Two-year Trends in Cancer Screening Among Low Socioeconomic Status Women in an HMO-based High-deductible Health Plan

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BACKGROUND: Cancer screening is often fully covered under high-deductible health plans (HDHP), but low socioeconomic status (SES) women still might forego testing.

OBJECTIVE: To determine the impact of switching to a HDHP on breast and cervical cancer screening among women of low SES.

DESIGN: Pre-post with comparison group.

PARTICIPANTS: Four thousand one hundred and eighty-eight health plan members enrolled for one year before and up to two years after an employer-mandated switch from a traditional HMO to an HMO-based HDHP, compared with 9418 propensity score matched controls who remained in HMOs by employer choice. Both groups had low outpatient copayments. High-deductible members had full coverage of mammography and Pap smears, but \$500 to \$2000 individual deductibles for most other services. HMO members had full coverage of cancer screening and low copayments for other services without any deductible. We stratified analyses by SES.

INTERVENTION: Transition to a HDHP.

MAIN MEASURES: Annual breast and cervical cancer screening rates; rates of annual preventive outpatient visits.

KEY RESULTS: In follow-up years 1 and 2, low SES HDHP members experienced no statistically detectable changes in rates of breast cancer screening (ratio of change, 1.14, 95 % CI, [0.93,1.40] and 1.05, [0.80,1.37], respectively) or preventive visits (difference-in-differences, +1.9 %, [-11.9 %, +17.7 %] and +10.1 %, [-9.4 %, +33.7 %], respectively) relative to HMO counterparts. Similarly, among low SES HDHP members eligible for cervical cancer screening, no significant changes occurred in either screening rates (1.01, [0.86,1.20] and 1.08, [0.86,1.35]) or preventive visits (+0.2 %, [-11.4 %, +13.3 %] and -1.4 %, [-18.1, +18.6]). Patterns were statistically similar for high SES members.

CONCLUSION: During two follow-up years, transition to an HMO-based HDHP with coverage of primary care visits and cancer screening did not lead to differentially lower rates of breast and cervical cancer screening or preventive visits for low SES women. Generalizability is limited to commercially insured women transitioning to HDHPs with low cost-sharing for cancer screening and primary care visits, a common design.

KEY WORDS: high-deductible health plans; cancer screening; vulnerable populations; women's health.

J Gen Intern Med 27(9):1112-9

DOI: 10.1007/s11606-012-2057-x

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The recent trend of rapidly increasing out-of-pocket medical costs could reduce use of essential health services such as cancer screening,¹⁻⁵ especially among vulnerable populations. High-deductible health plans (HDHP) include the highest cost sharing levels in the health insurance marketplace. Arrangements typically have lower monthly premiums than traditional health plans but subject many services to deductibles of at least \$500 per year.⁶ HDHPs have experienced rapid growth over the last five years⁶ and might accelerate due to national health insurance reform.⁷

Previous research suggests that cost-sharing broadly reduces use of medical services, including cancer screening.⁸⁻¹⁸ As a result, many HDHPs exclude appropriate screening services and other recommended care such as preventive visits from the deductible to minimize financial barriers to care.¹⁹

Our research group (studying an HMO-based HDHP among multiple employers)^{20,21} and others (examining preferred provider organization (PPO)-based HDHPs at multiple employers²² and a single employer²³) have found that exempting preventive visits and cancer screening tests from full cost sharing preserves their use overall in the commercially insured population (i.e., when examining across the full socioeconomic spectrum). Another HDHP study, however,

Dr. Wharam's salary was supported by the Harvard Medical School and Harvard Pilgrim Health Care Institute Department of Population Medicine. This research was funded by a faculty grant from the Harvard Pilgrim Health Care Foundation.

Received July 6, 2011

Revised December 28, 2011

Accepted March 19, 2012

Published online April 29, 2012

found 1–6 % reductions in breast and cervical cancer screening among lower income HDHP members.²⁴

We studied members receiving health insurance coverage through small employers who transitioned from a traditional HMO to an HMO-based HDHP to determine if excluding primary care visits and cancer screening tests from the deductible preserved utilization rates among low socioeconomic status (SES) members. The HDHP we examined excluded the same cancer screening-relevant services from the deductible (preventive visits and testing) as nearly all HDHPs,⁶ but is linked to HMO rather than the more commonly used PPO coverage.

