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Triple Aim and the Hospital Readmission Reduction Program

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Abstract

Objectives: Despite substantial attention on hospital readmission rates, the impact of the Hospital Readmission Reduction Program (HRRP) on a comprehensive set of Triple Aim goals has not been studied: improve hospital quality, reduce cost, and improve patient experience.

Methods: We analyze inpatient claims data from 2006 to 2015 from the Dallas Fort Worth Hospital Council Foundation with a panel of 27,397 patients with chronic obstructive pulmonary disease and congestive heart failure. We deploy a quasi-natural experiment using a difference-in-difference specification to estimate the effect of HRRP effect on readmission rates, length of stay (LOS), and hospital satisfaction.

Results: We find that the likelihood of 30-day readmissions declined by 2.6%, average LOS decreased by 7.9%, and overall hospital rating increased by 2.1% among hospitals that fell under the scope of the HRRP, compared to non-HRRP hospitals. Our results provide evidence of a spillover effect of the HRRP in terms of its impact not only on Medicare patients, but across all insurance types, and other performance measures such as cost and patient experience.

Conclusion: Our findings indicate that HRRP hospitals do not trade-off reductions in readmission rates with lower quality across other patient health outcomes. Rather, we find evidence that the HRRP has affected all 3 dimensions of the Triple Aim with respect to patient and hospital outcomes.

Keywords

Hospital Readmission Reduction Program, readmission, length of stay, patient satisfaction, triple aim

Introduction

The Centers for Medicare and Medicaid Services (CMS) established the Hospital Readmission Reduction Program (HRRP) in 2012, under Section 3025 of the Affordable Care Act (ACA), with a focus on reducing excessive hospital readmissions.[1] The HRRP mandates CMS to reduce payments to hospitals with excessive readmission rates. Initially, the program covered heart attack, congestive heart failure (CHF), and pneumonia, but was soon expanded to include other chronic conditions, such as chronic obstructive pulmonary disorder (COPD). In 2013, two-thirds of U.S. hospitals were penalized by 1% of overall Medicare reimbursements. CMS increased this penalty up to 2% in 2014, and up to 3% from 2015 onward. In 2019 alone, 2,583 hospitals were penalized for a total amount of $566 Million.[2] Considering that hospitals typically operate on an average gross margin of 5-7%, the financial penalty imposed by the HRRP policy is substantial.[3]

In this study, we evaluate the efficacy of HRRP based on its impact on the Triple Aim goals. The Triple Aim initiative was introduced by the Institute for Healthcare Improvement, building upon 3 interdependent pillars of healthcare: quality of

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population health, cost of care, and individual experience of care.[4] Prior research has used the Triple Aim to evaluate interventions that support development and use of patient self-management programs,[5,6] mental health treatment programs,[7] care transitions,[8] accountable care organizations,[9] and telehealth.[10]

Despite substantial efforts to reduce hospital readmission rates, the impact of the HRRP on the Triple Aim has not been studied in a unified manner. In this study, we analyze whether the HRRP achieved its intended Triple Aim goals, with respect to improvements in patient quality of care, reductions in cost, and improvements in patient experience, since it is important for policymakers to pursue synergies across these inter-dependent objectives. The HRRP has been criticized for only incentivizing hospitals to reduce readmission rates at all costs, but not for having mechanisms to enforce improvements in other important areas of healthcare delivery, such as patient safety and experience.[11] Since achieving the Triple Aim objectives may require hospitals to make significant tradeoffs, we investigate whether the HRRP had a significant impact on all 3 measures—healthcare quality, cost, and patient experience—simultaneously.[12]

