., and Froehlich, A. (2020). Under the ACA higher deductibles and medical debt cause those most vulnerable to defer needed care. *Journal of Health Care for the Poor and Underserved,* 31(1): 424-440.

Smith, S., Newhouse, J. P., and Freeland, M. S. (2009). Income, insurance, and technology: why does health spending outpace economic growth?. *Health Affairs*, *28*(5), 1276-1284.

Waters, T.M., Chang, C. F., Cecil, W.T., Kasteridis, P, and Mirvis, D. (2011). Impact of high-deductible health plans on health care utilization and costs. *Health Services Research*, 46(1): 155-172.

Weisbrod, B.A. (1991). The health care quadrilemma: An essay on technological change, insurance, quality of care, and cost containment. *Journal of Economic Literature*, 29(2): 523–552.

Wharam, J. F., Landon, B.E., Galbraith, A.A., Kleinman, K.P, Soumerai, S.B., and Ross-Degnan, D. (2007). Emergency department use and subsequent hospitalizations among members of a high-deductible health plan. *JAMA*, 297(10): 1093-1102.

Wharam, J. F., Landon, B.E., Zhang, F., Soumerai, S. B., and Ross-Degnan, D. (2011). High-deductible insurance: two-year emergency department and hospital use. *American Journal of Managed Care*, 17(10): e410-e418.

Wharam J.F., Zhang, F., Lu, C.Y., Wagner, A.K., Nekhlyudov, L., Earle, C.C., Soumerai, S.B., and Ross-Degnan, D. (2018)**.** Breast cancer diagnosis and treatment after high-deductible insurance enrollment. *Journal of Clinical Oncology*, 36(11): 1121–1127.

Wharam, J.F., Busch, A.B., Madden, J. Zhang, F., Callahan, M., LeCates, R.F., Foxworth, P., Soumerai, S., Ross-Degnan D.R., and Lu, C.Y. (2020). Effect of high-deductible insurance on health care use in bipolar disorder. *The American Journal of Managed Care*, 26(6): 248-255.

Woolhandler, S., and Himmelstein, D.U. (2007). Consumer directed healthcare: except for the healthy and wealthy it’s unwise. *Journal of General Internal Medicine*, 22(6): 879-881.

Tables and Figures

Table 1. Sample Characteristics

	LDHP	HDHP	Switchers
N	164,574	159,917	12,888
Female	49.8%	48.5%	49.8%
Age			
Mean	42.13	42.33	43.48
SD	12.23	12.16	12.09
Age group			
18-24	9.1%	8.7%	9.5%
25-29	5.8%	6.0%	5.8%
30-34	9.4%	9.3%	10.0%
35-39	11.0%	10.8%	11.0%
40-44	12.3%	11.7%	12.3%
45-49	13.8%	13.7%	13.8%
50-54	14.7%	15.3%	15.3%
55-59	14.3%	15.4%	15.2%
60 plus	9.5%	9.0%	7.1%
Region			
Northeast	7.4%	9.5%	12.9%
Midwest	22.2%	40.8%	35.3%
South	28.9%	23.5%	23.6%
West	41.4%	26.1%	28.0%
Unknown	0.0%	0.1%	0.2%
Charlson Score			
0	74.5%	77.6%	77.8%
1	17.2%	15.4%	15.6%
2	5.2%	4.5%	4.0%
3+	3.1%	2.5%	2.6%

Notes: This table reports the mean demographic characteristics of the members in our "stayer" (column 1 and column 2) and "switchers" (column 3) study samples. SD = standard deviation. "Charlson Score" refers to the member's Charlson comorbidity index or score. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Table 2. Patient Out-of-Pocket Shares by Setting

	2015	2016	2017	2018
LDHP				
Medical	14.2%	13.6%	13.0%	12.2%
Pharmacy	11.7%	10.7%	10.8%	10.3%
Total	13.5%	12.8%	12.3%	11.7%
HDHP				
Medical	24.5%	22.6%	21.4%	20.5%
Pharmacy	21.7%	19.6%	18.3%	17.1%
Total	23.8%	21.8%	20.6%	19.6%

Notes: This table reports the average patient out-of-pocket share of spending in the settings of medical, pharmacy, and total for each year of the study period (2015-2018). "Total" includes both medical and pharmacy settings. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Table 3a. LDHP Subgroup Analysis

