Financial Burden of Healthcare Utilization in Consumer-Directed Health Plans

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ABSTRACT

OBJECTIVES: To evaluate the impact of enrollment in a consumer-directed health plan (CDHP) on out-of-pocket (OOP) spending and on the financial burden associated with healthcare utilization.

STUDY DESIGN: Using commercial claims data from 2011 through 2013, we estimated difference-in-differences models that compared changes in outcomes for individuals who switched to CDHPs (CDHP group) with outcome changes for individuals who remained in traditional plans (traditional plan group).

METHODS: We estimated the impact of CDHP enrollment on OOP spending at the point of care and on having high financial burden, defined as whether an enrollee spent 3% or more of household income on OOP spending. Additionally, we assessed these outcomes for 2 subgroups: those with lower household income and those with chronic conditions.

RESULTS: Within the first year of CDHP enrollment, CDHP enrollees experienced a mean marginal increase in OOP spending of $285 (41% increase; 95% CI, $271-$299; *P* <.001) relative to traditional plan enrollees. The lower-income and chronic conditions subgroups experienced mean marginal increases in OOP costs of $306 (44% increase; 95% CI, $257-$353; *P* <.001) and $387 (56% increase; 95% CI, $339-$435; *P* <.001), respectively. The probability of an enrollee having excessive financial burden increased by 4.3 percentage points (95% CI, 4.0-4.6; *P* <.001) for the full CDHP sample. These effects were about 3 times larger for the lower-income subgroup (12.3 percentage points; 95% CI, 10.7-13.8; *P* <.001) and 2 times larger for the chronic conditions subgroup (8.0 percentage points; 95% CI, 6.9-9.1; *P* <.001).

CONCLUSIONS: CDHP enrollment led to a significant increase in financial burden associated with healthcare utilization, especially for those with lower incomes and those with chronic conditions.

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Consumer-directed health plans (CDHPs) are high-deductible health plans (HDHPs) coupled with a health savings account (HSA) or a health reimbursement arrangement (HRA). The proportion of covered workers with employer-sponsored insurance enrolled in a CDHP increased from 4% in 2006 to 29% in 2016.[1] In 2016, 56% of covered workers were employed by a firm that offered a CDHP and, among the 41% of covered workers who were offered only 1 type of plan, nearly one-third were offered only a CDHP.[1]

CDHPs are designed to make patients more cost-conscious and to encourage value-based decision making. Although previous work has consistently demonstrated that CDHPs reduce healthcare spending and utilization,[2-9] they may also increase financial burden when patients utilize healthcare. Previous research has shown that CDHP enrollees are more likely to have difficulty accessing necessary healthcare and to incur high medical bills and medical debt,[10,11] particularly among lower-income individuals and those with chronic conditions.[10-14]

However, many existing studies are based on findings from cross-sectional surveys and thus might be subject to potential selection bias. We therefore investigated the impact of CDHP enrollment on the financial burden of healthcare utilization at the point of service, using longitudinal private insurance claims data from January 1, 2011, to December 31, 2013. We estimated the effects of CDHP enrollment on out-of-pocket (OOP) costs both at the mean and across the distribution of healthcare spending. Additionally, we analyzed the effect of CDHP enrollment on the probability of an enrollee having excessive financial burden from OOP spending. Finally, given evidence that lower-income individuals and the chronically ill may be more likely to forgo or delay care due to cost, coupled with the fact that the RAND Health Insurance Experiment suggests that high cost sharing may lead to impaired health outcomes among the poor and sick,[15-18] we examined the effects of CDHP enrollment on financial burden for these vulnerable populations.

TAKEAWAY POINTS

Consumer-directed health plan (CDHP) enrollment increases the financial burden associated with healthcare utilization, especially for those with lower incomes, those with chronic conditions, and those at the higher end of the healthcare spending distribution.

- Due to the unpredictable nature of healthcare utilization, it is unclear in advance who will end up with high healthcare utilization and significant financial burden in a given year.
- More effort is needed to make individuals aware of the potentially significant out-of-pocket spending and financial burden that could be incurred after enrollment in a CDHP.

METHODS

Data and Sample

We used claims data from the OptumInsight (a subsidiary of UnitedHealth Group) Clinformatics Data Mart from 2011 to 2013 to analyze a 25% random sample of the insurer's commercially insured subscribers and dependents who were continuously enrolled over the full 3-year period in both employer-sponsored and nongroup plans. These claims data also include measures of socioeconomic status, including categorical household income, predicted by a demographic-based analytical model using Census block group–level data where the unit population size (~600-3000) is smaller than that of a Census tract (~1200-8000) or a zip code tabulation area.[19] The data also include measures of education level, predicted by the median level of education attained by individuals 25 years or older at the Census block level, and race/ethnicity code, derived from a combination of sources including public records, self-reported surveys, and a proprietary ethnic code algorithm.

We included 2 groups of enrollees. The CDHP group included enrollees who were in a traditional plan in 2011 and in a CDHP in 2012 and 2013 (switch date: January 1, 2012) and enrollees who were in a traditional plan in 2011 and 2012 and in a CDHP in 2013 (switch date: January 1, 2013); switching was split relatively evenly across the 2 years in the study sample (**eAppendix Table** [eAppendix available at **ajmc.com**]). The traditional plan control group included enrollees who were in a traditional plan throughout all 3 years. We excluded enrollees who were 65 years or older (5.7% of the sample) and enrollees with negative OOP costs (0.009% of the sample). The lower-income subgroup included enrollees with an estimated annual household income of less than $40,000 (the lowest category defined in the data). The chronic conditions subgroup was defined as enrollees with at least 1 chronic condition in the baseline year, defined by the Charlson Comorbidity Index (CCI).[20] The data were deidentified, and this study was approved by the University of Southern California University Park Institutional Review Board.

