Appendix

Figure A1 Definition of the Hospitalization Sample from the NRD

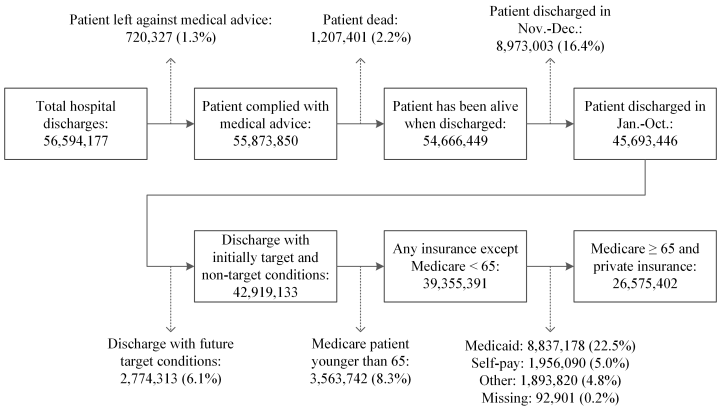


Table A1 Control Variables

Variable	Description
Patient controls	
Age	Categorical variable (0, 1-17, 18-44, 45-64, 65-74, 75-89, 90+)
Gender	Categorical variable (female, male)
Location	Categorical variable for population in county of residence (central counties of areas of $\geq$ 1m population, fringe counties of areas of $\geq$ 1m population, metro areas of 250,000-999,999 population, metro areas of 50,000-249,999 population, micropolitan, not metropolitan or micropolitan)
Resident	Indicator variable for residence of the patient in the same state as the hospital
Income	Median household income quartiles for patient's ZIP code
Hospital controls	
Volume	Size of hospitals based on the number of annual discharges (small, medium, large based on the 33rd and 66th percentile values of volume (1,625 and 7,210 discharges per year, respectively))
Ownership	Indicator variable for government or private ownership (public, private not-for-profit, private investor-owned)
Status	Categorical variable for teaching status and metropolitan area location (metropolitan teaching, metropolitan non-teaching, non-metropolitan)
Hospitalization controls (during index admission)	
Planned	Indicator variable for planned admission
Emergency department	Indicator variable for emergency department service
Operating room	Indicator variable for a major operating room procedure
Severity	Categorical variable for severity of illness (no class specified, minor, moderate, major, extreme)
Mortality risk	Categorical variable for mortality risk (no class specified, minor, moderate, major, extreme)
Same day event	Categorical variable for multiple discharges in a single day (no event, two transfers from different hospitals, two discharges at different hospitals, two discharges at the same hospital, more than two discharges)
Disposition	Categorical variable for discharge disposition (routine, transfer to short-term hospital, other transfers, home health care, unknown)
Primary condition	Categorical variable for the primary condition using CCS codes
Time controls	
Weekend	Indicator variable for index admission during weekend
Discharge month	Categorical variable for discharge month for index admission