METHODS

Data Source

In April 2002, Harvard Pilgrim Health Care (HPHC) in Massachusetts began offering an HMO-based HDHP with \$500–\$2000 individual annual deductibles and family deductibles of twice that amount. Most institution-based services (e.g. emergency department and hospital care), laboratory studies, and imaging procedures are subject to the deductible. Members have a \$20 copayment for most outpatient visits (independent of reaching the deductible), including primary care and specialist visits. Many preventive tests including Pap smears and mammograms have first dollar coverage. The plan functions essentially the same as the traditional HMO but with substantially higher cost sharing for most services. Members are not required to change physicians after joining.

Members of the traditional HMO plan comparison group also had first dollar coverage for Pap smears and mammograms, as well as outpatient copayments ranging from \$5–\$25. The HDHP and control groups had access to the same network of physicians and faced the same HMO utilization controls.

Study Groups

We drew a two-year follow-up sample from a previously established cohort of Massachusetts HPHC members aged 1–64 years,²¹ constructed as a pre-post with comparison group study with two cohorts of interest: an HMO-based HDHP group and an HMO control group. All study members of the initial cohort were insured by HPHC in Massachusetts between 2001 and 2008 for up to 4 years, the first year of which was in a traditional HMO plan. After the baseline year, HDHP group members experienced an employer-mandated switch to a HDHP and then remained continuously enrolled with the same employer in the same plan. We defined the date of the HDHP switch as the index date. We then randomly matched each HDHP member to eight contemporaneous HMO members (based on adult/child status and “association” plan enrollment) who

remained enrolled in the traditional HMO plan without an option to switch to a HDHP during the same period. Association plans are sold by independent brokers (“associations”) to very small businesses (fewer than 10 employees) so that the employers receive better premiums through pooled purchasing. We assigned control members the same index date as their matched HDHP member.

For our cancer screening analysis, we included the HDHP and control members from this initial pool with index dates after December 25, 2002 when the standard HDHP benefit package began. We then removed 113 HDHP plan members and 829 control members with missing descriptive data. Our cohorts age 1–64 (prior to applying inclusion criteria) included 15,122 HDHP and 100,507 control members.

From these cohorts we identified women eligible for breast or cervical cancer screening in the baseline and follow-up years based on insurance claims criteria in the 2008 Healthcare Effectiveness Data Information Set specifications (below).^{25–27} We required that women have at least a full follow-up year.

We considered women eligible for breast cancer screening if they were between age 40–64. We excluded 134 HDHP and 863 control members who had bilateral mastectomy, leaving a total of 3085 HDHP and 15,041 control members who met inclusion criteria. For cervical cancer screening, we included women age 21–64 except those who had a hysterectomy with no residual cervix (161 HDHP and 927 control members); 4437 HDHP and 24,234 control members met these criteria.

To minimize employer selection effects, we estimated propensity score models that predicted a member’s likelihood of being enrolled in a HDHP (versus the traditional HMO).^{28–31} As predictors, we included age; sex; Adjusted Clinical Groups morbidity;³² family versus individual plan; SES index; employer type; baseline outpatient, emergency department, and hospital copayment levels; year of index date; and baseline member and health plan expenditures.

Based on these variables, we matched each HDHP member to two HMO members from the respective control pool using a standard caliper matching approach.^{31,33}

The study was approved by the HPHC Institutional Review Board.

Assessment of Cancer Screening Status

We obtained all medical service claims for our study groups from HPHC’s claims database. We selected claims for breast and cervical cancer screening using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes in the 2008 Healthcare Effectiveness Data and Information Set technical specifications^{25–27} as well as HPHC-specific codes.

For breast cancer screening, our outcome of interest was the percentage of eligible women age 40–64 who had at

least one mammogram during each one-year study period of interest.

For cervical cancer screening, our outcome was the percentage of women age 21–64 who received at least one Pap smear during each one-year study period of interest.

Preventive Outpatient Visits

We used an algorithm developed by Fenton and colleagues³⁴ to detect outpatient visits for preventive and pregnancy care, when women would be most likely to be counseled about routine screening or tested.