Outcomes

We analyzed OOP spending and a binary indicator of excessive financial burden, defined by OOP spending being greater than or equal to 3% of household income, based on prior research.[12] We also used alternative thresholds (5% and 10%) to examine the sensitivity of our findings to this definition.[21] In all cases, OOP spending refers only to spending incurred at the point of care and represents the sum of co-payments, deductibles, and coinsurance paid by an enrollee for all healthcare services utilized in the given year. Because estimated household income was a categorical variable in our data, we calculated the excessive financial burden indicator using the midpoint of each income interval, capped at $100,000 (the highest category defined in the data).

Statistical Analysis

We used the χ^2 test and the *t* test to compare baseline characteristics between the CDHP group and the traditional plan group. We then performed descriptive analyses of the trends in mean OOP spending and the percentage of enrollees having excessive financial burden before and after CDHP enrollment. We used difference-in-differences (DID) regression analysis to compare changes in the outcomes for individuals who switched to CDHPs (CDHP group) with those for individuals who remained in traditional plans (traditional plan group). Compared with a standard DID model in which the participants in the treatment group usually experience a 1-time shift, we analyzed enrollees who switched to a CDHP at 2 different time points to enable estimation of both short-term (1-year) and medium-term (2-year) effects of CDHP enrollment. In all models, the analysis was at the enrollee-year level, and the primary independent variables were the indicators for the first and second year (where applicable) of CDHP enrollment, adjusted for group fixed effects, year fixed effects, age, gender, race, education, Census division, and CCI score.

For each population, we first estimated the impact of CDHP enrollment on mean OOP spending. Because OOP spending was highly skewed, we used a generalized linear model (GLM) with log link function and gamma distribution. We calculated the average marginal effects (incremental effects) of first- and second-year CDHP enrollment. Standard errors were clustered at the enrollee level. We also investigated the impact of CDHP enrollment on the distribution of differences in OOP spending (relative to traditional plan enrollees) using the linear quantile DID (QDID) model,[22] which outputs the treatment effects of CDHP enrollment at each decile of OOP spending. We used the QDID regression coefficients to predict traditional plan enrollees' adjusted OOP spending distribution in 2013 and the traditional plan group's counterfactual OOP spending distribution (ie, what the OOP spending distribution of the traditional plan group would have been had they enrolled in a CDHP). Based on the adjusted and counterfactual OOP cost distribution, we examined the change in the percentage of enrollees who would have very high OOP spending (eg, higher than $2000) due to CDHP

enrollment. Finally, we analyzed the impact of CDHP enrollment on the indicator of whether an enrollee had excessive financial burden (OOP spending to household income ratio ≥3%, 5%, or 10%) in a given year using GLM with logit link function and Bernoulli distribution. Standard errors were clustered at the enrollee level. Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc; Cary, North Carolina) and Stata version 14 (StataCorp; College Station, Texas). We used a significance level of $P \leq .05$ and all statistical tests were 2-sided.

RESULTS

Baseline Enrollee Characteristics

There were a total of 689,542 enrollees in our sample, consisting of 36,387 enrollees in the CDHP group and 653,155 enrollees in the traditional plan group. The baseline characteristics of each group are shown in **Table 1**. The χ^2 test indicates that CDHP enrollees differed from traditional plan enrollees in terms of age, education, gender, health status, region, and race and ethnicity. There were no statistically significant differences in predicted annual household income between the 2 groups.

Trends in OOP Spending and Financial Burden

Both the levels and trends in our key outcome variables were similar for the CDHP and the traditional plan group during the pre-CDHP enrollment period of up to 2 years (**eAppendix Figures 1** and **2**). Within the first year of CDHP enrollment, the percentage of CDHP enrollees having excessive financial burden rose from 9.7% (95% CI, 9.4%-10.0%) to 16.0% (95% CI, 15.7%-16.4%) for the full sample, compared with a slight increase from 9.0% (95% CI, 8.9%-9.1%) to 9.8% (95% CI, 9.7%-9.9%) among traditional plan enrollees (eAppendix Figure 2).

The impact of CDHP enrollment on financial burden was more pronounced among the lower-income and chronic conditions subgroups: The percentage of CDHP enrollees having excessive financial burden among these subgroups rose from 32.9% (95% CI, 31.4%-34.5%) to 47.7% (95% CI, 46.1%-49.4%) and from 25.3% (95% CI, 24.1%-26.5%) to 33.9% (95% CI, 32.7%-35.2%), respectively (eAppendix Figure 2). The effects of CDHP enrollment persisted for 2 years; OOP spending increased among CDHP enrollees while OOP spending for traditional plan enrollees remained stable (eAppendix Figure 1).

TABLE 1. Baseline Enrollee Characteristics (2011)

Variables	Traditional Plan Group (n = 653,155)	CDHP Group (n = 36,387)	*P*
Age, years, %			<.001
<17	24.3	25.9	
18-24	8.8	8.8	
25-44	29.8	29.6	
45-64	37.1	35.7	
Male, %	49.6	48.7	<.001
Race/ethnicity, %			<.001
Asian	4.6	6.4	
Black	10.1	12.0	
Hispanic	10.6	7.5	
White	74.7	74.1	
Education, %			<.001
High school diploma	24.3	24.1	
Less than bachelor's degree	54.0	53.5	
Bachelor's degree or higher	21.7	22.5	
Household income, %			0.08
<$40,000	9.7	9.9	
$40,000-$49,999	5.9	5.8	
$50,000-$59,999	6.6	6.7	
$60,000-$74,999	10.5	10.1	
$75,000-$99,999	17.1	16.9	
≥$100,000	50.3	50.7	
Census division, %			<.001
New England	3.7	2.4	
Middle Atlantic	7.7	3.9	
East North Central	13.8	15.5	
West North Central	12.5	8.4	
South Atlantic	27.7	34.3	
East South Central	3.1	2.8	
West South Central	16.0	12.4	
Mountain	8.4	11.5	
Pacific	7.2	8.7	
Charlson Comorbidity Index score, mean (SD)	0.3 (0.8)	0.2 (0.7)	<.001

CDHP indicates consumer-directed health plan.

