

# High-Deductible Health Plans and Costs and Utilization of Maternity Care

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Childbirth is the leading reason for hospitalization in the United States.<sup>1</sup> For both private insurers and Medicaid, hospital maternity and newborn charges exceed those for any other condition.<sup>2</sup> In US hospitals, vaginal and caesarean deliveries cost approximately \$8000 and \$11,000 respectively.<sup>3</sup>

High-deductible health plans (HDHPs) have expanded rapidly in recent years, with 27% of workers having a deductible of at least \$1000.<sup>4,5</sup> Between 2006 and 2010, enrollment in HDHPs tripled to 10.0 million members,<sup>6</sup> and analysts predict an “explosion” in growth due to the recent health reform legislation.<sup>7</sup>

Although HDHPs are intended to decrease escalating health costs and discretionary care, they have generated controversy.<sup>8-12</sup> High cost sharing can reduce appropriate healthcare utilization, including hospitalizations, preventive services, and essential medicines.<sup>13-15</sup> Therefore, HDHPs often fully cover preventive services, including prenatal care.<sup>16-19</sup> No previous studies have measured the impact of HDHPs on the costs and use of maternity care.<sup>20,21</sup>

Our study examined this question among women insured by a large Massachusetts-based health insurance program (Harvard Pilgrim Health Care) that predominantly insures members through HMO plans and began offering HDHPs in April 2002. We anticipated that HDHP membership would increase out-of-pocket maternity expenditures, shift costs to members, and possibly reduce total maternity care expenditures, consistent with the cost-containment goal of consumer-directed healthcare.<sup>22</sup>

Although use of exempted services might be expected to remain stable, we hypothesized 3 mechanisms that could decrease utilization. (1) Cost sharing for nonexempt services (such as laboratory tests) ordered during prenatal visits could discourage subsequent visits. (2) The intricacy of maternity benefit design in HDHPs (eg, deductible exemptions based on clinical conditions) combined with uncertainty regarding costs of anticipated services could cause confusion and reduced care even for exempt services.<sup>9,23</sup> (3) Experiencing a previous large deductible payment (eg, an emergency department visit) might induce “sticker shock” and broadly reduce utilization.<sup>24</sup>

The objective of this study was to evaluate the impact of transition from an HMO to an HDHP on the costs and utilization of maternity and delivery care services within the 6 months before and 3 months following delivery.

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**Objective:** To evaluate the impact of switching from an HMO to a high-deductible health plan on the costs and utilization of maternity care.

**Study Design:** Pre–post design, with a control group.

**Methods:** We compared 229 women who delivered babies before or after their employers mandated a switch from HMO coverage to a high-deductible health plan, with a control group of 2180 matched women who delivered babies while their employers remained in an HMO plan. Administrative claims from a large Massachusetts-based health insurance program were used in a difference-in-differences regression analysis.

**Results:** Mean out-of-pocket maternity care costs for high-deductible group members increased from \$356 for women who delivered before the insurance transition (n = 86) to \$942 for women who delivered after the transition (n = 143), compared with a change from \$262 (n = 711) to \$282 (n = 1569) for HMO members, a relative increase of 106% (P < .001) for high-deductible members. Delivery after transition to a high-deductible plan was not associated with changes in the odds of receiving early prenatal care (odds ratio [OR], 1.02; 95% confidence interval [CI], 0.32-3.19), recommended prenatal visits (OR, 1.64; 95% CI, 0.89-3.02), or postpartum care (OR, 0.74; 95% CI, 0.42-1.32).

**Conclusions:** Switching from an HMO to a high-deductible plan with exemptions for routine care increased out-of-pocket member costs for maternity care, but had no apparent adverse impacts on receipt of recommended prenatal and postpartum care.

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For author information and disclosures, see end of text.

### Take-Away Points

Transition from an HMO to a high-deductible health plan with deductible exemptions for routine preventive maternity services was associated with:

- Substantial increases in out-of-pocket expenses for maternity and delivery-related care (although information on changes in employer account contributions and employee premium contributions was not available).
- A statistically insignificant (but large) reduction in overall costs.
- No apparent adverse impacts on recommended prenatal and postpartum care.

routine urinalysis, Papanicolaou tests, and screenings for sexually transmitted infections. All hospital delivery charges and many outpatient procedures are subject to the deductible, but are covered in full after the deductible has been met. Copayments of \$20 apply to non-maternity care outpatient visits, urgent care visits, and specialist consultations. These copayments apply regardless of whether the member has exceeded the deductible spending level. However,

the HDHPs have an out-of-pocket maximum (including copayments and deductibles) of \$2000 to \$4000 for individuals and \$4000 to \$8000 for families. After a member reaches the out-of-pocket maximum, all services are covered in full. Provider networks for women in HDHPs and HMO plans are identical.

