Healthcare Spending and Preventive Care in High-Deductible and Consumer-Directed Health Plans

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Objective: To investigate the effects of high-deductible health plans (HDHPs) and consumer-directed health plans (CDHPs) on healthcare spending and on the use of recommended preventive care.

Study Design: Retrospective study.

Methods: We analyzed claims and enrollment data for 808,707 households from 53 large US employers, 28 of which offered HDHPs or CDHPs. We estimated the effects of HDHP or CDHP enrollment on healthcare cost growth between 2004 and 2005 using a difference-in-difference method that compared cost growth for families who were enrolled in HDHPs or CDHPs for the first time in 2005 with cost growth for families who were not offered HDHPs or CDHPs. Control families were weighted using propensity score weights to match the treatment families. Using similar methods, we examined the effects of HDHP or CDHP enrollment on the use of preventive care and the effects of HDHP or CDHP offering by employers on the mean cost growth.

Results: Families enrolling in HDHPs or CDHPs for the first time spent 14% less than similar families enrolled in conventional plans. Families in firms offering an HDHP or a CDHP spent less than those in other firms. Significant savings for enrollees were realized only for plans with deductibles of at least $1000, and savings decreased with generous employer contributions to healthcare accounts. Enrollment in HDHPs or CDHPs was also associated with moderate reductions in the use of preventive care.

Conclusions: The HDHPs or CDHPs with at least a $1000 deductible significantly reduced healthcare spending, but they also reduced the use of preventive care in the first year. This merits additional study because of concerns about enrollee health.

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For author information and disclosures, see end of text.

Curbing increases in healthcare costs is a top priority for policy makers and for employers. Many believe that high-deductible health plans (HDHPs), also known as consumer-directed health plans (CDHPs), when coupled with personal savings accounts, might be one way to hold down costs. These plans, intended to make patients more cost conscious, are becoming increasingly popular, and healthcare reform may foster further growth in enrollment. As of 2009, 20% of Americans with employer coverage were enrolled in a plan with a deductible high enough to be eligible for a health savings account. Among those purchasing coverage directly, 47% had a deductible at least this high.[1] A survey of large employers at the beginning of 2010 found that more than 54% offered at least 1 CDHP option, and another 7% were planning in 2011 to adopt one.[2] Growth is expected from 2 sources, namely, CDHPs with low premiums offered through health insurance exchanges and more CDHP offerings in the employer market because of taxes placed on generous "Cadillac" plans.

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Despite growing enrollment, little is known about the effects of HDHPs or CDHPs on healthcare costs and on the use of necessary care. Even less is known about the influence of specific HDHP or CDHP provisions, including deductible levels and account offerings.[3] Both questions are of key importance for those who are newly insured through exchanges and for those who are selecting plans in the employer or individual market. Part of the problem is the lack of good pre-post data for persons enrolling in diverse HDHP or CDHP and conventional plans. Most evidence is limited to studies with data from a single carrier, a single employer, or a single year; therefore, the findings may not apply outside of those settings. A review of these studies concluded that moving consumers from traditional plans to high-deductible plans could result in significant savings; however, coupling these plans with funded personal accounts could reduce this effect.[4] More recent work suggests that some CDHP plan designs might lead to higher spending over time, to discontinuation of chronic disease medications by patients, and to decreased use of office visits, hospitalizations, and emergency department care.[5-8] Other peer-reviewed studies[9-11] have found instances in which CDHP enrollment has no discernible effect on the use of preventive care. Reviewing a set of industry studies, the American

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Academy of Actuaries[12] concluded that CDHP plans saved 12% to 20% in their first year compared with control plans, with no evidence that this was due to a reduction in necessary care.

This study is the first to date to use longitudinal data from a diverse set of carriers, employers, and HDHP or CDHP designs to investigate the first-year effects on healthcare spending and on the use of preventive care. It also is the first study to examine the differential effects on these outcome measures of deductible levels, personal accounts, and employer account contributions.

Take-Away Points

The effect of enrollment in high-deductible health plans (HDHPs) or consumer-directed health plans (CDHPs) on healthcare spending and on the use of preventive care was assessed across multiple employers, insurance carriers, and plans in a 2-year retrospective study.

- Families enrolling in HDHPs or CDHPs and firms offering HDHPs or CDHPs spent less on healthcare.
- Significant savings were realized only for enrollees in plans with deductibles of at least $1000, and savings decreased with generous employer contributions to healthcare accounts.
- Enrollment in HDHPs or CDHPs was associated with moderate reductions in the use of preventive care, despite the fact that these plans waived the deductible for preventive care.