Covariates

To estimate comorbidity, we applied the Adjusted Clinical Group (ACG) algorithm to members' claims during the baseline year.^{32,35} To derive proxy measures of SES, we linked members' most recent residential street addresses to their 2000 US Census block group.³⁶ We used a principle components approach to calculate a neighborhood SES index over the entire cohort prior to the propensity score match based on census block levels of poverty and high school education.^{37–39} We defined low SES as the lower 33 % of the SES index. The mean of census block group median household income for this group was \$45,631, while the 2000 Massachusetts median household income was \$46,947.

Other covariates included age, individual versus family plan, and employer category.

Statistical Analysis

We compared baseline characteristics of our study groups using chi-squared tests, t-tests, and quantile regression.⁴⁰ We used a difference-in-differences analytic framework to examine the outcomes of interest.

We used generalized estimating equations^{41,42} to adjust for the correlation in a given individual's receipt of screening between the baseline and follow-up periods. After controlling for the aforementioned covariates, we modeled the independent effect of high deductible status on binary cancer screening rate outcomes using logistic regression. We modeled changes in preventive outpatient visits using Poisson regression. We included the index date in all models to control for secular trends in utilization.

We stratified all analyses by SES to determine if switch to the HDHP was associated with differential changes among more vulnerable women. In a sensitivity analysis, we varied the definition of low SES to include members in the lower 20 % of the SES index and the results were very similar, so we report the broader definition. We also examined whether our results were sensitive to the level of the deductible by conducting stratified analyses among

low SES HDHP members with \$500, \$1000, and \$2000 deductibles and using the same approach as in our main analyses.

Because not all expert panels recommended breast cancer screening between 40 and 50 years of age,⁴³ we stratified by age groups (40–49 and 50–64). We also separately analyzed women aged 21–30 who qualify for annual cervical cancer screening. To assess whether differential attrition among low SES HDHP members might have biased second-year follow-up results, we examined relative changes in screening in the first follow up year stratified according to whether members had one or two years of follow up. We performed all analyses using SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

Baseline Characteristics

We studied 2728 HDHP and 5214 control members eligible for breast cancer screening; all had one full year of follow-up and 48.5 % and 38.0 %, respectively, had two full years. The cervical cancer screening cohort comprised 3932 HDHP and 7520 control members, with all having one-year follow-up and 46.0 % and 36.4 %, respectively, having two full years. In both the breast and cervical cancer screening cohorts, the HDHP and control groups had similar measured characteristics including the percentages in family or association plans, distributions of the ACG score, and SES (Table 1). Several p-values for comparisons were statistically but not substantively different including for employer category, residents below poverty, and mean outpatient copayment.

The average ages of women eligible for breast and cervical cancer screening were approximately 51 and 45 years, respectively. Approximately 44–47 % of low SES women lived in higher poverty neighborhoods where greater than 10 % of residents had incomes below the federal poverty level, and about 63–66 % lived in lower education areas where greater than 15 % of adults had less than a high school education (data not shown).

Mean baseline outpatient copayments were \$15.9 and \$15.6 for HDHP and control members eligible for breast cancer screening, respectively ($p=0.03$). These rose to \$20 in both follow-up years for HDHP members and \$16.3 and \$17.4 for control members. Among HDHP and control members eligible for cervical cancer screening, mean baseline copayments were \$15.8 and \$15.7, respectively ($p=0.09$). In follow-up years 1 and 2, these HDHP members faced \$20 copayments and matched control members had copayments of \$16.3 and \$17.4, respectively.

The percentage of breast cancer screening-eligible HDHP members facing individual deductibles of \$500, \$1000, and \$2000 were 35.9, 41.5, and 22.5, respectively.

