High-Deductible Insurance: Two-Year Emergency Department and Hospital Use

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Objectives: To determine the 2-year impact of high-deductible health plans (HDHPs) on high-acuity, expensive medical care.

Study Design: Retrospective pre-post, with propensity score–matched comparison group.

Methods: We studied emergency department visits, hospitalizations, and related expenditures among 15,847 HMO members for 1 year before and up to 2 years after an employer-mandated switch to HDHPs, compared with 15,847 propensity-matched controls who remained in HMOs. Members were aged 1 to 64 years and insured between 2001 and 2008.

Results: Emergency department visits among HDHP members declined by 15.0% and 15.7% from baseline to the first and second follow-up years, respectively (95% confidence intervals –21.1% to –8.4% and –24.1% to –6.4%, respectively). Rates of nonemergent visits declined significantly in both years (–19.6% [–28.2% to –9.9%] and –18.1% [–29.8% to –4.4%], respectively), while intermediate-severity visits declined to a lesser degree (–13.4% [–23.0% to –2.5%] in the first and –10.9% [–24.4% to 5.1%] in the second follow-up year). Reductions in emergent visits were not detectable in either the first or second follow-up year (–9.7% [–26.9% to 11.5%] and –15.3% [–36.8% to 13.3%], respectively). Hospitalization rates decreased in the first follow-up year (–22.8% [–33.8% to –10.0%]), but hospitalization and cost reductions were not detectable by the second follow-up year (–11.8% [–27.9% to 7.9%] and 1.9% [–22.2% to 33.4%], respectively).

Conclusions: HDHP members experienced sustained reductions in emergency department visits over 2 years, but reductions in hospital utilization and costs were not apparent by the second year. Longer-term studies that assess deferred utilization and its effects are needed.

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For author information and disclosures, see end of text.

Payers[1] and employers[2] are increasingly turning to high-deductible health plans (HDHPs) to control rising health care costs. Compared with traditional employer-based plans, HDHPs have relatively low premiums but subject most services to annual deductibles of at least $1000.[2] HDHPs have shown unprecedented growth[1]; membership tripled between 2006 and 2010[1] and 27% of workers now have HDHPs.[2] National health insurance reform could cause an "explosion"[3-5] in HDHP growth.

The effects of HDHPs on healthcare utilization, costs, and health are controversial. Some suggest that HDHPs will reduce inappropriate medical services, control cost trends, and improve health outcomes.[6-10] Others are concerned that HDHPs will decrease necessary healthcare, causing adverse health outcomes and increased longer-term costs.[11-15]

Prior studies including the RAND Health Insurance Experiment suggest that increased cost sharing reduces use of both appropriate and inappropriate health services, including hospitalizations,[16] essential medications,[17,18] and preventive services.[16,19] These effects may be associated with worse health outcomes.[16-20] In contrast, patients primarily reduce discretionary services when emergency department care is subject to cost sharing, and adverse outcomes have not been detected.[21-26]

A previous 1-year follow-up study of emergency department and hospital utilization after HMO members were switched into HDHPs found that HDHP members primarily reduced low-severity emergency department visits after an initial emergency department visit, and hospitalizations also declined.[25] We hypothesized that care patterns among HDHP members in their second year of experience would be a better indicator of longer term utilization than year 1 patterns because of the "learning curve" that occurs under HDHPs.[25]

METHODS

Setting

Harvard Pilgrim Health Care insures approximately 1 million individuals in the Northeast. In April 2002, Harvard Pilgrim began offering HDHPs with $500 to $2000 individual annual deductibles. Members of family plans also have family deductibles equal to twice their individual deductible. Full coverage begins for individuals when they exceed their in-

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dividual deductible or for family members when the family's combined expenses exceed the family deductible. Most institution-based services (eg, 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). When HDHP member spending is below the deductible, healthcare providers bill patients directly at health plan–negotiated rates including for costs of emergency department care. After members exceed the deductible spending level, they have a $100 copayment for emergency department care that is waived if they are hospitalized. Employers purchasing the HDHPs may opt to combine them with a Health Reimbursement Arrangement. This allows employers to place money into an account to reimburse employees for out-of-pocket health expenses.