New Contributions

While a substantial body of research has studied HRRP mostly for its impact on quality outcomes (such as 30-day readmission rates),[13,14] the prior literature has not comprehensively studied the impact of HRRP on inter-dependent dimensions of health care performance (such as cost and patient experience).[15,16] To address this research gap, we perform a holistic assessment of the HRRP initiative to understand whether it achieved the Triple Aim objectives. A recent study by Ferro et al.[17] compared patient readmission rates after HRRP implementation, and observed that, since going into effect in 2012, readmissions have declined for patients with acute myocardial infarctions, pneumonia and heart failure. However, their study focused specifically on readmission rates, and not on the cost and patient satisfaction dimensions of the Triple Aim. Our study extends their findings to include additional dimensions that provide a more holistic perspective of hospital performance, going beyond readmission rates alone. By doing so, we are able to assess whether hospitals tradeoff improvements in readmission rates against other dimensions, such as costs and patient satisfaction, in order to avoid HRRP readmission penalties. Further, our study addresses the potential challenges of solely using patient readmission rates as a yardstick to measure hospital performance.

Methods

Data Source

We obtained our primary data from the Dallas Fort Worth Hospital Council (DFWHC) Research Foundation, spanning an overall sample of 63,479 patients with their inpatient visits across 68 non-federal hospitals in North Texas, tracked across a 10-year period between 2006 and 2015. Patient visits across multiple hospitals are tracked using a regional master patient index allowing us to obtain the patient's readmission history and patterns of patient care across multiple hospitals in the region. This is a significant improvement over previous studies that were restricted to using readmission data from hospitals within a single health system, with limited scope due to their sample size or focus on a specific class of patients.[18]

We also draw on data from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS)—a patient satisfaction survey required by CMS for all hospitals in the U.S. HCAHPS provides a national, standardized survey on patient perspectives of hospital care,[19] measuring patient hospital experience such as their communication with nurses and doctors, responsiveness of hospital staff, and overall hospital rating. We matched the hospital data on patient experience and satisfaction with the patient claims data from DFWHC.

Outcome Measures

We assessed 3 measures to proxy for the Triple Aim dimensions: 30-day hospital readmission rate, length of stay (LOS), and patient satisfaction. Readmission rate reflects the quality of healthcare delivery because care delivered at the index hospital determines the risk of being readmitted within a 30-day period.[20] LOS has been shown to be positively correlated with health care costs and resource utilization.[21-23] Finally, our proxy for patient satisfaction assesses the extent of patient interaction and experience with their care providers and the intensity of patient-provider engagement.[6,24,25]

In this research, we focus on patients diagnosed with COPD and CHF, since they represent 2 major chronic diseases monitored by CMS, and together account for more than 800,000 deaths in the United States in 2018 alone.[26] Following convention, we calculated 30-day readmissions by identifying all-cause readmissions with respect to the index hospitalization. The 30-day readmission variable is equal to one if a previously diagnosed patient is admitted to any regional hospital within 30 days of being discharged from the index hospital. The LOS for each admission is calculated as the difference between the discharge and admission dates, measured in days. Patient experience is measured based on whether patients rate their hospital with a score of 9 or 10, on a 10-point scale, leveraging the patient satisfaction question in the HCAHPS survey.

Covariates

We included several covariates that account for differences in patient, admission, and hospital-specific factors. While these covariates have been commonly used in the literature, they also mimic the factors conceptualized in Andersen's behavioral model of health services use framework.[27] First, we included patient demographics such as age, gender and race, i.e. proxying Andersen's predisposing factor. Next, for each admission, we defined patient disease severity across 2 levels: "major to

extreme" or "minor to moderate," i.e. proxying Andersen's individual need factor. Further, we recorded payer information based on 4 categories: Private, Medicaid, Medicare (Part A & B), and Uninsured, i.e. proxying Andersen's financial enabling factor. Finally, we classified providers based on their teaching status, geographic locations (urban, rural), patient case mix index (CMI), wage index, and facility size (number of beds).