METHODS

Study Design

We constructed a unique data set that included 2 years of enrollment and healthcare claims information for employees of 53 large US employers, 28 of which offered HDHPs or CDHPs to their employees. These employers offered health plans from all major and many smaller US insurance carriers. We defined a high deductible as $500 or more for single coverage and $1000 or more for family coverage in 2005, resulting in plans with a range of deductible levels and account provisions.

We estimated the differences between HDHP or CDHP and non–HDHP or CDHP enrollees using a difference-in-difference propensity score–weighted method. We compared the 2004 to 2005 change in healthcare costs for families who first enrolled in HDHPs or CDHPs in 2005 (treatment families) with the change in healthcare costs for families who remained in conventional plans (control families). Therefore, the analysis controls for all time-invariant differences across treatment and control families such as inherent propensity to use healthcare or trust in physicians and modern healthcare. However, our results might be confounded if treatment and control families had different cost growth trajectories. To address this, we took 3 additional steps. First, we only included families as controls if they were not offered an HDHP or a CDHP. Those who were offered and declined an HDHP or a CDHP were excluded from the analysis. Second, we used propensity score weights to produce a control group similar to the treatment group based on a rich set of observed characteristics, including family type, geocoded income and educational levels, presence of major diagnoses, actuarial value of the health plan before enrollment, and industry of employment.[13,14] Third, to account for residual confounding, we used these observed characteristics as covariates in multivariate regression models.

We also conducted an intent-to-treat analysis to estimate the effects on healthcare cost growth of the employer decision to offer HDHPs or CDHPs. Using difference-in-difference methods, we compared the 2004 to 2005 healthcare cost increases for employers who offered HDHPs or CDHPs in 2005 versus for employers who did not. We also estimated separate effects among employers who completely replaced their conventional plans with HDHPs or CDHPs.

Data Sources and Study Population

The study population consisted of active full-time employees and their dependents who were continuously enrolled for 2 full plan-years. A small proportion (0.4%) were dropped because of errors or omissions in their claims data. A slightly larger proportion (3.1%) were dropped because of errors in their enrollment information. This resulted in 808,707 families for analysis related to the effects of HDHP or CDHP enrollment and 981,973 families for analysis related to the effects of HDHP or CDHP offer.

The employers entered the study from 2 routes. One group of employers was recruited because they offered an HDHP or a CDHP during the period from 2003 to 2007. These employers were selected to encompass a range of geographic regions, employee income levels, proportion of employees enrolling in HDHPs or CDHPs, and HDHP or CDHP characteristics. The other group of employers was from the Thomson Reuters (New York, New York) MarketScan database. These employers were selected to match the geographic, size, and industry distribution of the recruited employers. In the 2004-2005 cohort used for this analysis, employers from both sources contributed to the treatment and control samples (83% of HDHP or CDHP–enrolled families are from recruited firms). The enrollment and claims data from insurers were standardized into a modified MarketScan format. An expert independent of the study organizations certified that the analysis data files received by the research team were deidentified, and the Human Subjects

Protection Committee at RAND Corporation approved the study.

Study Variables

Families are the unit of analysis, with additional variables indicating a single employee, employee plus spouse, and additional tiers. For the effect of HDHP or CDHP enrollment analysis, treatment families were those who first enrolled in an HDHP or a CDHP in 2005. For the effect of HDHP or CDHP offer analysis, the treatment families included all insured families in firms that first offered an HDHP or a CDHP in 2005. In both cases, the treatment group was restricted to those who worked for employers where at least 3% of employees enrolled in an HDHP or a CDHP. Control families worked for employers that did not offer high-deductible plans.

High-deductible health plans are classified into the following 4 types by individual deductible and by employer contribution to personal medical accounts: (1) moderate deductible ($500-$999), (2) high deductible (≥$1000) with no account, (3) high deductible with low employer account contribution of less than $500, and (4) high deductible with generous employer account contribution of at least $500 (the last 2 are also known as CDHPs); the types represented 44%, 11%, 33%, and 13% of the treatment sample, respectively. Almost all of these high-deductible plans waived the deductible for preventive care, as established by employer survey and interview data.