Regression Results

The effects of CDHP enrollment on mean OOP spending are shown in **Table 2**. In the first year of CDHP enrollment, the mean marginal increase in OOP spending was $285 (41% increase; 95% CI, $271-$299; P <.001). CDHP enrollment resulted in larger marginal increases in OOP spending for the lower-income ($306; 44% increase; 95% CI, $257-$354; P <.001) and chronic conditions ($387; 56% increase; 95% CI, $339-$435; P <.001) subgroups. By the second year of CDHP enrollment, mean marginal OOP spending increased by $306 among the full sample (44% increase; 95% CI, $286-$325; P <.001), $364 (53% increase; 95% CI, $300-$429; P <.001) among the lower-income subgroup, and $428 (62% increase; 95% CI, $364-$492; P <.001) among the chronic conditions subgroup. The larger increases in OOP spending in the second year of CDHP enrollment are consistent

TABLE 2. Marginal Effect of CDHP Enrollment on A) Mean OOP Spending and B) Probability of Having Excessive Financial Burden

Variables	Full Sample (n = 689,542)	Lower-Income Subgroup (n = 66,709)	Chronic Conditions Subgroup (n = 117,360)
A. Mean OOP Spending[a]			
First year of enrollment, $ (95% CI)	285 (271-299)*	306 (257-354)*	387 (339-435)*
Second year of enrollment, $ (95% CI)	306 (286-325)*	364 (300-429)*	428 (364-492)*
	Full Sample (n = 689,542)	**Lower-Income Subgroup (n = 66,709)**	**Chronic Conditions Subgroup (n = 117,360)**
B. Probability of Having Excessive Financial Burden[a]			
3% as financial burden threshold, percentage-point change (95% CI)			
First year of enrollment	4.3 (4.0-4.6)*	12.3 (10.7-13.8)*	8.0 (6.9-9.1)*
Second year of enrollment	5.0 (4.6-5.4)*	15.0 (13.0-17.0)*	9.4 (7.8-10.9)*
5% as financial burden threshold, percentage-point change (95% CI)			
First year of enrollment	2.1 (1.9-2.3)*	10.2 (8.7-11.6)*	4.3 (3.5-5.1)*
Second year of enrollment	2.6 (2.3-2.8)*	13.2 (11.4-14.9)*	5.1 (4.0-6.2)*
10% as financial burden threshold, percentage-point change (95% CI)			
First year of enrollment	0.7 (0.6-0.9)*	5.6 (4.6-6.6)*	1.5 (1.0-2.0)*
Second year of enrollment	0.9 (0.7-1.1)*	7.4 (6.1-8.7)*	1.9 (1.3-2.6)*

CDHP indicates consumer-directed health plan; OOP, out-of-pocket.
*P <.001.
[a]Regressions controlled for age, gender, race/ethnicity, education, Census division, and Charlson Comorbidity Index score.

TABLE 3. Effects of CDHP Enrollment on OOP Spending ($), Across the Distribution of OOP Spending[a]

	Full Sample (n = 689,542)		Lower-Income Subgroup (n = 66,709)		Chronic Conditions Subgroup (n = 117,360)	
Quantile	First Year of Enrollment	Second Year of Enrollment	First Year of Enrollment	Second Year of Enrollment	First Year of Enrollment	Second Year of Enrollment
10	0	0	0	0	22	38**
20	7**	8**	7*	21*	96**	111**
30	43**	51**	64	93**	200**	243**
40	93**	104**	139**	193**	341**	419**
50[b]	162**	182**	241**	318**	480**	542**
60	262**	296**	351**	524**	572**	677**
70	416**	476**	511**	772**	652**	809**
80	592**	702**	688**	902**	679**	881**
90[c]	726**	847**	715**	848***	647**	795**

CDHP indicates consumer-directed health plan; OOP, out-of-pocket.
*P <.05; **P <.01.
[a]Regressions controlled for age, gender, race/ethnicity, education, Census division, and Charlson Comorbidity Index score.
[b]From left to right, the 95% CIs at quantile 50 for each estimate are $150-$173, $167-$197, $200-$282, $264-$373, $425-$535, and $450-$635. P <.001 for all estimates.
[c]From left to right, the 95% CIs at quantile 90 for each estimate are $678-$773, $790-$904, $558-$871, $644-$1053, $495-$799, and $586-$1004. P <.001 for all estimates.

with prior work which has found that utilization increases in the second year of CDHP enrollment.[8,9]

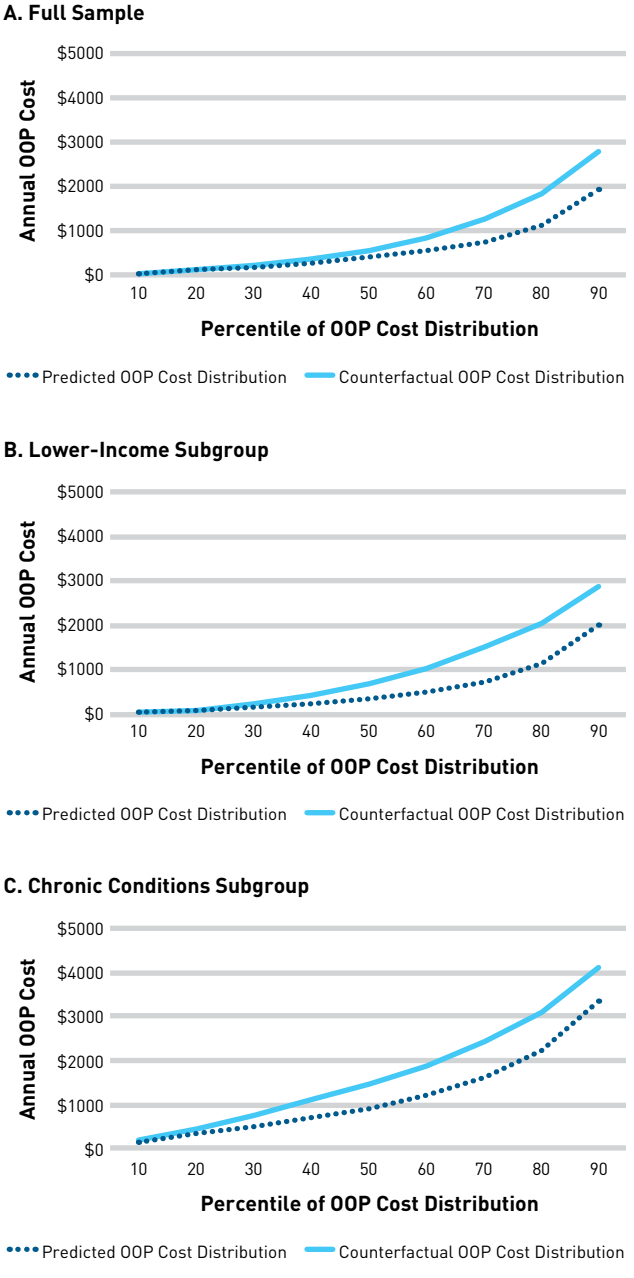
Table 3 presents the QDID estimates of the impact of CDHP enrollment at each decile across the distribution of OOP spending. Generally, the marginal effect of CDHP enrollment increased with higher levels of OOP spending. For example, among the full sample, CDHP enrollment led to a $162 (95% CI, $150-173; P <.001) marginal increase in OOP spending at the median in the first year compared with a $726 (95% CI, $678-$773; P <.001) marginal increase in OOP spending at the 90th percentile. That is, the marginal impact of CDHP enrollment on OOP spending (compared with traditional plan enrollees) was greater for those at the higher end of the OOP