The traditional HMO members we included had varying in-network emergency department and outpatient copayments (between $30-$100 and $5-$25, respectively). Inpatient copayments ranged from $0 to $1000 with a median of $250.

Take-Away Points

This is the first study to examine the longer-term impact of high-deductible health plans on high-acuity, expensive medical care. Policy makers should consider closely monitoring enrollees for unintended consequences of cost sharing.

- High-deductible health plans are expanding at unprecedented rates.
- High-deductible health plan members who remained enrolled for up to 2 years had fewer, mostly nonemergent visits to the emergency department.
- Initial large reductions in hospital utilization among high-deductible health plan members diminished by the second year.

Study Groups

HDHP Group. We identified Massachusetts members aged 1 to 64 years insured by Harvard Pilgrim between April 1, 2001, and February 28, 2008, with at least 1 year of continuous enrollment in a traditional HMO plan followed by at least 6 months in the HDHP. We chose members whose employers offered only a single health plan and who remained with the same employer for the entire period. Members were therefore unable to self-select their health plan. We included members from employers who bought plans directly from Harvard Pilgrim as well as from employers who purchased Harvard Pilgrim plans from independent brokers ("association" plans). We excluded members from employers that offered health plans from other insurers. This left an initial HDHP cohort of 16,472 members. We identified an index date for each member (the HDHP switch date), a 12-month baseline period, and a 6- to 24-month follow-up period.

We excluded 125 members with missing descriptive data including geocoded education and poverty levels, family versus individual insurance plan, employer category, baseline copayment levels, and whether the employer offered health insurance exclusively through Harvard Pilgrim.

HMO Group. To identify a control group, we first developed a pool of Harvard Pilgrim members from Massachusetts employers who were enrolled in traditional HMO plans during the same April 2001 to February 2008 eligibility period and whose employers did not offer the choice to enroll in an HDHP, any other Harvard Pilgrim benefit type plan, or plans from insurers other than Harvard Pilgrim for at least 18 months during their eligibility. We matched 8 members from this control pool to the HDHP member sample (before the exclusions above) based on contemporaneous enrollment, adult/child status, and whether the member was in an association plan. Each matched control member was then assigned the same index date and had the same baseline and follow-up periods as the matched HDHP member.

From this initial 111,014-member control pool we excluded 881 members with missing descriptive data and 13,590 members (12.2%) whose employers added a small deductible ($50-$100) or increased emergency department copayments at the index date. In addition, we censored the experience of 5810 control members after their first follow-up year because their employers added a small deductible or increased emergency department copayments in the second follow-up year. After these exclusions, the control pool comprised 96,543 members.

Propensity Score Matching. We then created propensity score models that predicted the likelihood of enrolling in an HDHP versus remaining in a traditional HMO after the baseline year. Propensity score matching is a well-established method for generating a control group with a similar likelihood of being exposed to a given "intervention" (in this case, shifting to HDHP coverage) based on measured characteristics when individuals have not been randomly allocated into study groups.[27-30]

In preparation for propensity score matching, we determined the variables that predicted employer choice into an HDHP in the overall cohort. We found that all variables we tracked (age; sex; Adjusted Clinical Groups morbidity[31]; family vs individual plan; census-block education and poverty level; employer type; baseline outpatient, emergency department, and hospital copayment levels; year of index date; and baseline member and health plan expenditures) predicted the choice of an HDHP at a statistically significant level.

We matched HDHP members to HMO members using 1 to 1 caliper matching without replacement.[30] Caliper matching selects the control with the propensity score closest to

that of the case, but only if the control's score is within a predefined distance (caliper) of the case.[30] Therefore, cases might not be matched to any controls; those cases would be dropped from the sample to avoid inappropriate matches. Caliper matching "without replacement" does not allow selecting the same control as a match more than once.[30] We used a caliper width equal to 0.6 of the pooled standard deviation of the propensity score, which has been found to eliminate the majority of bias due to measured confounding variables.[30,32]

Our final study group included 15,847 HDHP members and their matched controls.

Emergency Department Utilization

We identified emergency department claims from Harvard Pilgrim's claims database and used a validated[25,26] modification of the emergency department visit classification algorithm of Billings and colleages[33] to categorize visit severity as nonemergent, intermediate, or emergent. This algorithm and a method of developing clinically meaningful visit clusters using Clinical Classifications Software[34] have been described in a previous report.[25] To determine emergency department costs, we summed annual expenditures paid by members and Harvard Pilgrim for members' emergency department use.