Sample

We created our sample using a 2-step matching strategy to account for hospital- and admission-level confounding factors. In the first step, we followed a matching strategy to categorize hospitals into treatment and control groups as part of our difference-in-difference (DID) specification. Hospitals subject to HRRP penalties comprise our treatment group, whereas those not subject to HRRP penalties, such as children's, veterans affairs, critical access hospitals, and psychiatric facilities, constitute the control group,[28] which comprises 14 hospitals based on our sample. For each control hospital, we followed a matching strategy to identify 2 most similar hospitals from the treatment group. In the second step, we performed a second matching procedure to match patient admissions of control hospitals to admissions of treatment hospitals. We adopted a propensity score matching procedure and used the algorithm developed by Rosenbaum[29] to match providers between treatment and control groups as well as their admissions, utilizing the SAS macro developed by Mayo Clinic.[30] Our hospital matching strategy included provider controls, such as geographic locations (urban, rural), patient case mix index (CMI), wage index, and facility size (number of beds), whereas the admission matching strategy covered patient demographics (age, gender, race) and several other admission characteristics (e.g., insurance, severity, risk mortality, admission type—elective vs emergency). Our 2-step matching strategy resulted in 14 control and 28 treatment hospitals with a panel of 27,397 patients with 51,239 index hospitalizations.

Statistical Analysis

First, we study the impact of HRRP on Triple Aim as reflected through hospitals' quality, cost, and patient experience outcomes. Next, we use a quasi-natural experiment using a DID specification to compare the *Treatment* and *Control* groups of hospitals, where the treatment effect is measured against a control group, in the pre- and post-treatment periods. This specification addresses potential confounding effects of unobserved factors and time-invariant treatment effects.[31] We examined the average 30-day readmission rate, LOS, and patient satisfaction in pre- and post-intervention periods, i.e. before and after 2012 when HRRP went into effect[32] (i.e. indicator variable = 1 after 2012), across treatment and control hospitals (i.e. indicator = 1 for HRRP hospitals). Next, we examined the DID coefficients of the 3 Triple Aim measures and applied statistical t-tests to check whether these differences across treatment and control groups, before and after enactment of the HRRP, are significant.

To further account for hospital, patient and visit-level confounding factors, we estimated a regression model (1) that includes *HRRP*, *Post*, and *HRRP*Post* as independent variables along with the control variables, as described in Covariates subsection.

$$TripleAimGoal_{it} = \beta_1 HRRP_{ht} + \beta_2 Post_{ht} + \beta_3 HRRP * Post_{ht} + Controls_{iht}\beta + \in_{iht} \quad (1)$$

where *i* indicates patient, *h* indexes hospital, and *t* refers to the observation year. The DID coefficient as captured by the interaction term *HRRP*Post* is of primary interest. For *TripleAimGoal* outcome measures, we include 30-day readmission, LOS, and patient experience. We model 30-day readmission with a logistic regression specification, whereas LOS and patient experience measures are estimated using Ordinary Least Squares (OLS) with robust standard errors. We also conducted several sensitivity analyses, as reported in Robustness Test subsection below.

Results

Sample Statistics

We report descriptive statistics of our patient population in Table 1. The average readmission rate of the chronic disease patients in our study population is 15.7% and their average LOS is 5.1 days. The average charge is $43.1 K, with an average hospital rating (9 or 10) of 67.8%. Our sample consists of 56.0% Medicare, 8.0% Medicaid, 25.0% private insurance, and 11.0% uninsured (or self-pay) patients. 60% of patients in our data are female, their average age is 67.3 years, and 76% are of Caucasian origin, while African-Americans account for 18% of the sample. Patients with minor or moderate disease severity index comprise 54% of our sample. Our sample shows that 98% of admissions are from urban hospitals and 41% are from teaching hospitals. The average case mix index was 1.61, average wage index was 0.97, and average number of hospital beds was 326.6.

We plot the average 30-day readmission rates of HRRP and non-HRRP targeted hospitals over 10 years along with their standard errors in Figure 1. Prior to 2012, both treatment and control hospitals had similar trends across years, while the average readmission rates started diverging after 2012. As readmission rates in the treatment group continued to decline, patients in the control group experienced a slight increase in their readmission rates.