We derived plan cost-sharing provisions for all plans based on payment patterns in the claims data combined with employer survey data if available. We included in our analysis only plans with at least 100 employees to ensure sufficient observations to make reliable estimates of the deductible, which is used to assign treatment status. We validated our claims-based cost-sharing provisions by comparing them with survey responses from 27 employers about 138 plans they offer with a total enrollment of 1.1 million members in 2005. Comparing the treatment classification based on the 2 sources, we found agreement for 93% of enrollees. In addition, all high-deductible plans identified for this analysis were confirmed by survey data or other communication with the employer.

We calculated annual family costs for medical care (insurance and patient payments for care received) and divided these by 12 to obtain the mean monthly expenditures. Parallel calculations resulted in the mean monthly expenditures in each of the following 4 healthcare settings: outpatient, inpatient, emergency department, and prescription drugs.

The following 6 preventive care outcomes were created based on Healthcare Effectiveness Data and Information Set (HEDIS) measure definitions[15]: 2 child immunization measures, receipt of mammography, cervical and colorectal cancer screening, and glycosylated hemoglobin (A1C) testing for patients with diabetes mellitus. Dichotomous measures were created at the annual family level indicating whether some or none of the eligible family members had obtained the recommended care. We adapted HEDIS 2008 specifications to conform to the single-year windows in our analysis framework (discussed further in the **eAppendices**, available at **www.ajmc.com**). We created 2 child immunization measures indicating whether a child was on track to obtain the full set of recommended immunizations. Counting only care received in the current year caused these measures to be lower than typical HEDIS measures but consistently so in each year and across the treatment and control groups.

Covariates for analyses were derived from enrollment, claims, and geocoded location. Enrollment files provided family type, age of head of household, family size, geographic region, metropolitan statistical area status, and employer's industry type. Claims data supplied prospective relative risk scores based on diagnostic cost group[16,17] summed to the family level and indicators for whether a family received care in each of 23 major diagnostic categories. Actuarial values (percentage of allowed charges paid by the plan) were calculated for each plan using the plan provisions to simulate payment of claims for a standard population. The zip code–level geocoded characteristics are the median household income, percentage of adults with high school and college degrees, percentage unemployed, and percentage of Hispanic, black, and non-Hispanic white race/ethnicity.

Statistical Analysis

For the cost-outcome models of the effects of enrollment in HDHPs or CDHPs, we used propensity score weighting to balance the distributions of numerous characteristics observed in 2004 between treatment and control families.[18,19] Logistic regression analysis was used to model the odds of being a treatment family as a function of characteristics that predict both health plan selection and healthcare use (discussed further in the eAppendices). Predicted probabilities (propensity scores) were used to derive individual family weights for control families proportional to the conditional probability of being a treatment family. To check the adequacy of the propensity score model, we evaluated the balance of the weighted means of the measured characteristics. When balance is obtained, weighted analyses adjust for potential confounding owing to measured characteristics.

When estimating the effects for different types of high-deductible plans, treatment families were divided into different subgroups. Each subgroup was propensity score weighted to match the distribution of characteristics of the entire treatment sample (discussed further in the eAppendices).

Table 1. Selected Baseline Characteristics of HDHP/CDHP and Control Families

Characteristic	HDHP/CDHP (n = 36,211)	Control (n = 772,496)	Weighted Control (n = 772,496)
Family type, %			
Single male policyholder	17.0	14.4	17.0
Employee, spouse, children	26.4	34.2	26.2
Age of head of household, mean (SD), y	38.81 (11.98)	42.36 (10.74)	38.76 (18.82)
Prospective relative risk score summed for family, mean (SD)	2.03 (2.06)	2.41 (2.36)	2.04 (2.39)
Median household income, mean (SD), $	48,175 (20,964)	48,075 (22,376)	48,216 (27,879)
Area 4-year college degree, %	26.8	25.6	26.9
Area non-Hispanic white race/ethnicity, %	72.7	69.4	72.8
Region, %			
Northeast	15.4	15.0	15.6
North Central	31.2	39.3	31.3
South	42.3	36.5	41.9
West	11.1	9.2	11.2
Actuarial value of plan held in 2004, mean (SD)	0.82 (0.05)	0.83 (0.06)	0.82 (0.09)

HDHP/CDHP indicates high deductible health plan/consumer-directed health plan.