Hospital Utilization

We identified hospitalizations based on health insurance claims, and we calculated length of hospital stay. We excluded hospitalizations with the same admission and discharge date because these represent day procedures or surgeries such as colonoscopy or hernia repair. Multiple studies have used hospitalization rates or length of stay as proxy measures of patient morbidity.[18,20,22,24,35-37] We calculated mean length of stay and summed annual hospitalization days per member. To assess whether members deferred needed ambulatory care, we measured ambulatory care–sensitive hospitalizations using the Agency for Healthcare Research and Quality Prevention Quality Indicators algorithm.[38,39] Prevention Quality Indicators detect *International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)* codes indicating potentially preventable hospitalizations for 14 conditions.[38] Prevention Quality Indicators have been used in multiple academic studies.[40,41]

We calculated annual hospital expenditures by summing the amounts paid by members and Harvard Pilgrim for all claims during members' hospitalization dates after excluding emergency department and outpatient claims. We assigned hospitalizations spanning a study year to the previous year.

Control Variables

To estimate comorbidity, we applied the Adjusted Clinical Group algorithm to each member's 12-month baseline period. The Adjusted Clinical Group score is based on age, sex, and *ICD-9-CM* diagnostic codes derived from claims. It calculates a morbidity weight standardized across a reference population of adults and children.[31,42] Average morbidity is 1.0 and persons with more comorbidities have higher scores.

To derive proxy measures of socioeconomic status, we linked members' residential addresses to their 2000 US Census block group[43] and created previously established variables measuring education and poverty status.[44] We used a principal components approach to calculate a neighborhood socioeconomic status index based on census block levels of poverty and high school education. This approach creates a single variable from correlated variables[45] and has been validated as a measure of socioeconomic status.[46] We calculated baseline year total expenditures for each member by summing the amounts paid by Harvard Pilgrim and members for all claims. Other covariates included age, sex, employer category (based on number of employees and whether members were in association plans), and whether members were in individual or family plans.

Statistical Analyses

We compared baseline characteristics of our study groups using χ^2 tests and *t* tests. To determine whether longer follow-up duration and differential dropout might bias results, we used *t* tests to compare baseline emergency department visits, hospitalizations, and total costs for HDHP and control members with at least 18 months of follow-up. We used a difference-in-differences analytic framework to examine changes in the outcomes of interest in the HDHP group compared with the control group from baseline to the first and second follow-up years. Difference-in-differences analyses subtract the pre-post difference in outcomes in the intervention group from the pre-post difference in outcomes in the control group.

In the overall cohort, we analyzed annual rates of emergency department visits as well as those classified as nonemergent, intermediate severity, and emergent; the 5 most common clinical clusters (combined) of classified emergency department visits; annual overall and ambulatory care–sensitive hospitalizations; and annual hospitalization days among the groups in the baseline, first, and second follow-up year. We also examined total annual expenditures for emergency department visits and hospitalizations in the overall cohort. We calculated lengths of hospital stay among hospitalized members.

We then used Poisson regression to model the independent association between HDHP status and these outcomes

Table 1. Baseline Characteristics of the High-Deductible Health Plan and Control Groups