	Overall LDHP	LDHP Subgroups			
		Observed Choice	No Observed Choice	Very Low Deductible	No Deductible
N	164,574	42,628	63,214	51,614	36,897
Average Cost Levels					
Medical	$5,307	$5,370	$5,078	$5,305	$5,323
Pharmacy	$2,048	$2,047	$1,826	$1,991	$2,025
Total	$7,355	$7,417	$6,904	$7,296	$7,347
Average Annual Growth					
Medical	$438	$466	$472	$485	$524
Pharmacy	$231	$260	$212	$230	$236
Total	$670	$727	$685	$715	$760

Notes: This table reports spending levels and average growth for overall LDHP and LDHP subgroups. “Observed Choice” and "No Observed Choice" includes members of employers that respectively always and never offered HDHPs and LDHPs simultaneously each year of the study period (2015-2018); "Very Low" includes plans with individual/family deductibles ≤ $250/$500; HDHP = High deductible health plans, LDHP = Low deductible health plans.

Table 3b. HDHP Subgroup Analysis

	Overall HDHP	HDHP Subgroups			
		Observed Choice	No Observed Choice	Very High Deductible	HSA
N	159,917	25,339	72,591	60,369	44,767
Average Cost Levels					
Medical	$4,478	$4,247	$4,278	$4,256	$5,121
Pharmacy	$1,575	$1,297	$1,492	$1,378	$1,596
Total	$6,053	$5,544	$5,770	$5,634	$6,717
Average Annual Growth					
Medical	$475	$494	$473	$475	$504
Pharmacy	$190	$179	$181	$170	$185
Total	$665	$674	$654	$645	$689

Notes: This table reports spending levels and average growth for overall HDHP and HDHP subgroups. “Observed Choice” and "No Observed Choice" includes members of employers that respectively always and never offered HDHPs and LDHPs simultaneously each year of the study period (2015-2018); HSA = HDHP members with plan names explicitly indicating presence of a health savings account; "Very High" includes plans with individual/family deductibles ≥ $3,000/$6,000; HDHP = High deductible health plans, LDHP = Low deductible health plans.

Table 4. Mean and Median Annual Spending per Member Pre- and Post-Switch

	Year Before Switch	Year After Switch	Change	
			$	%
A. Mean Costs				
Medical				
Patient	$653	$929	$277	42%
Plan	$4,034	$3,894	-$140	-3%
Allowed	$4,743	$4,861	$118	2%
Pharmacy				
Patient	$182	$278	$96	52%
Plan	$1,494	$1,540	$46	3%
Allowed	$1,679	$1,821	$141	8%
Total				
Patient	$835	$1,207	$372	45%
Plan	$5,529	$5,434	-$95	-2%
Allowed	$6,423	$6,682	$259	4%
B. Median Costs				
Medical				
Patient	$191	$303	$111	58%
Plan	$577	$374	-$203	-35%
Allowed	$895	$836	-$59	-7%
Pharmacy				
Patient	$52	$63	$11	20%
Plan	$85	$34	-$51	-60%
Allowed	$177	$159	-$18	-10%
Total				
Patient	$357	$533	$176	49%
Plan	$1,024	$637	-$387	-38%
Allowed	$1,545	$1,393	-$152	-10%

Notes: This table reports mean and median annual spending levels for our "switchers" sample, members who switched from a LDHP to a HDHP during the study period (2015-2018), in the year before and the year after the switch. "Total" includes both medical and pharmacy settings. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Table 5. Linear Regression Models of Spending