Most of the covariates included in the propensity score model were also included in the weighted outcome models to provide estimates that are more efficient and "doubly robust" to misspecification of either model.[20] We tested a range of generalized linear model specifications (identity and log links and constant, proportional to the mean, and proportional to the mean squared variance functions) to address the skewness and truncation at zero in healthcare costs.[21,22] None of the other models tested outperformed the identity link and constant variance; hence, this is the model specification we use. Robust standard errors that account for clustering of family over time were used in all models. To estimate the effects of the employer decision to offer HDHPs or CDHPs on healthcare cost growth, we used parallel models but without propensity score weighting of those families not offered HDHPs or CDHPs.

For the HEDIS immunization outcomes, we computed unadjusted difference-in-difference estimates and then performed logistic regression analysis using the same framework and set of regressors as in the cost models aforedescribed.[23,24] Unlike in the cost regression analysis, the same sets of families are not eligible for each measure in the pre-post years. For the remainder of the HEDIS outcomes, we stratified the sample into those who did or did not receive the recommended care in 2004 and within strata compared the rates of receiving the recommended care in 2005 by treatment status, both unadjusted and controlling for the same set of regressors as the prior models. The stratification was to address concerns that families who are about to transition into a high-deductible plan will try to obtain care that they anticipate needing before the transitions; that is, they will try to "stock up" on care.

Analyses were performed using commercially available statistical software (SAS version 9.1; SAS Institute, Cary, North Carolina; and STATA version 10; StataCorp Inc, College Station, Texas). We report statistical significance levels from 2-sided tests without adjustment for multiple testing. Full results are provided in the eAppendices.

RESULTS

Study Population

Enrollees in high-deductible plans were more likely to be single men, were younger, had lower risk scores (better baseline health), and lived in areas with higher percentages of college graduates and non-Hispanic whites than families enrolled in control plans. After weighting using propensity scores, the samples have similar measured characteristics (Table 1 and eAppendix 1, available at **www.ajmc.com**).

At baseline, both groups were enrolled in plans with actuarial values that averaged 82%. The baseline monthly costs of the treatment and weighted control groups are given in Table 2 and eAppendix 2 (available at **www.ajmc.com**): both groups had similar monthly family healthcare costs of just over $500 and a distribution of costs by service type typical of those with employer-provided insurance. Before weighting, cost growth for the control group was 13%, similar to estimates for other data sources covering this period. Differences in the growth

Table 2. Monthly Household Costs and Cost Growth of HDHP/CDHP and Control Families[a]

	HDHP/CDHP (n = 36,211)	Weighted Control (n = 772,496)	
2004 Baseline Costs, $			
Total healthcare	513.89	516.55	
Outpatient	275.49	279.74	
Inpatient	121.8	100.42	
Emergency department	17.40	19.92	
Prescription drug	99.20	116.47	
Cost Growth From 2004 to 2005, $			**Between-Group Point Estimate (95% CI) Mean Difference**
Total healthcare	20.69	105.71	−85.03 (−102.34 to −67.71)[b]
Outpatient	10.00	55.88	−45.88 (−54.58 to −37.18)[b]
Inpatient	−0.84	34.89	−35.73 (−48.97 to −22.49)[b]
Emergency department	4.28	4.16	0.13 (−0.92 to 1.17)
Prescription drug	7.24	10.78	−3.54 (−6.90 to −0.18)[b]

CI indicates confidence interval; HDHP/CDHP, high-deductible health plan/consumer-directed health plan.
[a]After propensity score weighting and regression-based covariate adjustment for all variables described in the "Study Variables" subsection of the "Methods" section.
[b]Significant difference at $P = .05$.

for the control group after weighting reflect the alignment of the controls to match those who enroll in treatment plans.

Effects of HDHP or CDHP Enrollment on Cost Growth

Costs grew for both the treatment families and the control families, but they grew more slowly in the higher-deductible group (Table 2). The monthly costs of the households enrolled in higher-deductible plans grew by $85 less than the comparable controls; in percentage terms, the expenditures of the control group grew by 20%, while the expenditures of the treatment group grew by 4%. Consequently, in the first year after enrolling in an HDHP or a CDHP, spending was 14% (95% confidence interval, 11.3%-16.9%) lower than that for comparable families in control plans (difference in the post-year mean monthly costs for treatment and control families divided by the mean post-year costs for control families). This was due to lower growth in inpatient, outpatient, and prescription drug costs. Growth in expenditures for emergency department care did not differ significantly between the 2 groups.