Table A2 30-day Readmissions Change after HRRP Implementation – All Coefficients

	(1)		(2)		(3)	
Effect:	Main		Spillover across condition		Spillover across insurance	
$TCohort$	0.0307***	(0.0012)	0.0158***	(0.0007)	−0.0007	(0.0012)
$Post$	−0.0019***	(0.0005)	−0.0019***	(0.0005)	−0.0019***	(0.0005)
$TCohort \times Post$	−0.0116***	(0.0010)	−0.0052***	(0.0007)	−0.0037***	(0.0010)
Patient controls						
Age (18-44 – reference)						
0	−0.0101***	(0.0019)	−0.0106***	(0.0018)	−0.0109***	(0.0018)
1-17	−0.0102***	(0.0009)	−0.0112***	(0.0009)	−0.0116***	(0.0009)
45-64	0.0024***	(0.0003)	0.0028***	(0.0003)	0.0027***	(0.0003)
65-74	0.0083***	(0.0006)	0.0075***	(0.0006)	0.0081***	(0.0006)
75-89	−0.0026**	(0.0008)	−0.0013+	(0.0006)	0.0045***	(0.0009)
90+	−0.0270***	(0.0011)	−0.0175***	(0.0008)	−0.0138***	(0.0021)
Gender (Female – reference)						
Male	0.0003	(0.0002)	0.0041***	(0.0002)	−0.0004	(0.0002)
Location (Central counties of areas of $\geq$ 1m population – reference)						
Fringe counties of areas of $\geq$ 1m population	0.0011*	(0.0004)	0.0001	(0.0005)	0.0013**	(0.0004)
Metro areas of 250,000-999,999 population	−0.0041***	(0.0006)	−0.0092***	(0.0007)	−0.0023***	(0.0005)
Metro areas of 50,000-249,999 population	−0.0059***	(0.0007)	−0.0101***	(0.0007)	−0.0041***	(0.0006)
Micropolitan	−0.0082***	(0.0007)	−0.0142***	(0.0007)	−0.0053***	(0.0007)
Not metropolitan or micropolitan	−0.0106***	(0.0007)	−0.0171***	(0.0008)	−0.0072***	(0.0007)
Resident (Resident – reference)						
Nonresident	−0.0255***	(0.0007)	−0.0305***	(0.0007)	−0.0226***	(0.0007)
Income (4th quartile – reference)						
1st quartile	0.0076***	(0.0005)	0.0099***	(0.0005)	0.0049***	(0.0005)
2nd quartile	0.0044***	(0.0004)	0.0054***	(0.0004)	0.0034***	(0.0004)
3rd quartile	0.0020***	(0.0003)	0.0023***	(0.0003)	0.0017***	(0.0003)
Hospital controls						
Volume (Small – reference)						
Medium	−0.0069***	(0.0008)	−0.0054***	(0.0004)	−0.0034***	(0.0004)
Large	−0.0106***	(0.0009)	−0.0092***	(0.0009)	−0.0077***	(0.0009)
Ownership (Private, not-for-profit – reference)						
Public	0.0029***	(0.0008)	0.0026**	(0.0008)	0.0028***	(0.0008)
Private, investor-owned	0.0032***	(0.0006)	0.0053***	(0.0007)	0.0014**	(0.0005)
Status (Metropolitan teaching – reference)						
Metropolitan non-teaching	−0.0020***	(0.0005)	−0.0030***	(0.0006)	−0.0024***	(0.0005)
Non-metropolitan	−0.0011	(0.0008)	−0.0024*	(0.0009)	−0.0015†	(0.0008)
Hospitalization controls						
Planned (Not-planned – reference)						
Planned	−0.0229***	(0.0004)	−0.0256***	(0.0004)	−0.0229***	(0.0005)
Emergency department (Not visited – reference)						
Visited	0.0051***	(0.0004)	0.0047***	(0.0004)	0.0032***	(0.0004)
Operating room (No procedure – reference)						
Major procedure	−0.0147***	(0.0003)	−0.0107***	(0.0003)	−0.0149***	(0.0003)

Table A2 30-day Readmissions Change after HRRP Implementation – All Coefficients (continued)

	(1)		(2)		(3)	
Effect:	Main		Spillover across condition		Spillover across insurance	
Hospitalization controls						
Severity (Moderate – reference)						
No class specified	0.0050	(0.0089)	0.0104	(0.0087)	0.0009	(0.0086)
Minor	−0.0127***	(0.0002)	−0.0136***	(0.0002)	−0.0121***	(0.0002)
Major	0.0251***	(0.0004)	0.0295***	(0.0003)	0.0237***	(0.0004)
Extreme	0.0504***	(0.0010)	0.0593***	(0.0007)	0.0498***	(0.0012)
Mortality risk (Moderate – reference)						
Minor	−0.0367***	(0.0005)	−0.0346***	(0.0003)	−0.0371***	(0.0005)
Major	0.0236***	(0.0005)	0.0205***	(0.0003)	0.0226***	(0.0007)
Extreme	0.0088***	(0.0010)	0.0091***	(0.0007)	0.0021	(0.0013)
Same day event (No event – reference)						
Two transfers from different hospitals	0.0209***	(0.0015)	0.0252***	(0.0013)	0.0203***	(0.0016)
Two discharges at different hospitals	0.0048***	(0.0014)	0.0018†	(0.0010)	0.0041**	(0.0014)
Two discharges at the same hospital	−0.0125***	(0.0012)	−0.0125***	(0.0008)	−0.0159***	(0.0014)
More than two discharges	0.0259***	(0.0028)	0.0272***	(0.0018)	0.0264***	(0.0030)
Disposition (Routine – reference)						
Transfer to short-term hospital	0.0473***	(0.0019)	0.0506***	(0.0020)	0.0512***	(0.0019)
Other transfers	0.0453***	(0.0007)	0.0412***	(0.0005)	0.0429***	(0.0009)
Home health care	0.0410***	(0.0006)	0.0391***	(0.0004)	0.0418***	(0.0007)
Unknown	−0.1036***	(0.0047)	−0.1090***	(0.0034)	−0.0948***	(0.0058)
Time controls						
Weekend (Monday-Friday – reference)						
Saturday-Sunday	−0.0010***	(0.0002)	−0.0011***	(0.0002)	−0.0015***	(0.0002)
Discharge month (January – reference)						
February	0.0003	(0.0003)	−0.0006†	(0.0003)	−0.0001	(0.0003)
March	−0.0010**	(0.0003)	−0.0015***	(0.0003)	−0.0008*	(0.0003)
April	−0.0004	(0.0003)	−0.0015***	(0.0003)	0.0001	(0.0003)
May	−0.0002	(0.0003)	−0.0011***	(0.0003)	0.0000	(0.0003)
June	−0.0009**	(0.0004)	−0.0020**	(0.0003)	−0.0006	(0.0003)
July	0.0008*	(0.0003)	−0.0007*	(0.0003)	0.0008*	(0.0003)
August	0.0011**	(0.0004)	−0.0008*	(0.0003)	0.0010**	(0.0003)
September	0.0000	(0.0004)	−0.0025***	(0.0003)	0.0000	(0.0003)
October	−0.0004	(0.0004)	−0.0025***	(0.0003)	−0.0003	(0.0004)
Constant	0.0887***	(0.0015)	0.0933***	(0.0014)	0.0959***	(0.0015)
Treatment cohort	A		B		C	
Control cohort	D		D		D	
Observations	13,366,960		23,538,191		12,060,288	