The HDHPs we studied were not eligible to be paired with health savings accounts (HSAs); all were eligible to be combined with health reimbursement accounts (HRAs). Although we could not account for HRA purchases from other companies, only 3% of the HDHPs we studied had HRAs through Harvard Pilgrim. Nationally, fewer than half of HDHPs with deductibles over \$1000 are paired with HSA or HRA accounts,<sup>4</sup> so our analysis is relevant for the predominant type of HDHP.

## METHODS

The Office for Sponsored Programs (Harvard Pilgrim Health Care Institute) reviewed this study and granted institutional review board approval.

### Research Design

We used a pre-post study design with matched control group and a difference-in-differences analysis to measure changes in study outcomes.

### Setting

Harvard Pilgrim Health Care is a health plan serving approximately 1 million individuals in New England. On April 1, 2002, Harvard Pilgrim began offering HDHPs with annual deductible amounts of \$500 to \$2000 for individuals and \$1000 to \$4000 for families. Members of family plans also had individual deductibles equal to half of the family deductible. Of Harvard Pilgrim's commercially insured members, approximately 70% have HMO plans, 20% have preferred provider organization (PPO) plans, and 10% have HDHPs, compared with corresponding national rates of 58%, 19%, and 13%.<sup>4</sup> Although PPO plans are more common than the HMO plans we study, cost-sharing requirements for services such as preventive tests, hospitalizations, and specialist visits are quite similar<sup>4</sup>; the primary differences between HMO and PPO plans are the more limited provider network, the need for specialist referrals, and the inclusion of high deductibles in approximately 40% of PPO plans.<sup>4</sup>

Insurance coverage for maternity care in Harvard Pilgrim HMO plans includes full coverage of prenatal and postpartum care, with no cost sharing beyond office visit and hospitalization copayments. Outpatient visit copayments among HMO members in our study ranged from \$5 to \$25 (median \$15) while hospitalization copayments ranged from \$0 to \$1000 (median \$250).

In the HDHPs we studied, many maternity care services are exempt from the deductible, having either first dollar coverage or low copayments. First dollar coverage applies to routine prenatal and postpartum visits, fetal ultrasounds (sonograms),

### Study Population

Using previously established methods,<sup>24</sup> we created a cohort of health plan members enrolled through employers who exclusively offered insurance through Harvard Pilgrim Health Care. We defined 2 cohorts: an HDHP group and an HMO control group. The HDHP group included members enrolled in traditional HMO plans during a 1-year baseline period prior to an employer-mandated switch to an HDHP. The date of this switch was defined as the index date. For each HDHP member, we identified 8 contemporaneous members who were continuously enrolled in traditional HMO plans during the same time period. We assigned HMO controls the same index date as their HDHP counterparts, and the distribution of index dates was similar in the HDHP and HMO control groups in the final study population. We selected only HMO members whose employers did not offer an option to enroll in an HDHP or any other plan types. Therefore, no study members were able to self-select their health insurance plan or benefits structure.

From the HDHP and HMO groups, we identified women who had given birth using *International Classification of Diseases, Ninth Revision* diagnosis codes and diagnosis-related group payment codes. We further divided the study cohorts based on whether each woman delivered a baby prior to or following the index date. The final study population included 2409 women

who delivered babies between October 1, 2001, and November 30, 2007. This population included 229 women in the HDHP group (86 delivered prior to the index date and 143 after) and 2180 women in the HMO control group (711 delivered prior to the index date and 1569 after). Among women in the HDHP group, 95 had a \$500 deductible, 92 had a \$1000 deductible, and 34 had a \$2000 deductible (values unavailable for 8 women). The study used data from 6 months prior to and 3 months following delivery (the second and third trimesters of pregnancy and early postpartum period).

### Study Outcomes

Study outcomes included costs, quality, and utilization, categorized as delivery related (for care provided during the delivery hospitalization) and maternity related (for all types of maternity care, including delivery-related care). Cost measures included out-of-pocket and total expenditures. Out-of-pocket costs comprised all member expenditures toward copayments and deductibles. Total costs were calculated as the sum of the expenditures by the insurer (payer costs) and out-of-pocket expenditures by the member.

We calculated maternity and delivery-related costs using a previously established set of diagnosis, procedure, and payment codes that included prenatal and postpartum visits, obstetrical anesthesia, introduction and repair services, vaginal or caesarean delivery, radiology procedures, pathology and laboratory expenses, and in utero procedures.<sup>3</sup> We distinguished delivery services from non-delivery-related maternity care both by the specific service and procedure codes and by the timing of occurrence during the delivery hospitalization.