	No Controls			With Controls			With Member Fixed Effects		
	Total (1)	Medical (2)	Pharmacy (3)	Total (4)	Medical (5)	Pharmacy (6)	Total (7)	Medical (8)	Pharmacy (9)
Year (vs. 2015)									
2016	636.2***	358.8***	277.4***	603.8***	334.0***	269.8***	605.0***	329.8***	275.2***
	(113.0)	(100.2)	(39.61)	(106.8)	(96.54)	(38.28)	(87.23)	(83.45)	(21.71)
2017	1310.1***	860.1***	450.0***	1254.9***	821.5***	433.5***	1277.7***	842.5***	435.2***
	(113.5)	(100.7)	(39.81)	(107.4)	(97.03)	(38.48)	(88.43)	(84.59)	(22.01)
2018	2141.7***	1468.6***	673.1***	2049.8***	1404.4***	645.4***	2051.2***	1391.6***	659.7***
	(113.6)	(100.8)	(39.85)	(107.5)	(97.14)	(38.51)	(88.89)	(85.03)	(22.13)
Deductible x Choice									
LDHP x Observed	576.4***	397.3***	179.1***	287.2*	185.3	102.0*	206.8	282.4*	-75.55*
	(123.8)	(109.8)	(43.40)	(117.1)	(105.8)	(41.97)	(141.8)	(135.7)	(35.30)
HDHP x Not Observed	1140.1***	-823.5***	-316.6***	-665.8***	-435.6***	-230.2***	105.0	82.89	22.06
	(113.1)	(100.3)	(39.66)	(107.8)	(97.39)	(38.62)	(139.7)	(133.7)	(34.78)
HDHP x Observed	1348.2***	-853.7***	-494.6***	-712.7***	-410.7***	302.0***			
	(132.2)	(117.2)	(46.36)	(125.1)	(113.1)	(44.84)			
Deductible x Choice x Year									
LDHP x Observed x 2016	-36.37	-16.96	-19.41	31.08	33.89	-2.817	33.57	31.06	2.511
	(172.1)	(152.6)	(60.33)	(162.7)	(147.1)	(58.31)	(134.8)	(129.0)	(33.56)
LDHP x Observed x 2017	-181.2	-180.4	-0.859	-59.35	-95.51	36.15	-103.8	-167.3	63.55
	(173.2)	(153.6)	(60.74)	(163.8)	(148.1)	(58.71)	(138.7)	(132.6)	(34.52)
LDHP x Observed x 2018	-108.9	-162.3	53.39	92.79	-22.89	115.7	106.4	-12.47	118.9***
	(175.1)	(155.3)	(61.39)	(165.6)	(149.6)	(59.33)	(140.8)	(134.7)	(35.05)
HDHP x Not Observed x 2016	-20.86	84.06	-104.9	51.95	141.0	-89.07	55.98	129.0	-73.00*
	(158.3)	(140.4)	(55.50)	(149.7)	(135.3)	(53.65)	(122.2)	(116.9)	(30.41)

HDHP x Not Observed x 2017	-164.2	-30.80	-133.4*	-77.70	33.38	-111.1*	-101.4	-7.045	-94.37**
	(157.5)	(139.7)	(55.24)	(149.0)	(134.7)	(53.39)	(122.5)	(117.2)	(30.49)
HDHP x Not Observed x 2018	-177.6	-36.87	-140.7*	-80.27	33.58	-113.9*	-99.07	12.78	-111.9***
	(156.8)	(139.1)	(54.98)	(148.3)	(134.0)	(53.14)	(122.6)	(117.2)	(30.51)
HDHP x Observed x 2016	193.7	204.1	-10.49	160.2	167.9	-7.782	142.9	195.0	-52.09
	(189.6)	(168.2)	(66.49)	(179.4)	(162.1)	(64.29)	(147.5)	(141.1)	(36.71)
HDHP x Observed x 2017	-90.26	-35.35	-54.91	-60.03	-36.43	-23.60	-105.2	-47.86	-57.36
	(194.8)	(172.8)	(68.32)	(184.3)	(166.6)	(66.07)	(153.9)	(147.2)	(38.31)
HDHP x Observed x 2018	-324.2	-143.1	-181.1**	-162.6	-59.35	-103.3	-151.0	-8.073	-143.0***
	(199.8)	(177.2)	(70.06)	(189.1)	(170.9)	(67.77)	(159.2)	(152.3)	(39.63)
Year Relative to Switch x Stayer/Switcher x Choice									
Year t-3 x Switch x Not Observed	-1231.7	-910.6	-321.2	-753.2	-600.7	-152.5	855.8	448.4	407.4*
	(632.7)	(561.1)	(221.8)	(599.3)	(541.7)	(214.8)	(801.6)	(766.8)	(199.5)
Year t-3 x Switch x Observed	-997.1*	-717.1	-280.0	-449.0	-300.0	-149.0	658.8	252.3	406.5*
	(499.7)	(443.2)	(175.2)	(472.6)	(427.1)	(169.4)	(720.9)	(689.6)	(179.4)
Year t-2 x Switch x Not Observed	-719.6	-279.0	-440.6**	-250.0	25.90	-275.9	1571.6*	1344.0*	227.6
	(463.7)	(411.2)	(162.6)	(439.0)	(396.8)	(157.3)	(701.1)	(670.7)	(174.5)
Year t-2 x Switch x Observed	-849.4*	-644.2*	-205.1	-150.0	-128.2	-21.86	1057.4	783.5	273.9
	(341.9)	(303.2)	(119.9)	(323.3)	(292.3)	(115.9)	(634.4)	(606.9)	(157.9)
Year t-1 x Switch x Not Observed	-869.0*	-470.0	-399.0**	-151.9	31.64	-183.5	1347.9*	1118.4	229.5
	(437.7)	(388.2)	(153.5)	(414.2)	(374.4)	(148.5)	(670.7)	(641.6)	(166.9)
Year t-1 x Switch x Observed	-769.6**	-534.4*	-235.3*	-119.3	-59.22	-60.07	1155.1*	944.6	210.5
	(264.9)	(235.0)	(92.90)	(250.6)	(226.5)	(89.83)	(581.5)	(556.3)	(144.7)
Year t+1 x Switch x Not Observed	-211.9	-471.2	259.4*	-42.66	-307.6	264.9*	732.7	590.3	142.4
	(332.6)	(295.0)	(116.6)	(314.9)	(284.6)	(112.9)	(642.9)	(615.0)	(160.0)
Year t+1 x Switch x Observed†	1804.4***	-986.2***	-818.3***	-797.5**	-292.3	-505.2***	954.5	858.6	95.91
	(307.2)	(272.4)	(107.7)	(290.5)	(262.6)	(104.1)	(571.3)	(546.6)	(142.2)