Table 2 shows the average readmission rates, LOS, and hospital rating before and after 2012 (i.e. when HRRP became effective), across HRRP (treatment) and non-HRRP (control) hospitals. The column labeled "DID" shows the model-free DID results. We observe a significant 2.4% reduction ($p < 0.01$) in 30-day readmission rates of HRRP hospitals after 2012, compared to non-HRRP hospitals. Our results also show a significant reduction of 0.478 day ($p < 0.01$) in the average

Table 1. Descriptive Statistics.

Variable	Definition	Dimension	Mean	Std Dev
Readmission	30-day Readmission risk	Binary	0.157	0.36
Unplanned Readmission	30-day Unplanned Readmission risk	Binary	0.13	0.34
LOS	Length of stay	Cont's	5.10	4.3
Charges	Dollar value of charges per visit	$1,000	43.41	50.49
High Rated[a]	% Rated Hospital 9 or 10	Cont's	67.81	7.34
Medicare	1 = if patient was on Medicare	Binary	0.56	0.5
Medicaid	1 = if patient was on Medicaid	Binary	0.08	0.28
Uninsured	1 = if patient was Uninsured or Selfpay	Binary	0.11	0.31
Private	1 = if patient had Private insurance	Binary	0.25	0.43
Age	Patient age	Cont's	67.25	13.32
RaceOther	1 = if race is other or unknown	Binary	0.05	0.22
RaceAsian	1 = if race is Asian	Binary	0.01	0.08
RaceBlack	1 = if race is black	Binary	0.18	0.38
RaceWhite	1 = if race is Caucasian	Binary	0.76	0.42
Female	1 = if gender is female	Binary	0.60	0.49
SeverityMinor	1 = if patient's severity is minor or moderate	Binary	0.54	0.5
SeverityExtreme	1 = if patient's severity is extreme or major	Binary	0.46	0.5
HsUrban[b]	1 = if hospital is in urban location	Binary	0.98	0.15
HsPrivate[b]	1 = if hospital is proprietary	Binary	0.01	0.01
HsTeaching[b]	1 = if hospital is a teaching hospital	Binary	0.41	0.49
HsCMI[b]	Case mix index	Cont's	1.61	0.2
HsWageIndex[b]	Wage index	Cont's	0.97	0.02
HsBeds[b]	Number of beds	Cont's	326.60	204.76

[a]Authors' analyses of publicly reported data for 2006-15 from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS).
[b]Authors' analyses of publicly reported data for 2006-15 from the CMS Impact Files.

LOS of treatment hospitals compared to hospitals in the control group. The average rating of HRRP hospitals increased marginally by 3.3% ($p = 0.06$) compared to non-HRRP hospitals after HRRP went into effect.

Regression Results

In reporting the DID estimates in Table 2, we did not account for visit, patient, or hospital level covariates. In Table 3, we report regression results after including patient controls as well as hospital characteristics (urban, teaching status, proprietary, CMI, wage index, and bed size) as independent variables. The coefficient of the interaction term, *HRRP*Post*, represents the DID estimate of the outcome measures. We observe that the odds of a 30-day readmission to HRRP hospitals decreases by 18.1% ($p < 0.01$) after passage of the HRRP, compared to non-HRRP hospitals. This significant decrease translates into a reduction of 2.6% in the likelihood of a 30-day readmission in terms of average marginal effects.

Next, we observe a significant reduction of 7.9% ($p < 0.01$) in the average LOS of HRRP hospitals compared to their non-HRRP counterparts, which represents a reduction of 0.4 day. For the patient experience measure, our results reveal a 2.1% increase in the hospital ratings of HRRP hospitals compared to Non-HRRP hospitals, which is marginally significant at $p < 0.10$. Taken together, our regressions results suggest qualitatively similar results compared to our descriptive DID results earlier. Hence, our regression results provide significant evidence toward HRRP-induced improvements across all the 3 dimensions of hospital care delivery—quality, cost and patient experience.