Measures of maternity care quality included 3 measures based on Healthcare Effectiveness Data and Information Set (HEDIS) indicators (early prenatal care, appropriate frequency of prenatal care, and timely postpartum care).<sup>25</sup> Early prenatal care was defined as having at least 1 prenatal visit within 42 days of the second trimester. Appropriate frequency of prenatal care comprised at least 7 prenatal visits in the 190 days prior to delivery, as per consensus recommendations.<sup>26</sup> We calculated this measure only among women who delivered full-term babies (>37 weeks of gestation) due to lack of information on gestational age at delivery for preterm infants. Timely postpartum care was achieved by having a visit between 21 and 56 days after delivery. General maternity care utilization measures included the total number of prenatal visits and sonograms, and the length of stay for the delivery hospitalization.

### Covariates

Other variables were age at delivery, month of delivery, type of delivery (vaginal or caesarean), gestational diabetes,

high-risk pregnancy, preterm delivery, chronic disease score, socioeconomic status, and employer size (number of employees). Clinical conditions were defined using payment or diagnosis codes. As a measure of comorbidity and care-seeking behavior, we computed the chronic disease score, which predicts future healthcare spending based on pharmacy claims in the baseline year.<sup>27</sup> To develop a measure of socioeconomic status, we linked members' residential addresses to their 2000 US Census block group and created measures of neighborhood education levels and poverty status based on previously established standards.<sup>28</sup> Low socioeconomic status was indicated by living in a census block group with either more than 25% of adults having less than a high school education or more than 10% of households living below the poverty level.

### Statistical Analysis

We used regression models in a difference-in-differences analysis to assess the independent effect of switching to an HDHP on costs, quality, and utilization outcomes, after controlling for the covariates listed above. This analysis used 3 types of regression models: log-linear for costs, logistic for dichotomous quality measures, and linear for utilization measures (number of visits or days). We also conducted several sensitivity analyses to test the stability of results. Analyses excluding socioeconomic status (which is measured at the census block level rather than the individual level) and adjusting for inflation (using the medical component of the Consumer Price Index) had no impact on the direction or significance of the original findings.

All statistical analyses used 2-tailed tests and  $\alpha$  levels of .05, and were conducted using SAS version 9.1 (SAS Institute Inc, Cary, NC).

## RESULTS

Study groups were similar, with no statistically significant differences detected (**Table 1**). The average age at delivery was approximately 33 years. Between 15% and 18% lived in low socioeconomic status neighborhoods. More than 60% worked for small employers. Approximately one-third of women had a caesarean delivery, and between 20% and 30% experienced complications of high-risk pregnancy. Preterm deliveries accounted for fewer than 10% of births, and rates of gestational diabetes were low. Chronic disease scores were consistent across groups and indicate a generally healthy population.

**Table 2** presents costs, quality, and utilization outcomes in the study groups as well as regression-based estimates of the impact of switching from an HMO to an HDHP on each of these outcomes. Regression coefficients for cost outcomes may be interpreted as the estimated percentage change in cost.

■ **Table 1.** Characteristics of the Study Population

Characteristic <sup>a</sup>	HDHP Group, Mean (95% CI)		HMO Group, Mean (95% CI)	
	Delivery Prior to Index Date (n = 86)	Delivery Following Index Date (n = 143)	Delivery Prior to Index Date (n = 711)	Delivery Following Index Date (n = 1569)
Age at delivery, y	32.8 (31.6-33.9)	32.8 (32.0-33.6)	33.1 (32.7-33.4)	33.1 (32.8-33.3)
Low socioeconomic status, %	15.1 (7.4-22.8)	18.2 (11.8-24.6)	15.9 (13.2-18.6)	16.9 (15.0-18.8)
Small employer (50 or fewer employees), %	70.9 (61.1-80.7)	67.1 (59.3-74.9)	62.6 (59.0-66.2)	61.9 (59.5-64.4)
Caesarean delivery, %	36.0 (25.7-46.4)	33.6 (25.7-41.4)	32.5 (29.0-35.9)	34.5 (32.1-36.9)
High-risk pregnancy, %	19.8 (11.2-28.4)	21.7 (14.8-28.5)	23.9 (20.8-27.1)	30.2 (27.8-32.5)
Preterm delivery, %	5.8 (0.8-10.9)	9.1 (4.3-13.9)	8.7 (6.6-10.8)	8.5 (7.1-9.9)
Gestational diabetes, %	2.3 (0.0-5.6)	2.8 (0.1-5.5)	3.5 (2.2-4.9)	4.3 (3.3-5.3)
Chronic disease score, \$	1388 (1472-1539)	1539 (1405-1673)	1472 (1395-1549)	1524 (1470-1578)

CI indicates confidence interval; HDHP, high-deductible health plan.

<sup>a</sup>Low socioeconomic status is indicated by living in a census tract with either >25% of adults having less than a high school education or >10% of households living below the poverty level. The chronic disease score indicates expected annual expenditures based on prior year pharmaceutical utilization.