Year t+2 x Switch x Not Observed	-425.1	-622.0	196.9	-30.83	-307.2	276.4*	1139.7	1031.5	108.2
	(366.7)	(325.2)	(128.6)	(346.9)	(313.6)	(124.3)	(654.7)	(626.3)	(163.0)
Year t+2 x Switch x Observed†	2261.1***	1391.4***	-869.7***	-1206.5**	-662.9	-543.6***	257.2	303.0	-45.75
	(418.6)	(371.2)	(146.8)	(395.8)	(357.8)	(141.9)	(592.9)	(567.1)	(147.6)
Year t+3 x Switch x Not Observed	-518.3	-636.2	117.9	-142.2	-327.9	185.7	622.6	643.9	-21.25
	(522.2)	(463.1)	(183.1)	(493.8)	(446.3)	(177.0)	(736.5)	(704.5)	(183.3)
Year t+3 x Switch x Observed†	-2611.0***	-1755.2**	-855.8***	-1490.9**	-964.9	-526.0*			
	(606.2)	(537.6)	(212.6)	(573.1)	(518.0)	(205.4)			
Controls									
Sex	No	No	No	Yes	Yes	Yes	No	No	No
Age	No	No	No	Yes	Yes	Yes	No	No	No
Region	No	No	No	Yes	Yes	Yes	No	No	No
Charlson Score	No	No	No	Yes	Yes	Yes	No	No	No
Member Fixed Effects	No	No	No	No	No	No	Yes	Yes	Yes
Observations	1,070,428	1,070,428	1,070,428	1,069,644	1,069,644	1,069,644	1,070,428	1,070,428	1,070,428
Adjusted R-squared	0.002	0.001	0.002	0.108	0.073	0.067	-0.330	-0.332	-0.328
P-value for H0: β†= β† = β†	0.411	0.373	0.956	0.470	0.435	0.975			

Notes: This table reports results from our regression analysis which includes members exclusively enrolled in a HDHP or LDHP ("stayers") and members who switched from HDHP to LDHP ("switchers"). Columns (1)-(3) do not control for observable and unobservable risk factors, Columns (4)-(6) include observable risk factors, and Columns (7)-(9) include individual fixed effects. Standard errors are shown in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$. Coefficient estimates for controls are not shown. "Observed" and "Not Observed" includes members of employers that respectively always and never offered HDHPs and LDHPs. "Charlson Score" refers to the member's Charlson comorbidity index or score. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Table 6. Total Prescription Drug Spending by Selected Sample of Drugs