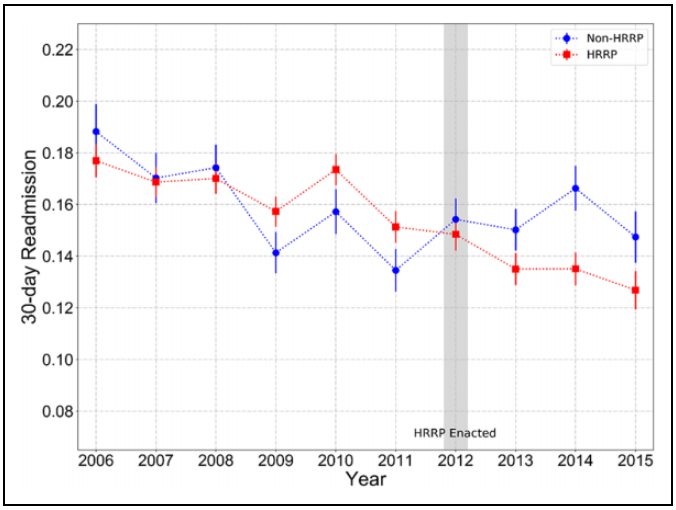

Figure 1. 30-Day readmission rates for treatment (HRRP) and control (Non-HRRP) hospitals. Analyses of claims data from the Dallas Fort Worth Hospital Council (DFWHC) Research Foundation for 2006-15 and includes inpatient admissions attributed to CHF and COPD patients across 42 non-federal hospitals in North Texas. The graph plots the average 30-day readmission rates of HRRP and non-HRRP hospitals. Circles and squares on the graph represent averages of the respective groups of hospitals, bars represent the standard error of the mean.

Table 2. Difference-in-Differences Analysis of Triple Aim Measures.

		Non-HRRP		HRRP		
Outcome measure		Pre	Post	Pre	Post	DID (treatment—control)
30 Day Readmission Rate	Mean	0.16	0.155	0.167	0.137	DID = −0.024***
	Stdev	0.366	0.362	0.373	0.344	t stat = −3.468
	N	10,067	7,019	22,987	11,166	p value < 0.01
	Difference	*−0.005*		*−0.029****		
	t stat	*−0.816*		*−6.928*		
LOS	Mean	5.042	4.801	5.412	4.692	DID = −0.478***
	Stdev	4.135	3.929	4.686	3.754	t stat = −5.762
	N	10,067	7,019	22,987	11,166	p value < 0.01
	Difference	*−0.241****		*−0.72****		
	t stat	*−3.831*		*−14.174*		
High Rated	Mean	67	70.16	64.63	71.12	DID = 3.325*
	Stdev	5.83	5.98	7.84	6.22	t stat = 1.853
	N	46	38	104	84	p value = 0.065
	Difference	*3.161***		*6.486****		
	t stat	*2.443*		*6.174*		

Two tailed-t test *p < 0.10, **p < 0.05, ***p < 0.01.

Next, critics have questioned whether hospitals intentionally gamed the system by making their 30-day readmission rates to appear more favorable in order to avoid HRRP penalties.[33] Gaming may include hospitals delaying readmissions beyond the 30-day window or keeping patients under observation without formally admitting them as inpatients.[34-36] However, recent research showed no significant association between keeping patients under observation longer and their respective readmission rates.[14] In order to address this concern, we examined patients' readmissions during the time window immediately beyond the 30-day window, i.e. did readmission rates increase during the window of 31-33 (+3 days) and 31-35 days (+5 days), after discharge? Our results for the +3-day and +5-day windows, as reported in Table 4, suggest that there are no significant changes in readmission rates of HRRP hospitals in the post-HRRP period. We conclude that there is no evidence of hospital gaming behavior with respect to patient readmissions.