Mean total maternity care costs for HDHP members were \$9761 for women who delivered prior to the insurance transition and \$9997 for those who delivered after the transition, compared with a change from \$9731 to \$10,434 for HMO members, a 12% ( $P = .114$ ) relative reduction in the HDHP group, after adjusting for covariates. This occurred despite a significant increase in the underlying cost trend over time (8%,  $P < .001$ ; see [Appendix A](#)). Further, the HDHP group experienced a 15% relative decline in delivery costs ( $P = .192$ ).

In contrast to overall costs, out-of-pocket spending increased following the transition from an HMO to an HDHP. Average out-of-pocket maternity care expenditures among HDHP members rose from \$356 before the HDHP transition to \$942 for those who delivered after, compared with nearly constant values (\$262 to \$282) for women who remained in HMO plans, a relative increase of 106% ( $P < .001$ ). Mean out-of-pocket costs for delivery care rose from \$258 to \$547 among HDHP members, compared with \$188 to \$218 among HMO members, a 45% relative increase ( $P < .001$ ).

Average insurer expenditures decreased for women who delivered babies after HDHP enrollment, falling from \$9405 to \$9055, while rising from \$9469 to \$10,152 for the control group, a 21% relative decrease ( $P = .005$ ). The relative decrease in insurer expenditures for delivery care was similar (22%,  $P = .049$ ).

Achievement of quality standards for early and frequent prenatal care as well as timely postpartum care did not vary significantly across study groups (Table 2). Nearly all women received early prenatal care, and the majority accessed recommended prenatal and postpartum care. Likewise, maternity care utilization was similar across groups, with an average of 9

to 10 prenatal visits and 7 to 8 sonograms (mode = 4; 25% of women had >10 sonograms) and an average delivery hospitalization stay of about 4 days (3 days for vaginal deliveries; 5 days for caesarean deliveries).

As expected, pregnancy and delivery complications, high chronic disease scores, and caesarean and preterm deliveries were generally associated with higher costs and utilization ([Appendices A, B, and C](#)).

## DISCUSSION

This study is the first to characterize the impact of HDHPs on maternity care services. Our findings demonstrate that transitioning from an HMO to an HDHP was associated with increased out-of-pocket costs but stable utilization and quality for maternity and delivery care. Out-of-pocket costs represented a small percentage of total maternity costs for both HMO (4%) and HDHP (11%) members and were in the same range as national averages (6% of total costs).<sup>29</sup> Nevertheless, HDHP members faced out-of-pocket costs 3 times higher than HMO members but received recommended prenatal and postpartum care at similar rates.

An overall reduction in costs associated with better consumer choice is one of the goals of HDHPs and other consumer-driven healthcare models.<sup>9,10</sup> We found a 12% (nonsignificant) decrease in the average costs of maternity-related care following transition to an HDHP. This trend might result from reductions in expensive individualized services or elective tests and procedures (such as prenatal genetic counseling or early screening for chromosomal abnormalities).

Transitioning from an HMO to an HDHP was not associated with adverse impacts on basic prenatal and postpartum

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■ **Table 2.** Maternity Care Before and After Index Date, HDHP Group Compared With HMO Group<sup>a</sup>

Element of Care	HDHP Group, Mean (SD)		HMO Group, Mean (SD)		Differences		
	Delivery Prior to Index Date (n = 86)	Delivery Following Index Date (n = 143)	Delivery Prior to Index Date (n = 711)	Delivery Following Index Date (n = 1569)	Adjusted Differences in Pre-Post Changes Between HDHP and HMO Groups		
<b>Costs, \$</b>					<b>Coefficient<sup>b</sup></b>	<b>SE</b>	<b>P</b>
<b>Total costs</b>							
All maternity	9761 (4585)	9997 (6024)	9731 (6889)	10,434 (6761)	-0.12	0.07	.11
Delivery only	6821 (2465)	6819 (2596)	6229 (3462)	6625 (2789)	-0.15	0.12	.19
<b>Out-of-pocket costs</b>							
All maternity	356 (293)	942 (631)	262 (296)	282 (313)	1.06	0.19	<.001
Delivery only	258 (231)	547 (519)	188 (225)	218 (233)	0.45	0.11	<.001
<b>Insurer expenditures</b>							
All maternity	9405 (4490)	9055 (5867)	9469 (6782)	10,152 (6638)	-0.21	0.07	.01
Delivery only	6564 (2426)	6272 (2685)	6041 (3428)	6407 (2758)	-0.22	0.11	.05
<b>Quality, %</b>					<b>Odds Ratio<sup>c</sup></b>	<b>95% CI</b>	
Early prenatal care	93.02 (25.62)	93.71 (24.37)	93.23 (25.14)	94.05 (23.66)	1.02	(0.32-3.19)	
Recommended schedule of prenatal care (among those with full-term deliveries)	40.74 (49.44)	54.62 (49.98)	52.24 (49.99)	55.68 (49.69)	1.64	(0.89-3.02)	
Timely postpartum care	60.47 (49.18)	51.05 (50.16)	58.79 (49.26)	56.91 (49.54)	0.74	(0.42-1.32)	
<b>Utilization</b>					<b>Coefficient<sup>d</sup></b>	<b>SE</b>	<b>P</b>
Number of prenatal visits	8.64 (5.19)	8.91 (4.3)	9.51 (6.21)	9.81 (5.5)	0.02	0.75	.98
Number of sonograms	6.63 (7.92)	8.43 (10.14)	8.14 (8.27)	8.85 (9.03)	1.21	1.15	.29
Length of stay (delivery hospitalization), d	4.04 (1.15)	3.99 (2.74)	4.21 (3.17)	4.01 (2.04)	0.16	0.33	.63