	Total 4Y Spending from 2015-2018	
	% of All Drugs	% of Top 100 Drugs
All Prescription Drugs	100%	
Top 100 Drugs	52%	100%
CE Study Found	48%	94%
Positive Spending Growth	35%	67%

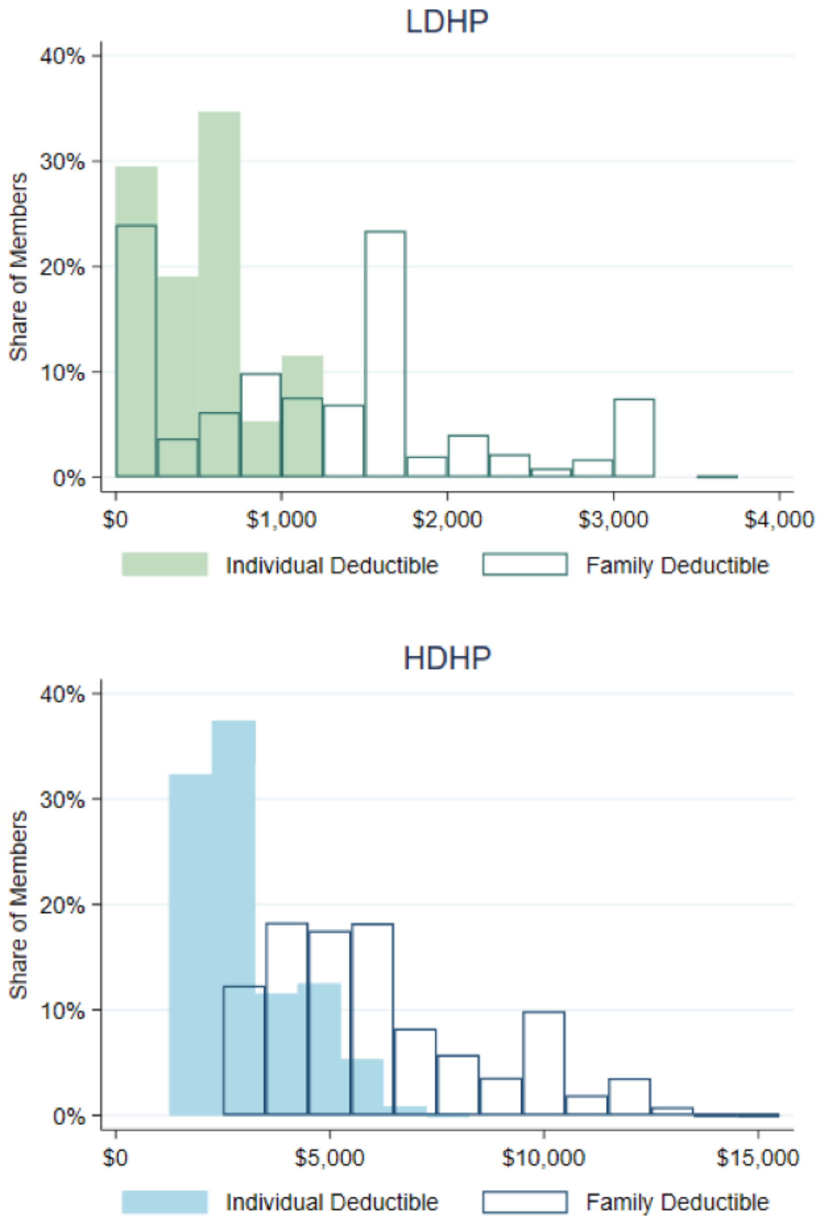
Notes: This table reports total spending of prescription pharmaceuticals for members in our "stayer" sample during the study period (2015-2018). Each row is a subset of the previous row. "All Prescription Drugs" refers to all prescription pharmaceuticals. "Top 100 Drugs" are the top 100 drugs with highest total spending over the study period. "CE Study Found" are the drugs we classified into high- or low-value using the Tufts CEA Registry. "Positive Spending Growth" refers to the drugs with positive spending growth from 2015-2018. CE = Cost-effective. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Table 7. Baseline Spending and Growth for Top Drugs