spending distribution. For the lower-income and chronic conditions subgroups, the marginal increases at the median were $241 (95% CI, $200-$282; *P* <.001) and $480 (95% CI, $425-$535; *P* <.001), respectively, and the marginal increases at the 90th percentile were $715 (95% CI, $558-$871; *P*<.001) and $647 (95% CI, $495-$799; *P*<.001), respectively.

The adjusted and counterfactual OOP spending distributions for the traditional plan group are shown in the **Figure**. As expected, the counterfactual OOP spending distributions fall above the predicted OOP spending distribution, suggesting that traditional plan enrollees would have had higher OOP spending if they had switched to a CDHP (Figure). As a sensitivity analysis, we also separately estimated the magnitude of these counterfactual spending estimates if the traditional plan group switched to CDHP/HRAs compared with CDHP/HSAs (based on separate underlying QDID regressions for the CDHP/HRA and CDHP/HSA populations). We found that increased OOP spending after enrollment in a CDHP tended to be larger for enrollees in CDHP/HRAs versus CDHP/HSAs across nearly all of the OOP spending distributions (**eAppendix Figure 3**). This is consistent with prior work, which has found that enrollees in CDHP/HSAs had significantly greater reductions in utilization than did enrollees in CDHP/HRAs, potentially because employees with HSAs have a stronger incentive to save money because HSA account balances are owned by the employee whereas HRA account balances are owned by the employer.[23]

CDHP enrollment also increased the probability of having very high OOP spending. For example, the percentage of enrollees spending more than $2000 increased by nearly 10 percentage points for the full sample and for the lower-income subgroup and by about 15 percentage points for the chronic conditions subgroup (Figure). These findings regarding the impact of CDHPs on the probability of having very high OOP spending are supported by the results of the impact of CDHP enrollment on the probability of having excessive financial burden (Table 2b). For the entire sample, enrollment in a CDHP increased the probability of an enrollee being exposed to excessive financial burden (defined as OOP spending being ≥3% of household income) by 4.3 percentage points (95% CI, 4.0-4.6; *P* <.001; baseline, 9.7%). The effects were about 3 times larger for the lower-income subgroup (12.3 percentage points; 95% CI, 10.7-13.8; *P* <.001; baseline, 32.9%) and 2 times larger for the chronic conditions subgroup (8.0 percentage points; 95% CI, 6.9-9.1; *P* <.001; baseline, 25.3%). These effects persisted in the second year of CDHP enrollment and were robust to alternative definitions of excessive financial burden (Table 2b).

FIGURE. Impact of CDHP Enrollment on OOP Spending, Across the OOP Spending Distribution[a]



CDHP indicates consumer-directed health plan; DID, difference-in-differences; OOP, out-of-pocket.

[a]The predicted OOP cost distribution shows the OOP cost distribution for traditional plan enrollees in 2013 adjusted using quantile DID estimates. The counterfactual OOP cost distribution shows the OOP cost distribution for traditional plan enrollees in 2013 had they switched to a CDHP in 2012 (ie, OOP cost distribution 2 years after CDHP enrollment). The counterfactual OOP cost distribution in 2012 (1 year after CDHP enrollment) is similar.

DISCUSSION

We estimated the impact of CDHP enrollment on financial burden due to cost sharing incurred at the point of service when utilizing care. We found that CDHP enrollment led to a significant increase in

OOP spending and that this higher financial burden was particularly pronounced for the lower-income and chronic conditions subgroups. For example, more than half of the lower-income subgroup and more than one-third of the chronic conditions subgroup faced excessive financial burden from OOP spending after enrollment in a CDHP. Moreover, we found that CDHP enrollment increased the probability of having very high OOP spending.

Limitations

Our sample was subject to potential selection concerns because we were unable to evaluate whether CDHP enrollees actively chose a CDHP among a menu of plan options or whether it was the only option made available to them by their employer, although the fact that the level and trend of the key outcome variables were similar between the CDHP and traditional plan groups in the baseline period reduces these concerns (eAppendix Figures 1 and 2). Additionally, the household income data were based on a prediction model and thus may be subject to measurement error, although the predictions were based on very local geography. We were also unable to link dependents to subscribers, so we could not assess financial burden due to OOP spending at the household level; however, because the income levels represent household (rather than individual) income whereas we assessed individual-level OOP spending, our estimates may thus represent a lower bound of financial burden on OOP spending pooled across all household members. Finally, our data did not include additional detail, such as plan premiums or whether and how much the employer contributed to the individual's HSA or HRA, so we could not directly evaluate the impact of CDHP enrollment on overall spending.