Characteristic	HDHP Group (n = 15,847)	Control Group (n = 15,847)	*P*
Age on index date, No. (%)			.19
1-4 y	764 (4.8)	684 (4.3)	
5-18 y	2963 (18.7)	2963 (18.7)	
18-44 y	5875 (37.1)	5897 (37.2)	
45-64 y	6245 (39.4)	6303 (39.8)	
Female, %	8112 (51.2)	8087 (51.0)	.78
In family plan, %	10,909 (68.8)	10,919 (68.9)	.90
Employer size, No. (%)			.05
>1000 employees, nonassociation[a]	199 (1.3)	191 (1.2)	
251-999, nonassociation	1024 (6.5)	906 (5.7)	
51-250, nonassociation	3114 (19.7)	3079 (19.4)	
2-50, nonassociation	4440 (28.0)	4562 (28.8)	
2-9, association	7070 (44.6)	7109 (44.9)	
Diabetes, No. (%)	347 (2.2)	310 (2.0)	.15
Asthma, No. (%)	302 (1.9)	318 (2.0)	.52
Hypertension, No. (%)	902 (5.7)	863 (5.5)	.34
Adjusted Clinical Groups score, mean (SD)	0.9 (1.5)	1.0 (1.6)	.50
No. (%) living in neighborhoods with			<.001
<5% below poverty	8959 (56.5)	9221 (58.2)	
5%-9.9% below poverty	4024 (25.4)	3886 (24.5)	
10%-19.9% below poverty	2166 (13.7)	1987 (12.5)	
≥20% below poverty	698 (4.4)	753 (4.8)	
No. (%) living in neighborhoods with			.01
<15% with <high school education	12,160 (76.7)	12,040 (76.0)	
15%-24.9% with <high school education	2401 (15.2)	2406 (15.2)	
25%-39.9% with <high school education	940 (5.9)	1086 (6.9)	
≥40% with <high school education	346 (2.2)	315 (2.0)	
Emergency department copayment, No. (%)			<.001
$30	1317 (8.3)	1457 (9.2)	
$50	12,263 (77.4)	12,334 (77.8)	
$75	1214 (7.7)	1068 (6.7)	
$100	1053 (6.6)	987 (6.2)	
Outpatient copayment, No. (%)			<.001
$5	621 (3.9)	719 (4.5)	
$10	3212 (20.3)	3347 (21.1)	
$15	5662 (35.7)	5232 (33.0)	
$20	5551 (35.0)	5865 (37.0)	
$25	801 (5.1)	684 (4.3)	
Inpatient copayment, $, mean (SD)[b]	297.60 (220.80)	299.60 (230.40)	.43
Mean annual expenses, $, mean (SD)	2681 (10,828.80)	2802.8 (12,585.90)	.36

HDHP indicates high-deductible health plan.
[a]Association plans are sold to employers by independent brokers.
[b]For members who had daily inpatient copayments rather than a single copayment covering an entire hospitalization, we multiplied their daily copayment by the median baseline hospitalization duration of 3 days to derive a single hospitalization copayment per member.

after controlling for the aforementioned covariates. Poisson regression is used to generate results adjusted for covariates when analyzing count outcomes that have skewed distributions. We included the index date in models to adjust for secular utilization trends. Because some members had partial-year follow-up, we also adjusted for follow-up duration. Two-part modeling can be used to model the 2-step process of deciding whether to use healthcare and how much to use, but we used 1-part general linear modeling because of key advantages when examining healthcare utilization, including predictions that are not biased by heteroscedasticity and coefficients that are easier to interpret.[47] Therefore, all statistical models used generalized estimating equations[48,49] to adjust for clustering of events within individuals between the baseline and follow-up years 1 or 2. Analyses were performed using SAS version 9.2 software (SAS Institute Inc, Cary, North Carolina).

The study was approved by the Harvard Pilgrim Health Care Institutional Review Board.

RESULTS

Baseline Characteristics

Study groups had similar age distributions, with 77% of members aged 18 to 64 years (Table 1). The sample was evenly divided by sex, and most members in both groups were in family insurance plans (HDHP group, 68.8%; control group, 68.9%, $P = .90$). Cohort members mostly worked for small employers receiving health coverage through association plans (HDHP group, 44.6%; control group, 44.9%), small nonassociation employers (HDHP group, 28.0%; control group, 28.8%), or mid-sized nonassociation employers (HDHP group, 19.7%; control group, 19.4%, $P = .05$). There were no clinically significant differences in the Adjusted Clinical Groups score; in rates of diabetes, hypertension, and asthma; or in socioeconomic status measures. HDHP and control members had mean follow-up durations of 1.44 and 1.31 years, respectively ($P < .001$), but there were no differences in baseline emergency department visits, hospitalizations, or total costs among members with at least 18 months of follow-up ($P = .39$, .76, and .41, respectively, data not shown).