Table 1. Baseline Demographic Characteristics

Characteristic	Breast Cancer Screening Cohort					Cervical Cancer Screening Cohort				
	HDHP (n=2728)		Control (n=5214)		P-value	HDHP (n=3932)		Control (n=7520)		P-value
Mean age on index date, y (SD)	51.6	(6.5)	51.3	(6.5)	0.12	45.5	(10.5)	45.2	(10.5)	0.11
In family plan, n (%)	1,427	(52.3)	2,742	(52.6)	0.81	2,192	(55.7)	4,236	(56.3)	0.55
Mean outpatient visits per member year, n (SD)	5.2	(6.0)	5.1	(5.9)	0.87	5.1	(6.4)	5.0	(6.2)	0.67
Employer Category, n (%)										
Association plan, 2–9 employees	1,266	(46.4)	2,589	(49.7)	0.01	1,717	(43.7)	3,450	(45.9)	<0.01
Non-association plan, 2–50 employees	716	(26.2)	1,352	(25.9)		1,131	(28.8)	2,157	(28.7)	
Non-association plan, 51–250 employees	511	(18.7)	832	(16.0)		770	(19.6)	1,266	(16.8)	
Non-association plan, 251–999 employees	201	(7.4)	387	(7.4)		265	(6.7)	542	(7.2)	
Non-association plan, ≥1000 employees	34	(1.2)	54	(1.0)		49	(1.2)	105	(1.4)	
Adjusted Clinical Group Score										
Mean (SD)	1.3	(1.7)	1.3	(1.7)	0.80	1.2	(1.5)	1.2	(1.6)	0.95
25th percentile (healthiest)	0.3		0.3			0.3		0.3		
Median	0.8		0.8			0.8		0.8		
75th percentile	1.7		1.7			1.7		1.7		
Neighborhood, n (%)										
Residents Below Poverty Level										
<5 %	1,529	(56.0)	3,043	(58.4)	0.02	2,167	(55.1)	4,286	(57.0)	0.06
5 %–9.9 %	715	(26.2)	1,311	(25.1)		1,007	(25.6)	1,915	(25.5)	
10 %–19.9 %	379	(13.9)	238	(11.9)		575	(14.6)	349	(12.9)	
≥20 %	105	(3.8)	238	(4.6)		183	(4.7)	349	(4.6)	
>66 % black residents	19	(0.7)	37	(0.7)	0.95	25	(0.6)	58	(0.8)	0.42
Residents with Less than High School Education										
<15 %	2,139	(78.4)	4,083	(78.3)	0.68	3,017	(76.7)	5,750	(76.5)	0.97
15 %–24.9 %	368	(13.5)	727	(13.9)		586	(14.9)	1,137	(15.1)	
25 %–39.9 %	163	(6.0)	312	(6.0)		252	(6.4)	492	(6.5)	
≥40 %	58	(2.1)	92	(1.8)		77	(2.0)	141	(1.9)	
Low Socioeconomic status, n (%)	929	(34.1)	1,707	(32.7)	0.24	1,416	(36.0)	2,663	(35.4)	0.52
Mean outpatient visit copay, \$ (sd)	15.9	(4.4)	15.6	(4.4)	0.03	15.8	(4.3)	15.7	(4.3)	0.09

HDHP: High-deductible health plan

Corresponding values for the cervical cancer screening HDHP cohort were 35.6, 42.8, and 21.5.

We estimated the effect size we could observe using our baseline screening rates. For our smaller subgroup (low SES members), we had 80 % power to detect at least an 11 % decline in breast cancer screening and a 9 % decline in cervical cancer screening. Corresponding values in the high SES group were 8 % and 7 %.

Cancer Screening Rates

HDHP and control members had similar baseline breast cancer screening rates (60.6 % vs. 60.1 %; $p=0.71$, respectively, Table 2). There were no significant differences in corresponding rates among low SES members (56.8 % vs. 58.9 %; $p=0.31$) and high SES members (62.5 % vs. 60.7 %; $p=0.22$).

After controlling for covariates, there were no statistically significant changes in breast cancer screening rates in the HDHP group compared with controls from baseline to the two follow-up years (0.99, 95 % CI, [0.88,1.12] and 1.01, [0.86,1.18], respectively). Corresponding ratios of change in the low socioeconomic HDHP cohort compared with controls were 1.14 (0.93,1.40) and 1.05 (0.80,1.37).

As with the breast cancer cohorts, there were no detectable differences in baseline cervical cancer screening rates among HDHP and control members (58.3 % vs. 59.6 %, respectively; $p=0.19$) or in the low SES (55.4 % vs.

58.7 %; $p=0.43$) or high SES (60.0 % vs. 60.1 %; $p=0.93$) cohorts. Adjusted ratios of change in the follow-up years among all HDHP members compared with controls were 0.98 (0.80,1.09) and 1.02 (0.89,1.16), respectively, and there were no significant differences by SES.