CI indicates confidence interval; HDHP, high-deductible health plan.  
<sup>a</sup>All regression models included an intercept term and controlled for the following: study group, pre/post indicator, month of delivery, age at delivery, caesarean delivery, high-risk pregnancy, preterm delivery, gestational diabetes, low socioeconomic status, chronic disease score, and small employer.  
<sup>b</sup>Log-linear regression models examined impacts on cost outcomes; coefficients may be interpreted as percentage changes.  
<sup>c</sup>Logistic regression models examined impacts on dichotomous measures of quality of care.  
<sup>d</sup>Linear regression models examined impacts on utilization.

quality measures, lending support to deductible exemptions for such services. Further, there was no measurable effect on prenatal visits, sonograms, or hospitalization following delivery. While a highly informed and “rational” consumer would not forgo any such services even if facing full cost sharing (because the expected delivery hospitalization essentially caps spending at the deductible level), immediate-term out-of-pocket costs might remain important potential barriers to HDHP members, especially among lower-income women.

Our findings have important implications for state and federal policy. Recently enacted healthcare reform legislation will establish state-sponsored health insurance exchanges, and policy makers must set minimum coverage criteria for included health plans. Given that previous studies have detected adverse impacts of cost sharing on the poor, further research is needed to investigate how HDHPs affect maternity care

among lower-income employed women, who might increasingly be enrolled in HDHPs because of the Patient Protection and Affordable Care Act’s individual mandate for health insurance coverage and taxation of more generous “Cadillac” health plans.<sup>30</sup>

This study has a number of important limitations. Data on the prevalence of HRAs, employer contributions to such accounts, and employee premium payments were not available, limiting our ability to examine overall cost impacts on health-related expenditures. However, as above, we expect a very limited prevalence of HRAs among the small employers included in our cohort. Although it would be more broadly generalizable to include information on PPO members, we were not able to do so in this study. The primary differences compared with PPOs are that HMOs generally have a more limited provider network, lower potential out-of-pocket maternity costs, and higher ac-

tuarial values.<sup>4,31</sup> These differences are important when interpreting study results in the national context, and future studies should include PPOs with and without high deductibles. Women in our study were insured primarily through small employers. HDHP benefit structures and cost-sharing requirements may differ in the small, individual, and large employer group markets.

Some HDHP members who delivered babies after the insurance transition received maternity care prior to switching to an HDHP. Although coverage was identical for measured prenatal services under HMO and HDHPs (exempt from HDHP deductibles), we conducted sensitivity analyses that excluded HDHP members who received prenatal care prior to the index date, which revealed unchanged findings. Sample size might have constrained our ability to detect statistically significant differences in overall costs and utilization of care, although we had sufficient power to examine the highly policy-relevant association between HDHPs and out-of-pocket costs. Sample size also limited examination of differences among subgroups of interest (eg, caesarean vs vaginal deliveries, lower-income families, higher vs lower deductibles). We had access to medical claims but not laboratory data; HEDIS guidelines recommend assessing both when measuring timely postpartum care. Therefore, we may have undercounted the true rate of this measure, though not differentially by study group. Also, for the small percentage of women whose employers did not offer pharmaceutical coverage, we assigned average chronic disease scores of women who do not use prescription drugs.

Enrollment in HDHPs has been growing rapidly and is likely to accelerate with the implementation of the Patient Protection and Affordable Care Act.<sup>7,32,33</sup> Insurers, employers, and policy makers should pay careful attention to HDHP design and associated financial burdens. Recent health reform legislation contains extensive provisions to reduce out-of-pocket cost sharing for low-income individuals and families who obtain coverage through health insurance exchanges. However, out-of-pocket costs remain a concern if employers offer “affordable” premiums but high deductibles to low-income employees who are not eligible for subsidized health insurance through exchanges.