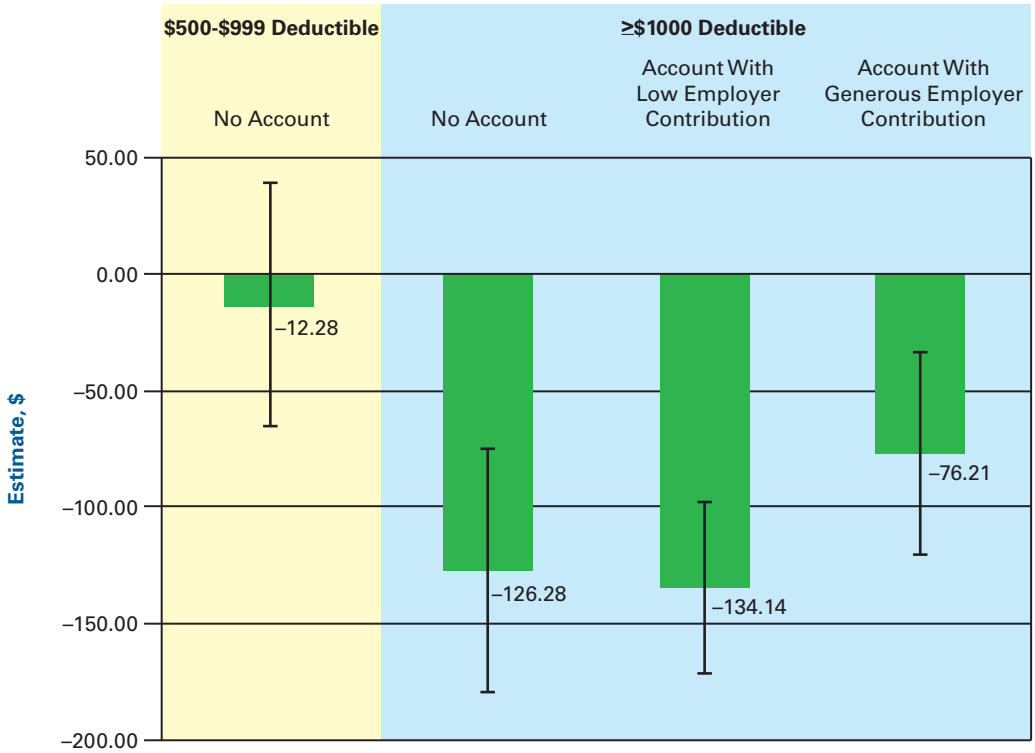
As shown in the Figure, cost growth for families in plans with moderately high deductibles ($500-$999) did not differ significantly from costs of those in control plans. However, cost reductions were greater (and significant) for families in plans with deductibles of $1000 or more. These cost reductions were maintained at a similar level when an account option was added with a low employer contribution (<$500 [mean, $399.32]). However, these cost reductions were attenuated when employers made generous contributions (≥$500 [mean, $768.38]) to the accounts. This pattern of results across plan characteristics held for each of the individual care settings as well (discussed further in the eAppendices).

Some evidence was observed of increases in healthcare costs in the final quarter of 2004 among families who were about to enter an HDHP or a CDHP in 2005 (not significant for the treatment group as a whole but significant for those with deductibles ≥$1000), suggesting possible stocking up by those about to change insurance. Because the opportunity for stocking up is limited by the timing of information on health plan offerings for the upcoming year, insurance restrictions on the frequency of many procedures, and uncertainty about future health needs, we assume that any stocking up of services would occur near the time of the insurance change and would include services that would otherwise be obtained early at the start of the new plan-year. As a robustness check (discussed further in the eAppendices), we compared cost growth using the same framework but using only costs from the second and third quarters of 2004 and 2005. We obtained similar results.

Effects of HDHP or CDHP Offer on Cost Growth

Costs in 2004 were similar for firms that offered HDHPs or CDHPs in 2005 and firms that offered only conventional health plans (Table 3 and eAppendix 3, available at **www.ajmc.com**). However, between 2004 and 2005, monthly costs per family increased more rapidly in firms that offered only conventional health plans. Monthly costs per family increased

■ **Figure.** Monthly Difference in Costs Between High-Deductible Families vs Controls, by Level of Deductible and Personal Savings Account