Low SES HDHP members with one and two years of follow-up had similar changes in screening in the first follow-up year; breast cancer screening ratios of change were 1.10 [0.84, 1.44] for the one-year subgroup and 1.17 [0.85, 1.60] for the two-year subgroup (data not shown). Corresponding values for the cervical cancer screening cohort were 1.00 (0.80, 1.24) and 1.02 (0.78, 1.35).

Breast and cervical cancer screening results among low SES HDHP members stratified by deductible level were similar to the main analyses (data not shown).

Preventive Outpatient Visits

At baseline, HDHP and control members eligible for breast cancer screening had the same preventive visit rates (0.53 and 0.53, respectively; $p=0.99$, Table 3). There were also no baseline differences in visit rates between low and high SES members. In adjusted analyses, HDHP members showed stable preventive visit rates from baseline to follow-up years 1 and 2 relative to controls (−2.3 %, [−9.9 %,5.8 %] and 2.3 %, [−8.0 %,13.8 %], respectively). Low and high SES members had no detectable changes in preventive visits.

Table 2. Breast and Cervical Cancer Screening Among Women in HDHPs and HMO Plans*

	HDHP Group, % (n)			Control Group, % (n)			Ratio of Change in Screening from Baseline to Follow-up vs. Control Group (95 % CI) †	
	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2	Year 1 vs. Baseline	Year 2 vs. Baseline
Breast Cancer Screening								
Low SES	60.6 (1652)	62.2 (1696)	62.4 (826)	60.1 (3135)	62.0 (3231)	62.1 (1228)	0.99 (0.88, 1.12)	1.01 (0.86, 1.18)
High SES	56.8 (528)	60.7 (564)	58.6 (246)	58.9 (1005)	59.6 (1018)	59.7 (359)	1.14 (0.93, 1.40)	1.05 (0.80, 1.37)
Age 40–49	62.5 (1124)	62.9 (1132)	64.2 (580)	60.7 (2130)	63.1 (2213)	63.1 (869)	0.92 (0.79, 1.07)	0.98 (0.81, 1.19)
Age 50–64	55.5 (613)	56.8 (628)	58.5 (313)	53.4 (1158)	56.7 (1229)	57.7 (457)	0.93 (0.77, 1.11)	0.95 (0.75, 1.22)
Cervical Cancer Screening	64.0 (1039)	65.8 (1068)	65.0 (513)	64.9 (1977)	65.7 (2002)	65.0 (771)	1.04 (0.89, 1.22)	1.05 (0.86, 1.29)
Low SES	58.3 (2294)	57.3 (2252)	56.6 (1023)	59.6 (4482)	59.1 (4441)	57.7 (1579)	0.98 (0.88, 1.09)	1.02 (0.89, 1.16)
High SES	55.4 (785)	53.5 (758)	52.6 (313)	58.7 (1564)	56.5 (1505)	54.5 (482)	1.01 (0.86, 1.20)	1.08 (0.86, 1.35)
Age 21–29	60.0 (1509)	59.4 (1494)	58.6 (710)	60.1 (2918)	60.4 (2936)	59.3 (1097)	0.96 (0.84, 1.09)	0.99 (0.84, 1.16)
Age 30–49	67.8 (215)	71.0 (225)	72.2 (83)	67.3 (421)	67.9 (425)	67.6 (115)	1.13 (0.77, 1.64)	1.27 (0.72, 2.24)
Age 50–64	60.3 (1246)	58.6 (1212)	59.5 (565)	61.0 (2434)	60.9 (2429)	59.1 (876)	0.94 (0.81, 1.09)	1.07 (0.89, 1.29)
	53.8 (833)	52.7 (815)	50.5 (375)	56.0 (1627)	54.6 (1587)	54.3 (588)	1.01 (0.86, 1.18)	0.93 (0.76, 1.14)

*All percentages are unadjusted.

†Ratio adjusted using generalized estimating equations to model the independent effect of high-deductible status on screening rates, controlling for age, sex, employer size, index date, socioeconomic status, association status, individual versus family plans, and illness. The result is the adjusted ratio of the follow-up to baseline odds ratios of the high-deductible health plan group divided by the ratio of the follow-up to baseline odds ratios of the control group. Subtracting 1 from the odds ratios and multiplying by 100 would provide values that can roughly be interpreted as the percent change in the HDHP group versus the control group from baseline to follow-up. The same applies to the confidence interval limits
HDHP: high-deductible health plan; SES: socioeconomic status; n: number of screening tests

HDHP members eligible for cervical cancer screening showed a similar pattern of preserved preventive visits (Table 3) without differences by SES.