Implications

Our findings, and in particular, the variation in the impact of CDHP enrollment on OOP spending across the distribution, should be considered in the broader context of overall healthcare spending, including premiums and potential HSA/HRA contributions. Nationally representative data on employer-sponsored health benefits indicate that, in 2013, the average annual worker contribution to premiums for single coverage was $1058 for CDHPs with an HRA, $726 for CDHPs with an HSA, and $1027 for non-CDHP plans. This suggests that enrollees in CDHPs with an HSA saved $301 ($1027 minus $726) in employee-paid premium contributions compared with those enrolled in non-CDHPs, on average. Additionally, 34% of covered workers in CDHPs with an HSA worked for an employer that did not make an HSA contribution but, among those that did, the average annual HSA contribution for a single employee was $950.[24]

At the lower end of the distribution, we found very modest increases in OOP spending at the point of care among CDHP enrollees compared with traditional plan enrollees. Thus, it is likely that these individuals may actually be financially better off by enrolling in CDHPs, as the savings in employee-paid premium contributions and/or the benefits of employer contributions to a tax-advantaged savings account likely more than offset the increased OOP spending at the point of care. However, at the high end of the distribution, the increased OOP spending would still heavily outweigh the reduced spending on employee contributions to premiums, particularly if the individual was among the one-third of covered workers who did not receive an HSA contribution from their employer. Moreover, even if those individuals at the lower end of the actual spending distribution may have lower total expenditures on premiums plus OOP spending at the point of care in a given year, due to the unpredictable nature of catastrophic health events, they still face the potential risk of having very large OOP spending under a high deductible, which may be particularly problematic for lower-income individuals with limited assets.[25]

The potential consequences of CDHP enrollees experiencing high financial burden are significant. Previous work suggests that high financial burden may cause CDHP enrollees to delay or skip needed healthcare.[10,11,26] Additionally, individuals who face financial burden often have to change their employment or lifestyle, or make other sacrifices, to make ends meet.[26] We do not know the extent to which individuals considered potential downstream OOP costs when enrolling in CDHPs. However, prior research suggests that many individuals make poor health plan choices and frequently choose worse plans when alternative choices that have both lower financial risk of OOP spending and lower premiums are available.[27,28] A possible explanation for these poor choices is that many individuals do not understand the basics of benefit design, such as the meaning of deductibles and co-payments.[29,30] Moreover, this problem of poor health insurance literacy is more acute among the low-income population,[30] suggesting that these individuals may not understand the potential financial burden associated with enrollment in CDHPs. Although prior work suggests that providing information on OOP costs can improve health plan choice,[28,31] more work is needed to design effective interventions for improving plan choice. Additionally, further research on the impact of financial burden associated with CDHP enrollment on the use of appropriate care, unmet medical need, and other health outcomes is warranted. ■