HRA/HSA indicates health reimbursement arrangement/health savings account. For supporting data, see **eAppendix 5** at www.ajmc.com. Compared are a $500 to $999 deductible for a single policy without an account (n = 15,872), deductible of $1000 or more without an account (n = 3850), deductible of $1000 or more with an HRA/HSA with low contribution (an employer contribution to an employee's personal account of <$500) (n = 11,840), and deductible of $1000 or more with an HRA/HSA with generous contribution (an employer contribution to an employee's personal account of ≥$500) (n = 4649). Point estimates are denoted by bars; the corresponding 95% confidence intervals are shown from the end of the bars.

by $138 in firms that offered HDHPs or CDHPs and by $165 in firms that offered conventional health plans, resulting in monthly cost savings of almost $28 per family ($P$ <.05). Larger savings ($133) were realized in firms that completely eliminated conventional health plans, and smaller savings ($22) were realized in firms that offered both conventional and HDHP or CDHP plans (P <.05 for both).

Because all employees in firms that eliminated conventional plans enrolled in HDHPs or CDHPs, the $133 estimate is also an estimate of the cost savings of enrolling in HDHPs or CDHPs. While this point estimate is larger than our main estimate of $85 given in Table 2, the confidence intervals of the estimates overlap. Moreover, in our sample, the firms that eliminated conventional plans offered 1 type of HDHP or CDHP (≥$1000 deductible account with low employer contribution), and the $133 estimate is similar to the point estimate specific to this HDHP or CDHP type obtained using the enrollee estimation framework (Figure). A final estimate of the overall effect of HDHP or CDHP enrollment on cost growth can be obtained by dividing the difference-in-difference estimate from the first model in Table 3 by the overall enrollment rate of 17.3% among those offered; this estimate is not smaller than the values in Table 2, suggesting that selection based on the enrollment decision is not upwardly biasing Table 2 estimates.

The estimates in Table 2 rely on the assumption that, after adjusting for observable differences, families enrolling in HDHPs or CDHPs would have experienced the same growth in costs as similar families who were not offered HDHPs or CDHPs if the enrolling families had instead not been offered HDHPs or CDHPs. In contrast, the estimates in Table 3 rely on the assumption that, after adjusting for observable differences, treatment and control firms would have experienced the same growth in costs if the offering firms had continued to offer similar plans in 2005. Neither of these assumptions is directly testable, but the pattern of results is encouraging.

Effects of HDHP or CDHP Enrollment on Preventive Care Use

Child immunization rates increased for the control group and decreased for the treatment group, resulting in significant differences (Table 4 and eAppendix 4, available at **www.**

Table 3. Intent-to-Treat Results of Monthly Household Cost Growth for Families Offered HDHP/CDHP vs Control Families[a]

	Offered HDHP/CDHP (n = 209,477)	Control (n = 772,496)	
2004 Baseline Costs, $			
All employers[b]	608.82	615.33	
<Full replacement	609.03	615.33	
Full replacement	611.85	615.33	
Cost Growth From 2004 to 2005, $			**Between-Group Point Estimate (95% CI) Mean Difference**
All employers	137.58	165.49	−27.91 (−36.04 to −19.78)[c]
<Full replacement	143.14	165.49	−22.36 (−30.68 to −14.04)[c]
Full replacement	32.33	165.49	−133.17 (−202.65 to −63.69)

CI indicates confidence interval; HDHP/CDHP, high-deductible health plan/consumer-directed health plan.
[a]After regression-based covariate adjustment for all variables described in the "Study Variables" subsection of the "Methods" section.
[b]Baseline costs for controls differ from those reported in Table 2 because controls in Table 2 are propensity score weighted to match those enrolling in HDHPs/CDHPs.
[c]Significant difference at $P = .05$.

ajmc.com). For each of 3 cancer screening measures, among those who did not receive the recommended screening in 2004, significantly fewer HDHP or CDHP enrollees went on to receive the care in 2005 compared with controls. Among patients with diabetes not receiving the recommended care in 2004, no differences were detected in the A1C measure in 2005. Among those who received the recommended care in 2004 (cancer screenings or A1C measurement), there were no differences detected (discussed further in the eAppendices). After adjusting for demographic and health status factors, these effects were virtually unchanged except that the results for colorectal cancer screenings lose statistical significance.

DISCUSSION

This is the first study to date to demonstrate across a large number of carriers, employers, and plan designs that HDHP or CDHP plans significantly curb healthcare costs in the first year. Recent healthcare reform may create incentives to spur the growth in HDHPs or CDHPs, and our results suggest that a move to HDHPs or CDHPs might help policy efforts to bring healthcare costs under control.[25] However, we need further research to determine whether the data herein represent 1-time savings or whether policy makers might use insurance benefit design as a tool to help slow the growth in costs.