DISCUSSION

We found that transition to a HDHP with low outpatient copayments and full coverage of mammography and Pap smears was associated with stable cancer screening and preventive visit rates for women over two follow-up years, overall and after stratification by socioeconomic group.

Observers have raised concerns that vulnerable HDHP members might forego medical care such as outpatient visits due to associated high-cost testing, affecting even recommended services exempted from the deductible. In contrast, we found that fully covering primary care visits and preventive tests in HDHPs might preserve screening among commercially insured low SES members, even in the face of a small outpatient copayment increase. On the other hand, supporters of consumer-directed health care suggest that HDHPs will increase use of beneficial services and we found no evidence of this either. It is also important to note that, if cancer were detected, lower income HDHP members are likely to experience financial strain and might defer care.

Few studies have examined preventive care among low SES HDHP members. Our results differ slightly from a recent study demonstrating small reductions in breast and cervical cancer screening among HDHP members that lived in low income areas.⁹ That study examined a larger and more geographically diverse HDHP population with and without saving accounts. In contrast to our study, it did not account for education levels in the SES stratification, the sample included members that self-selected into HDHPs, and study subjects had uncertain changes in mammography, Pap smear, and preventive visit cost-sharing, possibly accounting for the slightly different findings. Other studies of HDHPs and breast and cervical cancer screening have detected stable rates but have not examined vulnerable subpopulations.^{20,22,23} A 3-year study found no differences in breast or cervical cancer screening rates between HDHP members and preferred provider organization members by the third year.²²

Our data and previous studies indicate that exempting annual preventive or primary care visits and cancer screening from deductibles can preserve utilization among established managed care members, even as economic pressures force employers and publicly funded insurers to adopt high cost-sharing benefit structures.

The generalizability of our results should be substantial, but must be considered carefully. Although our sample

Table 3. Preventive Visits Among Women Eligible for Breast and Cervical Cancer Screening

	HDHP Group, mean (n)*			Control Group, mean (n)*			Change in Screening from Baseline to Follow-up vs. Control Group (95 % CI) †	
	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2	Year 1 vs. Baseline	Year 2 vs. Baseline
Breast Cancer Screening Cohort								
Low SES	0.53 (1445)	0.51 (1402)	0.49 (653)	0.53 (2787)	0.53 (2769)	0.49 (961)	-2.3 % (-9.9 %, 5.8 %)	2.3 % (-8.0 %, 13.8 %)
High SES	0.48 (444)	0.46 (426)	0.45 (190)	0.51 (862)	0.48 (812)	0.43 (259)	1.9 % (-11.9 %, 17.7 %)	10.1 % (-9.4 %, 33.7 %)
Age 40–49	0.56 (1001)	0.54 (976)	0.51 (463)	0.55 (1925)	0.56 (1957)	0.51 (702)	-4.1 % (-12.9 %, 5.7 %)	-1.0 % (-12.8 %, 12.5 %)
Age 50–64	0.51 (562)	0.48 (533)	0.48 (259)	0.49 (1072)	0.50 (1090)	0.45 (355)	-6.7 % (-18.9 %, 7.3 %)	5.0 % (-11.9 %, 25.1 %)
Cervical Cancer Screening Cohort								
Low SES	0.54 (883)	0.54 (869)	0.50 (394)	0.56 (1715)	0.55 (1679)	0.51 (606)	0.5 % (-8.8 %, 10.8 %)	1.0 % (-11.6 %, 15.3 %)
High SES	0.55 (2173)	0.54 (2114)	0.51 (918)	0.55 (4153)	0.55 (4118)	0.52 (1426)	-1.9 % (-8.9 %, 5.6 %)	-2.8 % (-12.1 %, 7.6 %)
Age 21–29	0.53 (751)	0.50 (707)	0.47 (280)	0.55 (1453)	0.51 (1365)	0.49 (435)	0.2 % (-11.4 %, 13.3 %)	-1.4 % (-18.1 %, 18.6 %)
Age 30–49	0.57 (1422)	0.56 (1407)	0.53 (638)	0.56 (2700)	0.57 (2753)	0.54 (991)	-3.0 % (-11.5 %, 6.4 %)	-3.6 % (-14.6 %, 8.7 %)
Age 50–64	0.65 (206)	0.66 (210)	0.57 (65)	0.60 (373)	0.59 (369)	0.66 (113)	3.0 % (-18.9 %, 30.9 %)	-22.1 % (-47.4 %, 15.4 %)
	0.54 (1120)	0.51 (1065)	0.50 (471)	0.55 (2188)	0.54 (2159)	0.52 (774)	-3.6 % (-14.0 %, 8.0 %)	-3.6 % (-17.1 %, 12.2 %)
	0.55 (847)	0.54 (839)	0.51 (382)	0.55 (1592)	0.55 (1590)	0.50 (539)	-0.8 % (-10.2 %, 9.6 %)	2.9 % (-10.1 %, 17.8 %)