Baseline emergency department copayments were $30 and $50 for 8.3% and 77.4% of HDHP members, respectively, and 9.2% and 77.8% of control members ($P < .01$). The percentages of HDHP members with outpatient copayments of $10, $15, and $20 were 20.3%, 35.7%, and 35.0%, respectively, compared with 21.1%, 33.0%, and 37.0% among controls ($P < .01$). Between the baseline and follow-up years, control group members had unchanged emergency department copayments while mean outpatient copayments were $15.80, $16.40, and $16.50, respectively (data not shown). HDHP members had mean outpatient copayments of $15.90 at baseline and $20 in the follow-up years. The average inpatient copayment for HDHP members in the baseline period was $297.60 compared with $299.60 in the control group ($P = .43$). This copayment increased to $324.30 and $330.80 for controls in follow-up years 1 and 2, respectively.

Emergency Department Utilization

Table 2 displays unadjusted values for emergency department and hospital utilization and related costs for the HDHP and control group at baseline and in the follow-up periods. It also shows the change in these values in year 1 compared with baseline and in year 2 compared with baseline after adjusting for differing baseline characteristics of the groups. The HDHP and control groups had similar emergency department visit rates at baseline (213.6 vs 208.5 visits per 1000 members, respectively, $P = .44$). After adjusting for the covariates above, HDHP members experienced significant relative reductions in emergency department visits of 15.0% and 15.7% from baseline to the first and second follow-up years, respectively (95% confidence intervals [CIs] −21.1% to −8.4% and −24.1% to −6.4%, respectively). These reductions were greatest for nonemergent visits (−19.6% in year 1 [−28.2% to −9.9%] and −18.1% in year 2 [−29.8% to −4.4%] compared with baseline), while intermediate-severity visits dropped to a lesser degree (−13.4% [−23.0% to −2.5%] in year 1 and −10.9% [−24.4% to 5.1%]) in year 2). Reductions in emergent visits were not detectable in either follow-up year 1 or 2 (−9.7% [−26.9% to 11.5%] and −15.3% [−36.8% to 13.3%], respectively).

Emergency department expenditures among HDHP members relative to controls declined significantly by 15.9% (95% CI −23.9% to −7.1%) and 16.6% (−27.8% to −3.8%) from baseline to the first and second follow-up years, respectively.

Table 3 shows unadjusted values for the top 5 most common emergency department visit reasons by severity category among HDHP members and control members at baseline and in the follow-up periods, as well as adjusted relative changes that were experienced by the HDHP group. At baseline, visits in the 5 most common diagnostic clusters represented 37.5%, 58.0%, and 47.7% of visits in the nonemergent, intermediate-severity, and emergent categories, respectively. Aggregate changes experienced by the HDHP group in these visit clusters were similar to changes in overall nonemergent, intermediate, and emergent visits (Table 3).

Hospital Utilization

Annual hospitalization rates were similar at baseline in the HDHP and control groups (55.2 and 55.0 per 1000, respectively; $P = .97$, Table 2). After controlling for covariates,

Table 2. Emergency Department and Hospital Visit Rates and Expenditures Among HDHP Members and HMO Control Members