Employers often make contributions to personal medical accounts to provide incentives to employees to switch to high-deductible plans, as high enrollments are necessary to capture substantial cost savings. Some have posited that such contributions would reduce the cost savings of HDHPs or CDHPs by undermining consumer cost sensitivity.[26,27] However, this was not the case for HDHPs or CDHPs with moderate employer contributions. These HDHPs or CDHPs seem to reduce spending as much as plans with similar deductibles but no employer account contribution.

Health policy makers included provisions in the Patient Protection and Affordable Care Act to encourage greater use of preventive services. The Act required that cost sharing for proven preventive care services should be eliminated in Medicare and private insurance plans by 2010. However, our finding that preventive care service use is moderately lower in the first year of HDHP or CDHP enrollment, despite waiving the deductible, provides a cautionary tale for these reform goals. It suggests that, at least in the short run, eliminating the copayment for preventive services may not expand use. There are several possible explanations for this finding. A high deductible may have deterred patients from seeking care for health problems that would have prompted a referral for some preventive or screening procedure. Alternatively, patients could have sought preventive care outside of their plan, for example through immunization clinics. Finally, new enrollees might not have understood that preventive care was covered, and over time as people become more familiar with plan provisions, the use of benefit design to encourage preventive service use may be more successful. Nonetheless, our finding suggests that policy makers may wish to explore programs to reinforce the financial incentives to promote preventive service use.

To address the potential effect of reductions in preventive care on the scale observed herein, we used estimates by Maciosek et al (2006) of the quality-adjusted life-years (QALYs)

Table 4. Preventive Care Results[a]

Variable	HDHP/CDHP	Control	Between Group Point Estimate (95% CI) Mean Difference
Effect of HDHP/CDHP on increase in child immunization, %			
Child immunization score at age 0 y (n = 22,627)	−3.64	2.68	−6.32 (−12.44 to −0.20)[b]
Child immunization score at age 1 y (n = 25,122)	−8.59	0.60	−9.20 (−14.17 to −4.24)[b]
Effect of HDHP/CDHP on screening and testing rates for adults, %[c]			
Mammography (n = 256,963)	27.5	30.28	−2.78 (−3.69 to −1.87)[b]
Cervical cancer (n = 373,381)	31.43	33.79	−2.37 (−3.14 to −1.60)[b]
Colorectal cancer (n = 209,373)	17.8	20.16	−2.36 (−3.27 to −1.44)[b]
Diabetes A1C measurement (n = 256,963)	44.04	41.91	2.13 (−3.52 to 7.79)

A1C indicates glycosylated hemoglobin; CI, confidence interval; HDHP/CDHP, high-deductible health plan/consumer-directed health plan.
[a]Unadjusted difference-in-difference estimates (for regression-adjusted estimates, see eAppendix 4).
[b]Significant difference at $P = .05$.
[c]Rates are for 2005, and the sample is restricted to those who were eligible and did not receive the recommended care in 2004.

associated with the cancer screenings we examined.[28] The estimated reductions in cancer screenings among HDHPs or CDHPs would reduce QALYs among 10,000 HDHP or CDHP enrollees by 32 to 41 QALYs per screening compared with comparable control plan enrollees.

There are several limitations of our study. First, we focus only on the first-year experience in an HDHP or a CDHP. Second, the amount of information we examined about what kind of care is reduced is limited. For example, the RAND Health Insurance Experiment found that cost sharing reduced both necessary and unnecessary care. Our results suggest that some appropriate care, namely, preventive services, is reduced in HDHPs or CDHPs, but further exploration of how they produce cost savings is needed to assess whether HDHPs or CDHPs should be embraced as a cost-saving approach or introduced with caution (eg, as detailed by Wharam et al[11] about colorectal cancer screenings). Third, family-level and firm-level selection remains the main threat to the validity of our conclusions, as with all observational studies of HDHPs or CDHPs.

Overall, our study findings suggest that HDHPs or CDHPs produce at least 1-time savings in the first year. The results highlight the need for further research to understand whether costs continue to grow more slowly for HDHP or CDHP enrollees and whether these enrollees increase their use of preventive care over time as they become more familiar with plan provisions.

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