We found that the increased out-of-pocket costs associated with a transition from an HMO to an HDHP did not produce concerning changes in the utilization of recommended prenatal and postpartum care. In the future, larger studies should examine the impact of HDHPs on low-income families and on socioeconomic disparities in maternity and delivery care.

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## REFERENCES

1. Kozak LJ, DeFrances CJ, Hall MJ. National hospital discharge survey: 2004 annual summary with detailed diagnosis and procedure data. *Vital Health Stat* 13. 2006;(162):1-209.
2. Andrews RM, Elixhauser A. *The National Hospital Bill: Growth Trends and 2005 Update on the Most Expensive Conditions by Payer; Statistical Brief 42*. Rockville, MD: Agency for Healthcare Research and Quality; 2007.
3. Thomson Healthcare. *The Healthcare Costs of Having a Baby*. Santa Barbara, CA: Thomson Healthcare; April 2007.
4. The Kaiser Family Foundation and Health Research & Educational Trust. *Employer Health Benefits 2010 Annual Survey*. <http://ehbs.kff.org/pdf/2010/8085.pdf>. Accessed September 27, 2010.
5. Claxton G, DiJulio B, Whitmore H, et al. Job-based health insurance: costs climb at a moderate pace. *Health Aff (Millwood)*. 2009;28(6):w1002-w1012.
6. Yoo H. *January 2010 Census Shows 10 Million People Covered by HSA/High-Deductible Health Plans*. America's Health Insurance Plans Center for Policy and Research. May 2010. <http://www.ahipresearch.org/pdfs/HSA2010.pdf>. Accessed September 29, 2010.
7. Reuters. Advocates see growth for health savings accounts. March 23, 2010. <http://www.reuters.com/article/idUSTRE62M4AY20100323>. Accessed March 23, 2010.
8. Lee T, Zapert K. Do high-deductible health plans threaten quality of care? *N Engl J Med*. 2005;353(12):1202-1204.
9. Davis K. Consumer-directed health care: will it improve health system performance? *Health Serv Res*. 2004;39(4 pt 2):1219-1234.
10. Ginsburg P. Controlling health care costs. *N Engl J Med*. 2004;351(16):1591-1593.
11. Davis K, Doty M, Ho A. *How High Is Too High? Implications of High-Deductible Health Plans*. Commonwealth Fund publication 816. New York: The Commonwealth Fund; 2005.
12. Newhouse J. Consumer-directed health plans and the RAND Health Insurance Experiment. *Health Aff (Millwood)*. 2004;23(6):107-113.
13. Newhouse J, Archibald RW, Bailit HL, et al. *Free for All? Lessons From the Rand Health Insurance Experiment*. Cambridge, MA: Harvard University Press; 1993.
14. Tamblyn R, Laprise R, Hanley J, et al. Adverse events associated with prescription drug cost-sharing among poor and elderly persons. *JAMA*. 2001;285(4):421-429.