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REFERENCES

1. Kaiser Family Foundation and Health Research & Educational Trust. *Employer Health Benefits: 2016 Annual Survey*. Menlo Park, CA: Kaiser Family Foundation; 2016. files.kff.org/attachment/Report-Employer-Health-Benefits-2016-Annual-Survey. Accessed March 7, 2018.
2. Chen S, Levin RA, Gartner JA. Medication adherence and enrollment in a consumer-driven health plan. *Am J Manag Care*. 2010;16(2):e43-e50.
3. Fronstin P, Sepulveda MJ, Roebuck MC. Medication utilization and adherence in a health savings account-eligible plan. *Am J Manag Care*. 2013;19(12):e400-e407.
4. Beeuwkes Buntin M, Haviland AM, McDevitt R, Sood N. Healthcare spending and preventive care in high-deductible and consumer-directed health plans. *Am J Manag Care*. 2011;17(3):222-230.
5. Finkelstein A, Taubman S, Wright B, et al; Oregon Health Study Group. The Oregon health insurance experiment: evidence from the first year. *Q J Econ*. 2012;127(3):1057-1106.
6. Haviland AM, Marquis MS, McDevitt RD, Sood N. Growth of consumer-directed health plans to one-half of all employer-sponsored insurance could save $57 billion annually. *Health Aff (Millwood)*. 2012;31(5):1009-1015. doi: 10.1377/hlthaff.2011.0369.
7. Haviland AM, Eisenberg MD, Mehrotra A, Huckfeldt PJ, Sood N. Do "consumer-directed" health plans bend the cost curve over time? *J Health Econ*. 2016;46:33-51. doi: 10.1016/j.jhealeco.2016.01.001.
8. Parente ST, Feldman R, Christianson JB. Evaluation of the effect of a consumer-driven health plan on medical care expenditures and utilization. *Health Serv Res*. 2004;39(4 pt 2):1189-1210. doi: 10.1111/j.1475-6773.2004.00282.x.
9. Lo Sasso AT, Rice T, Gabel JR, Whitmore H. Tales from the new frontier: pioneers' experiences with consumer-driven health care. *Health Serv Res*. 2004;39(4 pt 2):1071-1090. doi: 10.1111/j.1475-6773.2004.00274.x.
10. Collins SR, Kriss JL, Davis K, Doty MM, Holmgren AL. Squeezed: why rising exposure to health care costs threatens the health and financial well-being of American families. The Commonwealth Fund website. commonwealthfund.org/publications/fund-reports/2006/sep/squeezed--why-rising-exposure-to-health-care-costs-threatens-the-health-and-financial-well-being-of. Published September 1, 2006. Accessed March 7, 2018.
11. Davis K, Doty MM, Ho A. How high is too high? implications of high-deductible health plans. The Commonwealth Fund website. commonwealthfund.org/publications/fund-reports/2005/apr/how-high-is-too-high--implications-of-high-deductible-health-plans. Published April 1, 2005. Accessed March 7, 2018.
12. Galbraith AA, Ross-Degnan D, Soumerai SB, Rosenthal MB, Gay C, Lieu TA. Nearly half of families in high-deductible health plans whose members have chronic conditions face substantial financial burden. *Health Aff (Millwood)*. 2011;30(2):322-331. doi: 10.1377/hlthaff.2010.0584.
13. Abdus S, Selden TM, Keenan P. The financial burdens of high-deductible plans. *Health Aff (Millwood)*. 2016;35(12):2297-2301. doi: 10.1377/hlthaff.2016.0842.
14. Reed M, Fung V, Price M, et al. High-deductible health insurance plans: efforts to sharpen a blunt instrument. *Health Aff (Millwood)*. 2009;28(4):1145-1154. doi: 10.1377/hlthaff.28.4.1145.
15. Brot-Goldberg ZC, Chandra A, Handel BR, Kolstad JT. What does a deductible do? the impact of cost-sharing on health care prices, quantities, and spending dynamics [NBER working paper no. 21632]. National Bureau of Economic Research website. nber.org/papers/w21632. Published October 2015. Updated November 2015. Accessed March 7, 2018.
16. Non-group health insurance: many insured Americans with high out-of-pocket costs forgo needed health care. Families USA website. familiesusa.org/sites/default/files/product_documents/ACA_HRMSurvey%20Urban-Report_final_web.pdf. Published May 2015. Accessed March 7, 2018.
17. Wharam JF, Landon BE, Galbraith AA, Kleinman KP, Soumerai SB, Ross-Degnan D. Emergency department use and subsequent hospitalizations among members of a high-deductible health plan [correction in *JAMA*. 2008;299(2):171]. *JAMA*. 2007;297(10):1093-1102. doi: 10.1001/jama.297.10.1093.
18. Newhouse JP, Group RCIE. *Free For All? Lessons From The RAND Health Insurance Experiment*. Cambridge, MA: Harvard University Press; 1993.
19. 2010 Census geographic terms and concepts. United States Census Bureau website. census.gov/geo/reference/terms.html. Accessed March 7, 2018.
20. Quan H, Li B, Couris CM, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol*. 2011;173(6):676-682. doi: 10.1093/aje/kwq433.
21. Collins SR, Rasmussen PW, Doty MM, Beutel S. Too high a price: out-of-pocket health care costs in the United States. findings from the Commonwealth Fund Health Care Affordability Tracking Survey. September-October 2014. *Issue Brief (Commonw Fund)*. 2014;29:1-11.
22. Meyer BD, Viscusi WK, Durbin DL. Workers' compensation and injury duration: evidence from a natural experiment. *Am Econ Rev*. 1995;85(3):322-340.
23. Haviland A, Sood N, McDevitt R, Marquis MS. How do consumer-directed health plans affect vulnerable populations? *Forum Health Econ Policy*. 2011;14(2):1-25.
24. 2013 Employer Health Benefits Survey: section eight: high-deductible health plans with savings option. Kaiser Family Foundation website. kff.org/report-section/ehbs-2013-section-8. Published August 20, 2013. Accessed March 7, 2018.
25. Jacobs PD, Claxton G. Comparing the assets of uninsured households to cost sharing under high-deductible health plans. *Health Aff (Millwood)*. 2008;27(3):w214-w221. doi: 10.1377/hlthaff.27.3.w214.
26. Hamel L, Norton M, Pollitz K, Levitt L, Claxton G, Brodie M. The burden of medical debt: results from the Kaiser Family Foundation/*New York Times* medical bills survey. Kaiser Family Foundation website. kff.org/health-costs/report/the-burden-of-medical-debt-results-from-the-kaiser-family-foundationnew-york-times-medical-bills-survey. Published January 5, 2016. Accessed March 7, 2018.
27. Abaluck J, Gruber J. Choice inconsistencies among the elderly: evidence from plan choice in the Medicare Part D program. *Am Econ Rev*. 2011;101(4):1180-1210. doi: 10.1257/aer.101.4.1180.
28. Bhargava S, Loewenstein G, Sydnor J. Do individuals make sensible health insurance decisions? evidence from a menu with dominated options [NBER working paper no. 21160]. National Bureau of Economic Research website. nber.org/papers/w21160. Published May 2015. Accessed March 7, 2018.
29. Loewenstein G, Friedman JY, McGill B, et al. Consumers' misunderstanding of health insurance. *J Health Econ*. 2013;32(5):850-862. doi: 10.1016/j.jhealeco.2013.04.004.
30. Barcellos SH, Wuppermann AC, Carman KG, et al. Preparedness of Americans for the Affordable Care Act [correction in *Proc Natl Acad Sci U S A*. 2015;112(6):E597-E601]. *Proc Natl Acad Sci U S A*. 2014;111(15):5497-5502. doi: 10.1073/pnas.1320488111.
31. Kling JR, Mullainathan S, Shafir E, Vermeulen LC, Wrobel MV. Comparison friction: experimental evidence from Medicare drug plans. *Q J Econ*. 2012;127(1):199-235.