	2015 Levels				3Y Growth			
	LDHP	HDHP	Difference	p-value	LDHP	HDHP	Difference	p-value
All Prescription Drugs	$1,696	$1,285	-$411	<0.001	$694	$570	-$124	<0.001
Top 100 with CE Study								
All (N = 86)	$786	$644	-$142	<0.001	$348	$300	-$48	0.020
High-value (N = 57)	$560	$457	-$104	<0.001	$214	$201	-$13	0.429
Low-value (N = 29)	$226	$188	-$38	<0.001	$134	$100	-$35	0.007
Top 100 with CE Study + Positive Growth								
All (N = 57)	$468	$392	-$76	<0.001	$526	$442	-$84	<0.001
High-value (N = 41)	$370	$310	-$60	<0.001	$340	$301	-$39	0.005
Low-value (N = 16)	$98	$82	-$16	0.015	$186	$141	-$45	<0.001

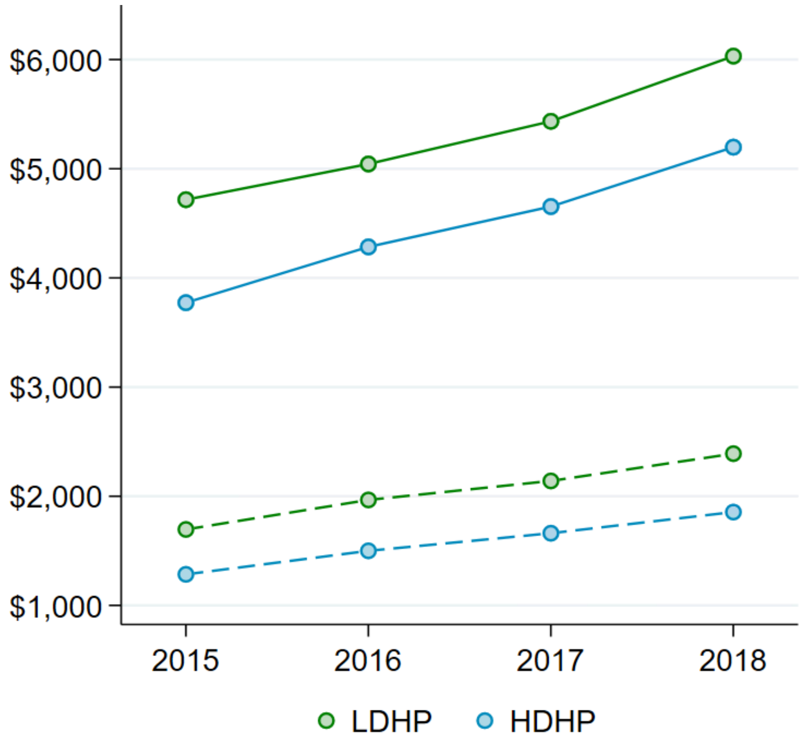
Notes: This table reports average values of spending and change in spending for each category of drugs separately for our HDHP and LDHP stayer samples. “All Prescription Drugs” refers to all prescription pharmaceuticals. “Top 100 Drugs” are the top 100 drugs with highest total spending over the study period. “CE Study” are the drugs we classified into high- or low-value using the Tufts CEA Registry. “Positive Growth” refers to the drugs with positive spending growth from 2015-2018. High- and low-value drugs include those with an incremental cost-effectiveness ratio (ICER) below and above $50,000, respectively. The p-values reported in the last columns are from two-tailed t-tests of the difference in means for the LDHP and HDHP stayer groups, assuming equal variance. 3Y = Three-year change in total spending per member (2015-2018). CE = Cost-effective. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Figure 1. Average Deductibles for LDHP and HDHP Members



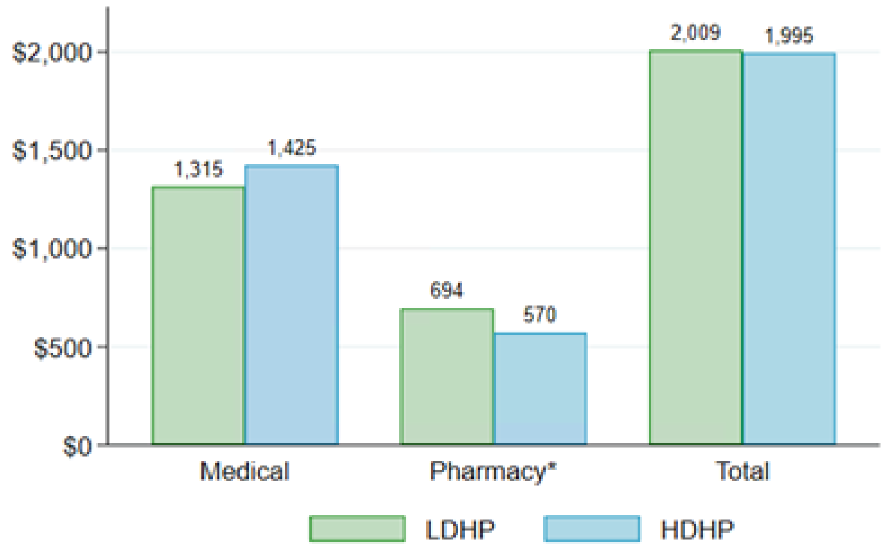
Notes: This figure shows the distribution of individual and family deductibles for members in our HDHP and LDHP stayer groups using an enrollment-weighted average for each member; HDHP = High deductible health plans, LDHP = Low deductible health plans.