Robustness Tests

We studied 2 alternate patient experience measures reported in the prior literature: (i) response-based satisfaction and (ii) communication-based satisfaction.[37] Response-based satisfaction refers to patients' perceptions on how well caregivers responded to their requests. Following Senot et al.,[37] we utilize 2 response-based satisfaction measures extracted from the HCAHPS survey to calculate an average of: (a) responsiveness of hospital staff and (b) how well the pain was managed. Communication-based satisfaction refers to how effectively caregivers communicate with patients, reflecting caregiver's ability to address patients' requests. Accordingly, we utilize 4 HCAHPS measures to calculate communication-based satisfaction: (a) nurse communication, (b) doctor communication, (c) medication explanation, and (d) discharge instructions. In our sample, we observe that the average response-based satisfaction is 64.6% while communication-based satisfaction is 73.9%. DID estimation results using these alternative satisfaction measures are shown in Table A1 in the Online Appendix. Although we observe an increase in both measures, only response-based satisfaction showed a marginally significant increase of 2.0% (p = 0.07) for HRRP hospitals. Our results suggest that HRRP hospitals significantly improved their response-based processes compared to non-HRRP hospitals, whereas no significant difference was observed for communication-based satisfaction. Regression results incorporating hospital-level control variables, as reported in Table A2, indicate similar findings with respect to improvement in response-based patient satisfaction.

Next, we estimate a linear probability model (LPM) for 30-day readmission rate. Based on our results in the second column of Table A3, we observe a 2.5% significant reduction (p < 0.01) in the likelihood of readmissions to HRRP hospitals, compared to non-HRRP hospitals. We also assess the impact of HRRP on unplanned readmission rates by studying readmissions with emergency status as a proxy, and report our results in the third column of Table A3. Our results suggest a 2.9% reduction in the probability of unplanned readmissions after HRRP went into effect. Further, using inflation-adjusted hospital charges as an alternate measure of costs (fourth column of Table A3), we observe a significant reduction of 6.0% in HRRP hospital costs.

Since our original sample had twice as many hospitals in the treatment group compared to the control group, we next created a smaller but more balanced sample following a one-to-one matching procedure. The resulting sample of 28 matched treatment and control hospitals includes 34,159 admissions and 173 hospital-year observations. Our results in Tables A4 and A5 are qualitatively similar with respect to the sign and significance of all Triple-Aim measures.

Table 3. DID Regression Results for Triple Aim Measures.

Triple aim pillar:	Quality			Cost		Experience	
Dependent Variable:	Readmission			Log(LOS)		High Rating	
Estimation Method:	Logistic			OLS		OLS	
Level of Analysis:	Admission			Admission		Hospital	
Estimate:	OR	95% CI	Marg. Eff.	Coef.	SE	Coef.	SE
HRRP	1.067*	[0.99-1.14]	0.008*	0.044***	(0.007)	−0.730	(1.110)
Post	1.018	[0.93-1.11]	0.002	−0.016*	(0.009)	2.774**	(1.137)
HRRP*Post	0.819***	[0.74-0.91]	−0.026***	−0.079***	(0.010)	2.157+	(1.389)
Log(Age)	1.162***	[1.05-1.29]	0.020***	0.086***	(0.013)	–	–
GenderFemale	0.875***	[0.83-0.92]	−0.018***	0.064***	(0.005)	–	–
RaceOther	0.884**	[0.79-0.99]	−0.016**	−0.052***	(0.011)	–	–
RaceAsian	0.971	[0.73-1.29]	−0.004	0.063**	(0.028)	–	–
RaceBlack	0.934**	[0.87-1]	−0.009**	−0.041***	(0.007)	–	–
SeverityMajor	1.259***	[1.2-1.32]	0.030***	0.353***	(0.005)	–	–
Medicare	1.156***	[1.09-1.23]	0.019***	−0.011*	(0.006)	–	–
Medicaid	1.715***	[1.56-1.88]	0.071***	−0.018*	(0.010)	–	–
Uninsured	1.006	[0.91-1.11]	0.001	−0.083***	(0.009)	–	–
HsUrban	0.859	[0.69-1.07]	−0.02	0.119***	(0.023)	−3.722	(3.393)
HsPrivate	0.654	[0.09-4.98]	−0.056	0.195	(0.200)	–	–
HsTeaching	0.995	[0.93-1.06]	−0.001	−0.017***	(0.006)	−2.807***	(0.934)
HsCMI	1.042	[0.87-1.24]	0.005	0.002	(0.018)	13.097***	(2.749)
HsWageIndex	28.114***	[3.85-205.17]	0.439***	1.563***	(0.189)	−44.846	(31.283)
Log(HsBed)	0.966	[0.91-1.03]	−0.005	−0.019***	(0.007)	3.812***	(0.946)
Constant	0.004***	[0-0.03]	–	−0.421**	(0.190)	71.861**	(29.026)
R_2		0.008		0.121		0.367	
LogLikelihood		−22,121.78		−39,775.38		−865.39	
AIC		44,281.55		79,588.76		1,748.78	
N		51,239		51,239		272	