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15. **Roblin D, Platt R, Goodman M, et al.** Effect of increased cost-sharing on oral hypoglycemic use in five managed care organizations: how much is too much? *Med Care.* 2005;43(10):951-959.
16. **Solanki G, Schauffler HH, Miller LS.** The direct and indirect effects of cost-sharing on the use of preventive services. *Health Serv Res.* 2000;34(6):1331-1350.
17. **Wharam JF, Galbraith AA, Kleinman KP, Soumerai SB, Ross-Degnan D, Landon BE.** Cancer screening before and after switching to a high-deductible health plan. *Ann Intern Med.* 2008;148(9):647-655.
18. **Busch SH, Barry CL, Vegso SJ, Sindelar JL, Cullen MR.** Effects of a cost-sharing exemption on use of preventive services at one large employer. *Health Aff (Millwood).* 2006;25(6):1529-1536.
19. **Rowe JW, Brown-Stevenson T, Downey RL, Newhouse JP.** The effect of consumer-directed health plans on the use of preventive and chronic illness services. *Health Aff (Millwood).* 2008;27(1):113-120.
20. **Borghi J, Ensor T, Somanathan A, Lissner C, Mills A; Lancet Maternal Survival Series steering group.** Mobilising financial resources for maternal health. *Lancet.* 2006;368(9545):1457-1465.
21. **Sakala C, Corry MP.** *Evidence-Based Maternity Care: What It Is and What It Can Achieve.* 2008. Childbirth Connection. The Reforming States Group. Milbank Memorial Fund. <http://www.childbirthconnection.org/pdfs/evidence-based-maternity-care.pdf>. Accessed December 1, 2010.
22. **Cogan JF, Hubbard RG, Kessler DP.** Making markets work: five steps to a better health care system. *Health Aff (Millwood).* 2005;24(6):1447-1457.
23. **Woolf SH, Chan EC, Harris R, et al.** Promoting informed choice: transforming health care to dispense knowledge for decision making. *Ann Intern Med.* 2005;143(4):293-300.
24. **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 [published correction appears in *JAMA.* 2008;299(2):171]. *JAMA.* 2007;297(10):1093-1102.
25. **National Committee for Quality Assurance (NCQA).** *Technical Specifications.* Washington, DC: NCQA; 2008. *HEDIS 2009: Healthcare Effectiveness Data & Information Set; vol 2.*
26. **American College of Obstetricians and Gynecologists and American Academy of Pediatrics.** *Guidelines for Perinatal Care.* 6th ed. Washington, DC: American College of Obstetricians and Gynecologists; 2007.
27. **Clark DO, Von Korff M, Saunders K, Baluch WM, Simon GE.** A chronic disease score with empirically derived weights. *Med Care.* 1995;33(8):783-795.
28. **Krieger N, Chen JT, Waterman PD, Rehkopf DH, Subramanian SV.** Race/ethnicity, gender, and monitoring socioeconomic gradients in health: a comparison of area-based socioeconomic measures—the public health disparities geocoding project. *Am J Public Health.* 2003;93(10):1655-1671.
29. **March of Dimes.** *Costs of Maternity and Infant Care.* 2007. [http://search.marchofdimes.com/files/MOD\\_Maternity\\_fact\\_sheet\\_final\\_%282%29.pdf](http://search.marchofdimes.com/files/MOD_Maternity_fact_sheet_final_%282%29.pdf). Accessed October 15, 2010.
30. **111th Congress of the United States of America.** *The Patient Protection and Affordable Care Act.* HR 3590. 2010. <http://democrats.senate.gov/reform/patient-protection-affordable-care-act-as-passed.pdf>. Accessed July 28, 2010.
31. **McDevitt R, Gabel J, Lore R, Pickreign J, Whitmore H, Brust T.** Group insurance: a better deal for most people than individual plans. *Health Aff (Millwood).* 2010;29(1):156-164.
32. **Globe Staff.** Study: high deductible health plans may proliferate. *Business Updates.* July 29, 2010. [http://www.boston.com/business/ticker/2010/07/high\\_deductible.html](http://www.boston.com/business/ticker/2010/07/high_deductible.html). Accessed August 12, 2010.
33. **Fronstin P.** Employers may move by 2018 to avoid tax [response to: A future for consumer-directed health plans? by Marilyn Werber Serafini]. *National Journal—Health Care. Expert Blogs.* May 24, 2010. <http://healthcare.nationaljournal.com/2010/05/a-future-for-consumer-directed.php>. Accessed August 12, 2010. ■

■ **Appendix A.** Effect Estimates From Log-Linear Regression Models for Cost Outcomes<sup>a</sup>

Variable	Total Costs (Out-of-Pocket and Insurer Expenditures)			
	All Maternity-Related Care	P	Delivery Care	P
Delivery after index date	0.082 (0.024)	<.001	0.087 (0.039)	<.05
HDHP (vs HMO)	0.070 (0.058)		0.171 (0.091)	<.10
HDHP (vs HMO) and delivery after index date	-0.115 (0.073)		-0.150 (0.115)	
Age at delivery, y	-0.012 (0.002)	<.001	-0.009 (0.004)	<.05
Caesarean delivery	0.359 (0.022)	<.001	0.315 (0.035)	<.001
High risk pregnancy	0.142 (0.024)	<.001	0.032 (0.039)	
Preterm delivery	0.368 (0.038)	<.001	0.143 (0.060)	<.05
Gestational diabetes	0.313 (0.053)	<.001	0.061 (0.085)	
Low socioeconomic status	0.030 (0.028)		0.034 (0.044)	
Chronic disease score (in \$1000s)	0.007 (0.010)		-0.007 (0.016)	
Small employer (50 or fewer employees)	0.034 (0.021)		-0.020 (0.034)	

HDHP indicates high-deductible health plan.

<sup>a</sup>Cell entries are log-linear effect estimates (standard errors). All models also included an intercept term and a series of dummy variables indicating the month of delivery.