Figure 2. Trends in Average Annual Spending per Member



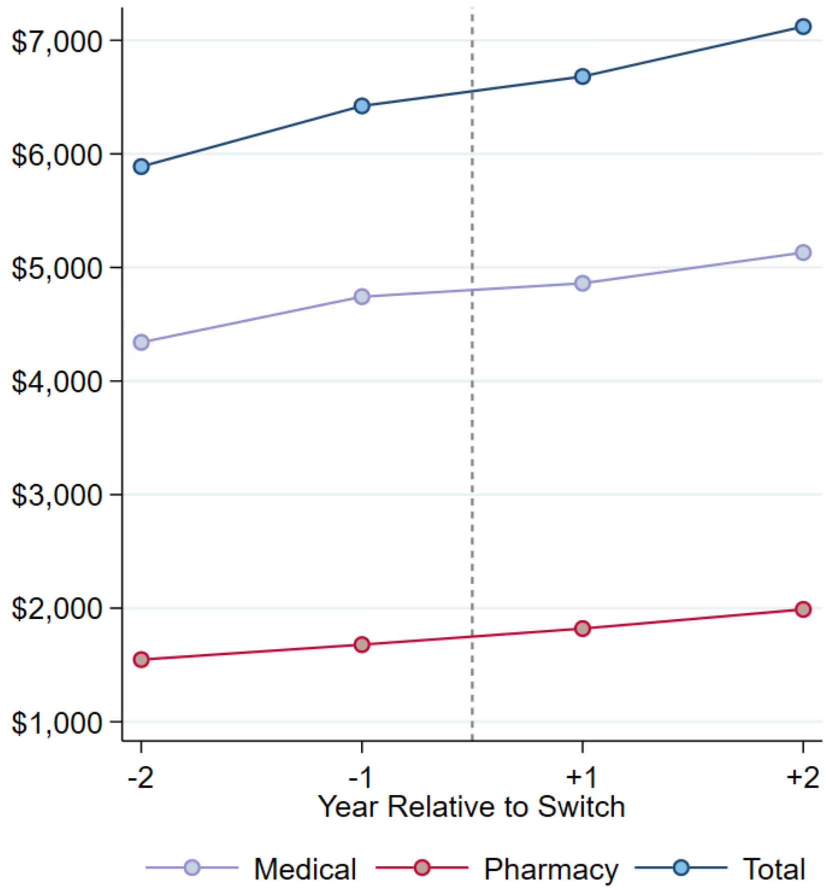
Notes: This figure shows the trends in average per-member medical and pharmacy spending for each year over the study period from 2015 to 2018; solid trends represent medical spending and dashed trends represent pharmacy spending. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Figure 3. Average Cost Growth per Member



Notes: This figure shows the average 3-year cost growth from 2015 to 2018 for members in our HDHP and LDHP stayer groups in absolute terms, unadjusted for any observable individual characteristics. "Total" includes both medical and pharmacy settings; * represents the difference in spending within the category is statistically significant with $p < 0.01$. HDHP = High deductible health plans, LDHP = Low deductible health plans.

Figure 4. Average Annual Spending
Pre- and Post-Switch from LDHP to HDHP



Notes: This figure presents trends in mean allowed costs per member including up to two years before and two years after the switch from a LDHP to a HDHP over the study period (2015-2018). "Total" includes both medical and pharmacy settings. HDHP = High deductible health plans, LDHP = Low deductible health plans.