*All visit rates are unadjusted.

†Adjusted differences in differences are from Poisson models with generalized estimating equations that included age, sex, employer category, index date, socioeconomic status, individual vs. family plan, and morbidity.

HDHP: high-deductible health plan; SES: socioeconomic status; n: number of visits

mostly comprised employees of small firms, 50 % of workers at small employers are enrolled in HDHPs (versus only 22 % at large employers)⁶ and small businesses employ half the US workforce.⁴⁴ As in our study, most small employers (85 %)⁶ offer only one choice of insurance type and they are less likely to offer savings account options (54 % of workers with HDHPs at small firms have no savings account option and even more have no savings account).⁶ Furthermore, the small employer market is experiencing the most rapid HDHP growth at approximately 7 % per year compared to 3 % per year in the large employer market.⁶ In addition, the HDHP we examined excluded the same cancer screening-relevant services from the deductible (preventive visits and testing) as nearly all HDHPs.⁶ Coverage of all primary care visits (as opposed to annual preventive visits alone) is also common among plans with deductibles.⁶ HMO-based HDHPs have been less common in the small employer market than those based on PPO or point of service (POS) arrangements.⁶ Our results might therefore have reduced generalizability if members in HMO compared to PPO/POS networks respond differently to fully covered services. Otherwise, our pre-post with comparison group study design should isolate the impact of the switch to HDHP coverage regardless of the network composition.

Our study has several other limitations. Several baseline characteristics in the study groups were statistically different due to our large sample size. However, substantively these differences were small, they did not

lead to statistically significant baseline differences in our outcomes of interest, and we controlled for them in logistic regression models. We were unable to assess cancer screening prior to the baseline year, likely leading to underestimation of true population screening rates. However, our HDHP and control groups were similar with regards to key demographic variables and insurance coverage at baseline, so rates of previous screening should also be similar. Our results largely apply to health plan members switching from traditional commercial insurance plans to HDHPs and this population is not broadly representative of very low SES populations. Finally, there was some attrition in our sample over the two years of follow-up, which limits our power to detect longer term differences. Attrition, however, was similar between the two groups.

In conclusion, our findings suggest that, among continuously enrolled women with employer-based insurance, HDHPs that fully cover mammography and Pap smears and have relatively low cost-sharing for primary care visits are not associated with reductions in preventive visit rates or cancer screening for up to two years. Consequently, such designs could serve as a model for policymakers hoping to transition populations to lower premium plans while preserving preventive care across the sociodemographic spectrum. Ultimately HDHPs must be assessed based on their benefits and unintended consequences to a multitude of stakeholders. While such a discussion is beyond the scope of this paper, future

research should examine long-term health and financial impacts on both HDHP members and broader society, especially given that many Americans are expected to have HDHPs in the coming decades.^{45,46}

Acknowledgment: The authors would like to acknowledge the helpful assistance with data collection of Irina Miroshnik, MS, of the Harvard Medical School and Harvard Pilgrim Health Care Department of Population Medicine. Dr. Wharam affirms that everyone who contributed significantly to the work is acknowledged here.

This study was funded by a grant from the Harvard Pilgrim Health Care Foundation.

Dr. Wharam presented interim results from this study on May 14, 2009 at the Society of General Internal Medicine national meeting in Miami, Florida

Conflict of Interest: The authors declare that they do not have a conflict of interest.

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