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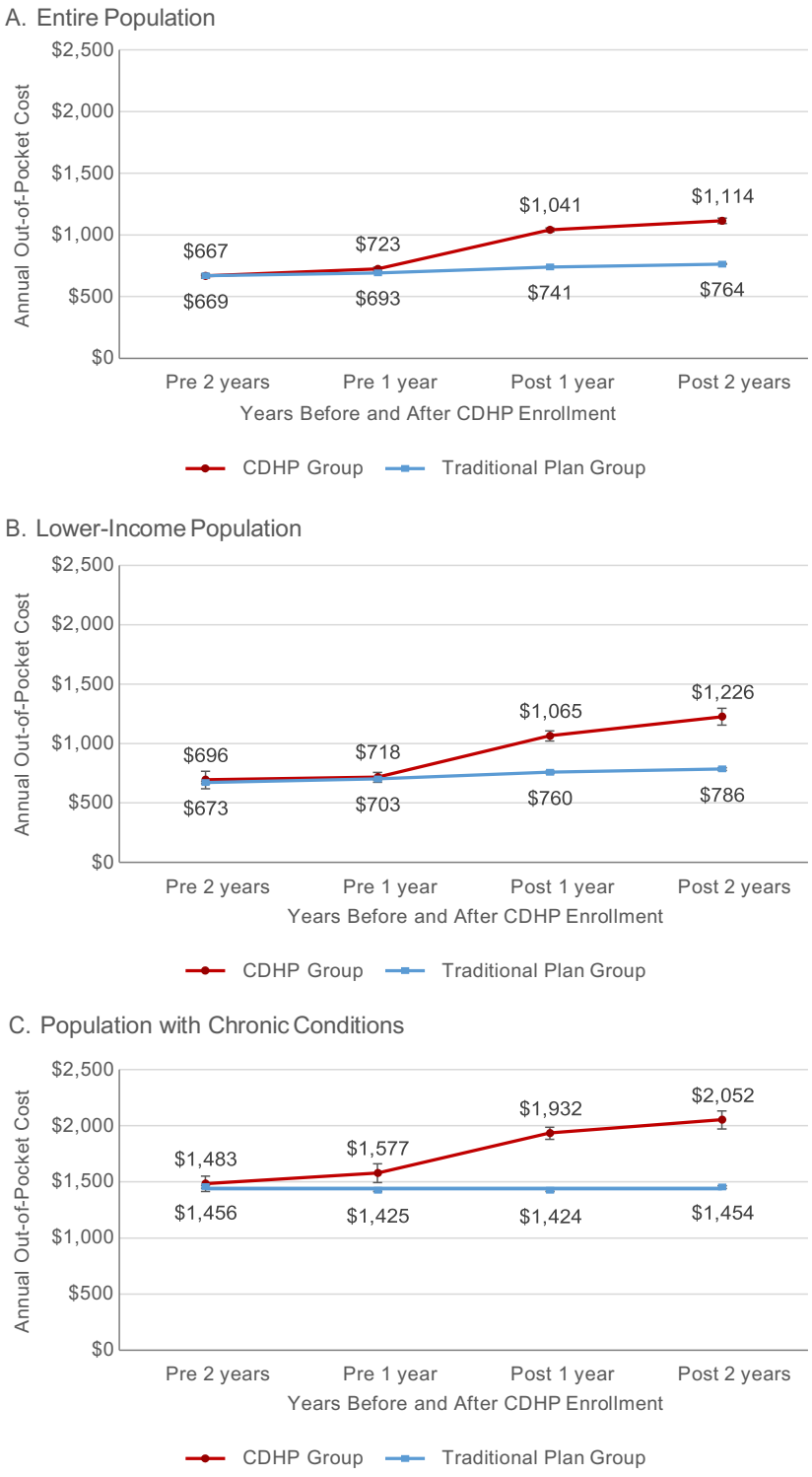
eAppendix Table. Enrollment by Plan Type and Year

Variables	Full Sample (n = 689,542)	Lower-Income Subgroup (n = 66,709)	Chronic Condition Subgroup (n = 117,360)
Traditional Plan Group	653,155	63,121	112,102
CDHP Group	36,387	3588	5258
Switch Date: 2012	*19,392*	*1879*	*2710*
Switch Date: 2013	*16,995*	*1709*	*2548*

CDHP indicates consumer-directed health plan.

eAppendix Figure 1. Trends in Out-of-Pocket Spending, by Plan Type

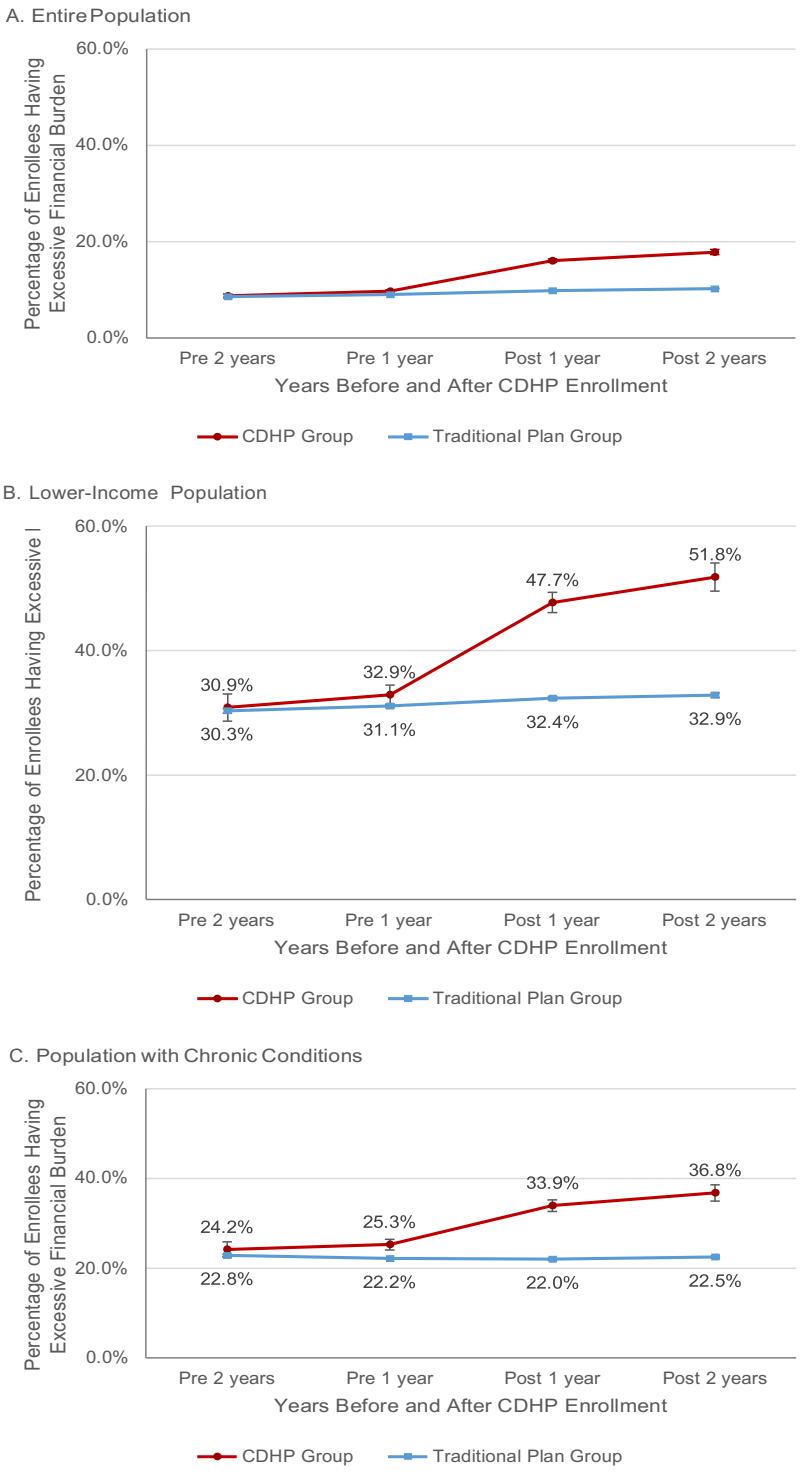


CDHP indicates consumer-directed health plan.