Robust standard errors are in parentheses.
Two tailed-t test *p < 0.10, ** p < 0.05, *** p < 0.01.
+ One-tailed t test p < 0.10.

Table 4. DID Analysis of Readmission Rates of HRRP Hospitals Within +3 and +5-days Outside 30-Day Window.

		Non-HRRP (Control)		HRRP (Treatment)		
		Before	After	Before	After	DID (HRRP—Non-HRRP)
+3 Days	Mean	0.011	0.01	0.009	0.009	DID = 0.001
	Stdev	0.104	0.098	0.095	0.094	t stat = 0.563
	N	10,067	7,019	22,987	11,166	p value = 0.573
	Difference	−0.001		0.000		
	t stat	−0.785		−0.164		
+5 Days	Mean	0.017	0.015	0.015	0.015	DID = 0.002
	Stdev	0.129	0.122	0.121	0.121	t stat = 0.672
	N	10,067	7,019	22,987	11,166	p value = 0.502
	Difference	−0.002		−0.000		
	t stat	−0.911		−0.134		

Two tailed t test *p < 0.10, ** p < 0.05, *** p < 0.01.

We also replicated our analysis with a more conservative approach where we place more emphasis on inpatient admissions of Medicare patients. Our results are qualitatively similar but with an increased effect size for the quality and cost dimensions of Triple Aim. We also obtained similar results when considering 2013 as a possible treatment year, assuming a lagged effect of the HRRP implementation on hospital performance (results are available upon request).

Discussion

Our assessment of the impact of HRRP on the Triple Aim goals reveals significant improvements across all 3 dimensions of patient care delivery—quality, cost, and patient experience. The 30-day hospital readmission rate is a widely used measure of hospital care quality[38] and CMS advocated its use to assess the quality of hospital care.[39] Other dimensions, including hospital length of stay and patient satisfaction, are also important in assessing the overall effectiveness of healthcare. With respect to readmission rates, our results indicate that penalties imposed under the HRRP policy had their intended effect with a 2.6% reduction in readmissions among hospitals targeted by the HRRP, compared to hospitals that did not fall under the HRRP mandate. This result is also evident during the post 30-day period, suggesting no evidence of gaming behavior by hospitals that may try to strategically defray readmissions beyond the 30-day window, in order to avoid HRRP penalties. Our results provide evidence of a spillover effect of the HRRP policy. That is, its impact not only manifests in its target patient population (i.e. Medicare), but on other types of patients and performance measures such as cost and patient experience as well.[13,40] It is likely that private insurance companies may use the HRRP policy to guide development of similar programs with healthcare providers.

Next, we study the impact of HRRP on the overall LOS of patients, a useful measure of resource utilization within hospitals. Our results reveal a significant decline of 7.9% in the average LOS after 2012, which translates into a 0.4-day reduction. Since LOS serves as a useful proxy for overall inpatient costs, our results provide evidence of the effectiveness of HRRP in reducing hospital costs, and highlight its success in accomplishing the second goal of the Triple Aim initiative. Our results are robust to using 2013 as the cutoff year, and it is possible that its full impact was not observed until the following year.