■ **Appendix B.** Odds Ratios From Logistic Regression Models for Quality of Care Outcomes<sup>a</sup>

Variable	Early Prenatal Care	P	Recommended Schedule of Prenatal Care <sup>b</sup>	P	Timely Postpartum Care	P
	Delivery after index date	1.053 (0.718-1.545)		1.100 (0.897-1.351)		0.880 (0.725-1.067)
HDHP (vs HMO)	0.965 (0.395-2.358)		0.613 (0.377-0.994)		1.092 (0.688-1.734)	
HDHP (vs HMO) and delivery after index date	1.017 (0.323-3.196)		1.640 (0.891-3.019)		0.741 (0.416-1.320)	
Age at delivery, y	1.027 (0.991-1.065)		1.008 (0.988-1.027)	<.10	0.995 (0.977-1.014)	
Caesarean delivery	1.860 (1.241-2.787)	<.01	1.206 (0.999-1.456)	<.05	0.928 (0.779-1.105)	
High-risk pregnancy	1.519 (0.983-2.346)	<.10	2.220 (1.790-2.753)		1.259 (1.037-1.529)	<.05
Preterm delivery	0.562 (0.324-0.975)	<.05	NA		0.894 (0.664-1.203)	
Gestational diabetes	1.641 (0.508-5.298)		3.363 (1.906-5.934)		1.065 (0.697-1.626)	
Low socioeconomic status	0.977 (0.625-1.529)		0.931 (0.732-1.184)		1.030 (0.824-1.286)	
Chronic disease score (in \$1000s)	1.143 (0.934-1.399)		1.271 (1.150-1.404)		0.989 (0.912-1.072)	
Small employer (50 or fewer employees)	1.471 (1.047-2.067)	<.05	1.150 (0.959-1.379)	<.05	0.925 (0.781-1.097)	

HDHP indicates high-deductible health plan; NA, not applicable.

<sup>a</sup>Cell entries are odds ratios (95% confidence intervals). All models also included an intercept term and a series of dummy variables indicating the month of delivery.

<sup>b</sup>Calculated among women with full-term deliveries.



## High-Deductible Plans and Maternity Care

Out-of-Pocket Costs				Insurer Expenditures			
All Maternity-Related Care	P	Delivery Care	P	All Maternity-Related Care	P	Delivery Care	P
0.069 (0.069)		0.048 (0.043)		0.081 (0.025)	<.01	0.087 (0.038)	<.05
0.331 (0.155)	<.05	0.130 (0.093)		0.060 (0.059)		0.164 (0.090)	<.10
1.063 (0.192)	<.001	0.446 (0.114)	<.001	-0.206 (0.074)	<.01	-0.223 (0.114)	<.05
-0.028 (0.007)	<.001	-0.008 (0.004)	<.05	-0.012 (0.002)	<.001	-0.008 (0.004)	<.05
0.108 (0.061)	<.10	0.042 (0.037)		0.369 (0.022)	<.001	0.338 (0.035)	<.001
-0.087 (0.067)		0.009 (0.041)		0.142 (0.025)	<.001	0.043 (0.038)	
-0.085 (0.101)		-0.180 (0.066)	<.01	0.379 (0.038)	<.001	0.146 (0.059)	<.05
0.354 (0.140)	<.05	0.085 (0.086)		0.308 (0.054)	<.001	0.047 (0.084)	
0.084 (0.078)		-0.007 (0.047)		0.028 (0.028)		0.030 (0.044)	
-0.011 (0.029)		-0.016 (0.018)		0.009 (0.010)		-0.007 (0.016)	
0.671 (0.061)	<.001	0.375 (0.038)	<.001	0.015 (0.022)		-0.049 (0.034)	

### ■ Appendix C. Effect Estimates From Linear Regression Models for Utilization Outcomes<sup>a</sup>

Variable	Number of Prenatal Visits	P	Number of Sonograms	P	Length of Stay (Delivery Hospitalization)	P
Delivery after index date	0.037 (0.252)		0.453 (0.385)		-0.267 (0.111)	<.05
HDHP (vs HMO)	-0.687 (0.597)		-1.218 (0.910)		-0.160 (0.262)	
HDHP (vs HMO) and delivery after index date	0.019 (0.750)		1.211 (1.148)		0.161 (0.331)	
Age at delivery, y	0.042 (0.024)	<.10	0.036 (0.037)		-0.010 (0.011)	
Caesarean delivery	1.056 (0.228)	<.001	2.334 (0.349)	<.001	1.814 (0.101)	<.001
High-risk pregnancy	2.228 (0.251)	<.001	4.649 (0.385)	<.001	0.127 (0.112)	
Preterm delivery	3.683 (0.389)	<.001	8.058 (0.592)	<.001	2.113 (0.175)	<.001
Gestational diabetes	5.625 (0.554)	<.001	6.559 (0.844)	<.001	0.738 (0.250)	<.01
Low socioeconomic status	0.144 (0.290)		-0.436 (0.443)		0.166 (0.130)	
Chronic disease score (in \$1000s)	0.731 (0.105)	<.001	0.555 (0.162)	<.001	0.074 (0.047)	
Small employer (50 or fewer employees)	0.116 (0.222)		1.271 (0.340)	<.001	0.013 (0.098)	

HDHP indicates high-deductible health plan.  
<sup>a</sup>Cell entries are effect estimates (standard errors). All models also included an intercept term and a series of dummy variables indicating the month of delivery.