The graphs show the mean out-of-pocket spending with 95% CIs in the years before and after

CDHP enrollment for the full sample (panel A), the lower-income subgroup (panel B) and the subgroup with chronic conditions (panel C).

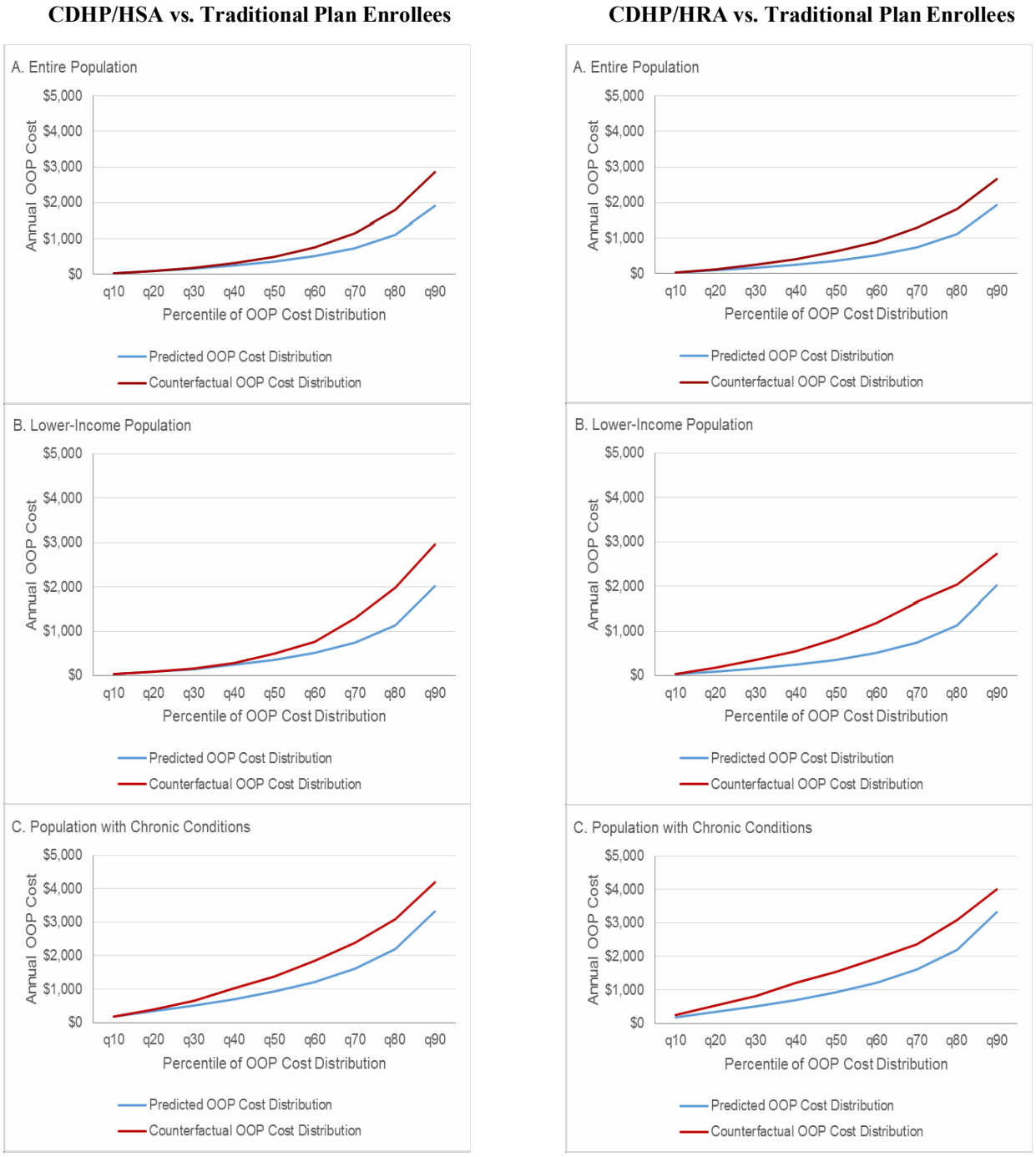
eAppendix Figure 2. Trends in the Percentage of Enrollees Having Excessive Financial Burden, by Plan Type



CDHP indicates consumer-directed health plan.

The graphs show the percentage of enrollees having excessive financial burden with 95% CIs in the years before and after CDHP enrollment for the full sample (panel A), the lower-income subgroup (panel B) and the subgroup with chronic conditions (panel C).

eAppendix Figure 3. Impact of CDHP Enrollment on Out-of-Pocket Spending, Across the Out-of-Pocket Spending Distribution, by CDHP/HSA Enrollees vs. CDHP/HRA Enrollees



CDHP indicates consumer-directed health plan; HRA, health reimbursement account; HSA, health savings account; OOP, out-of-pocket.

The predicted OOP cost distribution shows the OOP cost distribution for traditional plan

enrollees in 2013 adjusted using quantile DID estimates. The counterfactual OOP cost distribution shows the OOP cost distribution for traditional plan enrollees in 2013 had the traditional plan enrollees switched to a CDHP with either an HSA or HRA in 2012 (i.e. OOP cost distribution 2 years after CDHP enrollment). The counterfactual OOP cost distribution in 2012 (1 year after CDHP enrollment) is similar.