	HDHP Group[a]			Control Group[a]			Change From Baseline to Follow-up, HDHP Group vs Controls, % (95% CI)[b]	
ED Visit or Hospitalization	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2	Year 1 to Baseline	Year 2 to Baseline
ED visits per 1000 members (total No. of visits)	213.6 (3385)	197.6 (2977)	185.6 (1429)	208.5 (3304)	227.4 (3391)	215.5 (1205)	−15.0 (−21.1 to −8.4)	−15.7 (−24.1 to −6.4)
Nonemergent	87.1 (1381)	77.5 (1168)	72.9 (561)	84.3 (1336)	93.5 (1395)	86.6 (484)	−19.6 (−28.2 to −9.9)	−18.1 (−29.8 to −4.4)
Intermediate severity	80.0 (1267)	72.9 (1099)	70.1 (540)	77.9 (1235)	82.3 (1227)	76.7 (429)	−13.4 (−23.0 to −2.5)	−10.9 (−24.4 to 5.1)
Emergent	22.5 (356)	21.4 (322)	19.9 (153)	22.5 (357)	23.8 (355)	23.6 (132)	−9.7 (−26.9 to 11.5)	−15.3 (−36.8 to 13.3)
Unclassified	24.0 (381)	25.8 (388)	22.7 (175)	23.7 (376)	27.8 (414)	28.6 (160)	−8.2 (−25.6 to 13.2)	−21.5 (−40.6 to 3.6)
Mean ED expenditures per member, $	104.6	109.8	111.8	96.6	120.8	121.7	−15.9 (−23.9 to −7.1)	−16.6 (−27.8 to −3.8)
Hospitalizations per 1000 members (total No. of hospitalizations)	55.2 (874)	48.3 (728)	51.4 (396)	55.0 (872)	62.6 (933)	58.3 (326)	−22.8 (−33.8 to −10.0)	−11.8 (−27.9 to 7.9)
ACS hospitalizations	3.4 (54)	3.7 (56)	1.7 (13)	2.6 (41)	3.4 (51)	3.8 (21)	−17.1 (−55.9 to 56.0)	−67.8 (−86.0 to −26.1)
Hospitalization days per 1000 members (total No. of hospital days)	230.5 (3652)	205.0 (3088)	229.3 (1765)	250.3 (3966)	273.8 (4083)	254.0 (1420)	−18.6 (−34.8 to 1.7)	−2.8 (−27.1 to 29.7)
Mean duration of hospitalization, d[c]	4.2	4.5	5.4	4.5	4.6	5.7	5.9 (−8.9 to 23.1)	8.7 (−8.9 to 29.8)
Mean hospital expenditures per member, $	722.7	797.2	925.0	754.0	944.2	933.9	−11.8 (−27.8 to 7.8)	1.9 (−22.2 to 33.4)

ACS indicates ambulatory care sensitive; CI, confidence interval; ED, emergency department; HDHP, high-deductible health plan.
[a]Unadjusted rates.
[b]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.
[c]Calculated among members with overnight hospitalizations.

the HDHP group experienced a significant 22.8% (95% CI −33.8% to −10.0%) relative reduction in hospitalization rates in the first follow-up year, but a reduction that was not statistically significant by the second follow-up year (−11.8% [−27.9% to +7.9%]). Hospitalization days also trended down in year 1 (−18.6% [−34.8% to 1.7%]) but were unchanged by year 2 (−2.8% [−27.1% to +29.7%]). Ambulatory care–sensitive hospitalizations among HDHP members compared with controls decreased by 17.1% (−55.9% to +56.0%) in the first follow-up year and 67.8% (−86.0% to −26.1%) in the second follow-up year, with the change in year 2 being statistically significant. Lengths of hospital stay were statistically unchanged among HDHP members in both follow-up years (5.9% [−8.9% to +23.1%] and 8.7% [−8.9% to +29.8%], respectively). HDHP members experienced a statistically nonsignificant decrease in hospital expenditures in the first follow-up year (−11.8% [−27.8% to +7.8%]); in the second follow-up year, hospital expenditures for HDHP members were unchanged (1.9% [−22.2% to +33.4%]).

DISCUSSION

We examined emergency department and hospital utilization among HDHP members as they continued into their second enrollment year. Patients, physicians, and policy makers would benefit from understanding whether HDHPs cause deferral of essential care, ultimately increasing morbidity and costs. We found that HDHP members reduced emergency department visits and expenditures by about 15% and selectively reduced nonemergent visits by approximately 20% in both follow-up years. In contrast, initial reductions in hospital utilization among HDHP members diminished by the second follow-up year.

Similar to results of this analysis, a previous 1-year follow-up study reported that HDHP members insured through early

Table 3. Top 5 Most Common Emergency Department Visit Reasons by Severity Category Among HDHP Members and HMO Control Members