Previous research has reported mixed findings on the association between LOS and readmissions. It has been suggested that keeping patients in a hospital longer may allow patients to improve their health, which in turn, may reduce the risk of future readmissions.[41,42] Other studies have observed that reductions in LOS may result in an increase in readmission risk.[43,44] Our research provides new evidence suggesting that, while the HRRP significantly reduced hospital readmission rates, it also helped lower the financial cost burden on the US healthcare system through simultaneous reductions in LOS, especially among Medicare patients.

The third dimension of the Triple Aim focuses on patient experience. Since patient experience is related to the level of satisfaction and extent of patient engagement with healthcare providers,[6,24,25] we studied the impact of HRRP on patient experience. While communication-based patient engagement did not exhibit a significant increase, caregivers' responsiveness and overall hospital ratings increased significantly, after HRRP. Since healthcare bears features of a credence good, patients may have difficulty in accurately assessing the quality of care received from healthcare providers,[45] which may explain the insignificant impact on communication-based satisfaction.

While the health policy literature has debated the effectiveness of the 30-day readmission rate as a useful accountability metric of hospital performance, our research seeks to broaden this discussion to include other dimensions of performance that are important in a value-based healthcare environment. Specifically, our deployment of inpatient LOS and patient experience as proxies for hospital costs and patient satisfaction, respectively, provides a more holistic approach to this debate, providing evidence that in the era of accountable care, hospitals do not make such tradeoffs by simply reducing readmission rates at the expense of patient satisfaction or LOS. Our research provides an initial blueprint to conduct field studies of hospitals who have successfully implemented appropriate interventions to not only reduce readmission rates, but also managed their costs and patient experience effectively.

Our study has a few limitations. First, our research is restricted to chronic disease patients with COPD or CHF, within one geographic region. Although the North Texas region is fairly large and diverse in terms of its population, further studies are needed to account for patient demographic characteristics in other regions of the country. Future studies can extend these models to study other chronic diseases, such as AMI and Diabetes, which are characterized by long hospital stays and high readmission rates. We rely on secondary, administrative claims data obtained from the region's hospitals, and are limited by the scope of this dataset. For example, administrative claims data do not include the actual reimbursement amount or clinical data, such as patient medical history or medications administered during hospitalization. Future studies may incorporate such data to evaluate other clinical measures of hospital quality and costs. As part of the ACA, CMS initiated several value-based programs that are similar to HRRP, including End-stage Renal Disease Quality Incentive Program (ESRD QIP), Value Modifier Program (VM), Hospital Acquired Conditions Reduction Program (HAC), and Hospital Value-based Purchasing Program (VBP). Our close examination of these programs reveal no significant concerns regarding potential confounding effects, with the exception of VBP. Although, VBP may have overlapped with HRRP in terms of its target population and implementation year, most of the outcomes tracked under VBP are substantially different than HRRP and unlikely to incur a significant confounding effect.

Conclusions

Prior research on health policy has questioned the value of the HRRP in terms of whether solely focusing on readmission rates could lead hospitals to make sub-optimal tradeoffs against care cost, patient experience and satisfaction.[11] This effect may be attributed to strategies that are intended to reduce hospital readmission rates and cap growth in healthcare costs by reducing patient LOS and allocating insufficient resources to improve patient experience. We analyzed all the 3 dimensions of the Triple Aim to holistically evaluate the impact of HRRP on

patient care quality, cost of care and experience, using a quasi-natural experimental design based on a large longitudinal study of chronic disease patients. Our findings indicate that hospitals do not trade-off reductions in readmission rates with other outcome measures, but in fact, such improvements co-exist with other dimensions of the Triple Aim. Overall, our study of a large sample of chronic disease inpatients in North Texas across a 10-year period suggests that passage of the HRRP was associated with a 2.6% reduction in hospital readmission rates, 7.9% reduction in inpatient length of stay, and a 2.1% increase in hospital satisfaction ratings. Our results provide evidence of a spillover effect in terms of the impact of HRRP not only on Medicare patients but across all insurance types as well as other outcomes such as cost and patient experience. Our research adds to the growing debate on the effectiveness of the HRRP and its impact on multiple dimensions of hospital performance.

Declaration of Conflicting Interests

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Supplemental Material

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