Reason for ED Visit	ED visits per 1000 Members (Total No. of Visits)[a]						Change From Baseline to Follow-up, HDHP Group vs Controls, % (95% CI)[b]	
	HDHP Group			Control Group				
	Baseline	Year 1	Year 2	Baseline	Year 1	Year 2	Year 1 to Baseline	Year 2 to Baseline
Top 5 nonemergent conditions (upper respiratory tract infections, joint pain and swelling, low-severity injuries, back and neck pain, pain and swelling in limbs)	34.1 (541)	29.1 (439)	27.3 (210)	32.0 (507)	35.8 (534)	34.8 (219)	−23.5 (−36.0 to −8.6)	−26.5 (−41.9 to −7.2)
Top 5 intermediate-severity conditions (chest pain, external open wounds, abdominal pain, superficial injuries, sprains and strains)	46.9 (743)	39.2 (591)	40.8 (314)	45.1 (714)	45.1 (672)	38.8 (244)	−16.2 (−28.2 to −2.%)	0.9 (−18.8 to 25.4)
Top 5 emergent conditions (asthma, urinary tract stones and renal colic, cardiac arrhythmias, open head wounds, high-severity injuries)	10.9 (173)	9.7 (146)	8.3 (64)	10.0 (158)	9.8 (146)	9.4 (59)	−9.2 (−34.0 to 25.0)	−18.2 (−47.9 to 28.3)

CI indicates confidence interval; ED, emergency department; HDHP, high-deductible health plan.
[a]Unadjusted rates.
[b]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.

adopting employers experienced reductions in low-severity emergency department visits and hospitalizations but not in emergent visits.[25] A smaller study found large reductions in emergency department use among HDHP members in their first or second year of experience, although visits were not categorized by severity.[50] Other studies including the RAND Health Insurance Experiment have demonstrated selective reductions in low-severity emergency department visits[21-26] and reductions in hospital use[16,51-53] related to cost sharing. A recent 1-year follow-up study by Beeuwkes Buntin and colleagues found that inpatient spending declined among HDHP employers although emergency department spending was unchanged.[54]

These longer-term results add several new insights and suggest areas for further investigation. The sustained reductions in emergency department visits and selective decreases in nonemergent visits indicate that HDHPs might be an effective tool for curtailing inappropriate emergency department use in the longer term. Stability in lengths of hospital stay among HDHP members over 2 follow-up years might indicate that morbidity did not increase, but the upward trend in hospitalization days between the first and second follow-up years could also suggest that HDHP members initially deferred needed care and therefore required more hospital care by year 2. Furthermore, the rebound in hospital utilization calls into question whether HDHPs alone will "bend the curve" of high-cost utilization and lead to flat or downward cost trends. Future studies should determine whether hospital utilization among HDHP members continues to climb after the second follow-up year. Hibbard and colleagues found that members who transitioned from preferred provider organization plans to HDHPs experienced an initial decline in outpatient visits followed by a rebound in utilization.[55]

Our results have implications for policy makers overseeing the recently enacted Patient Protection and Affordable Care Act. This legislation aims to reduce healthcare spending and expand insurance coverage,[56] and is expected to accelerate HDHP adoption.[3-5] The HDHP designs and deductible levels we examined might not have the desired long-term impact on costs, although policy makers might still view "one-time" emergency department cost reductions (an initial drop in growth that then continues at previous rates) as at least better than the continued high growth rates among traditional health plans. Alternative benefit designs or additional policies among the commercially insured might be needed to control healthcare cost inflation. In the meantime, policy makers should carefully monitor HDHP populations for evidence of deferred care and adverse outcomes.

Our study has several limitations. Employers might have chosen plans based on knowledge of employees' health plan preferences, health status, or prior expenditures. Our use of propensity score matching that included employer and em-

ployee characteristics, however, should have minimized this bias. Furthermore, we reduced the larger problem of member self-selection by restricting the study population to individuals who had only a single choice of plan in the follow-up period. Sample size limited our ability to examine key subgroups that might be driving utilization patterns in the second follow-up year, such as members with low socioeconomic status and high morbidity. The data do not represent individuals working for larger employers, many of whom self-insure, or those with choices of health plans. However, HDHP uptake is increasing especially rapidly among small employers,[2] so our findings are relevant to a major segment of the health insurance industry. Finally, we did not have an accurate method of determining whether employers offered Health Reimbursement Arrangements, but uptake was likely quite low among these small employers.

CONCLUSIONS

Our longer term results demonstrate that decreases in emergency department use persist but that first-year reductions in hospital utilization diminish by the second year of HDHP experience. It will be important to determine whether the reduced impact on hospital use might be due to deferred emergency department care in the first follow-up year.

Policy makers and health insurance decision makers should monitor for adverse utilization patterns under HDHPs and proactively identify patients at risk of deferring appropriate care. Future studies should follow HDHP members into their third year of experience and examine utilization among large employers.

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