Notes. Estimates are from linear regression models. All models include all controls in Equation (1), including condition fixed effects. Robust standard errors clustered by hospital-year in parentheses.

$^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

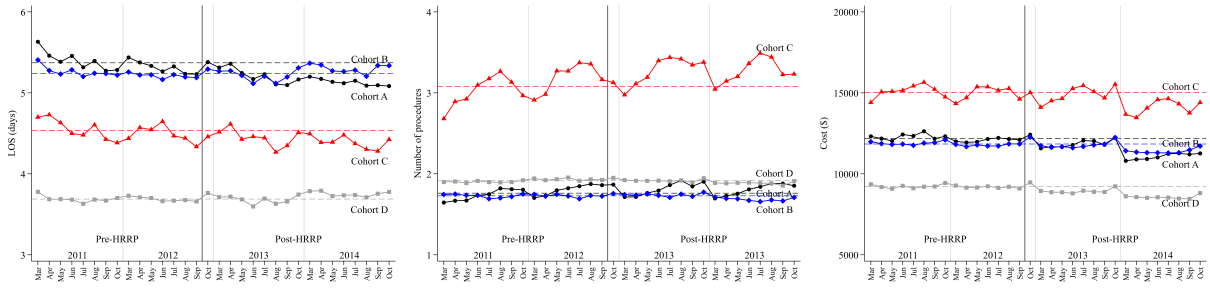
Table A3 Care Intensity Measure Means of Hospital Admissions

	(1)	(2)	(3)	(4)	(5)
	Cohort A	Cohort B	Cohort C	Cohort D	Overall
Length of stay (days)					
2011	5.41	5.26	4.57	3.69	4.50
2012	5.33	5.22	4.49	3.70	4.49
2013	5.22	5.21	4.45	3.68	4.48
2014	5.13	5.30	4.39	3.75	4.54
Pre-HRRP (Jan 2011 - Sep 2012)	5.37	5.24	4.53	3.69	4.49
Post-HRRP (Oct 2012 - Oct 2014)	5.19	5.26	4.43	3.72	4.51
Number of procedures					
2011	1.73	1.73	3.00	1.90	1.84
2012	1.81	1.73	3.17	1.93	1.86
2013	1.81	1.74	3.27	1.92	1.86
2014	1.80	1.69	3.26	1.89	1.82
Pre-HRRP (Jan 2011 - Sep 2012)	1.76	1.73	3.08	1.92	1.85
Post-HRRP (Oct 2012 - Oct 2014)	1.81	1.71	3.26	1.90	1.84
Cost ($)					
2011	12,293	11,898	15,059	9,231	10,716
2012	12,113	11,836	14,962	9,215	10,686
2013	11,833	11,774	14,880	8,928	10,514
2014	11,059	11,395	14,094	8,565	10,095
Pre-HRRP (Jan 2011 - Sep 2012)	12,190	11,840	15,012	9,208	10,680
Post-HRRP (Oct 2012 - Oct 2014)	11,495	11,618	14,508	8,781	10,339
Observations	1,143,429	8,208,826	345,984	8,747,107	18,445,346

Notes. Each observation is a hospitalization. Data are limited to first visits in a 30-day time window. Cost is inflation-adjusted and is shown in 2011 U.S. dollars.

Figure A2 Care Intensity Measures Trend by Cohort

(a) Length of Stay (b) Number of Procedures (c) Cost



Notes. Dashed lines show average value for each cohort-metric in 2011-2012.
Cohort A: Medicare, target conditions; Cohort B: Medicare, non-target conditions; Cohort C: private insurance, target condition;
Cohort D: private insurance, non-target conditions.

Table A4 Robustness: 30-day Readmissions Change after HRRP Implementation (Probit & Logit)

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit			Logit		
Effect:	Main	Spillover across		Main	Spillover across	
		Condition	Insurance		Condition	Insurance
TCohort	0.1107***	0.0694***	−0.0124*	0.1978***	0.1263***	−0.0284*
	(0.0054)	(0.0034)	(0.0063)	(0.0100)	(0.0065)	(0.0121)
Post	−0.0171***	−0.0140***	−0.0175***	−0.0338***	−0.0270**	−0.0348***
	(0.0040)	(0.0043)	(0.0040)	(0.0083)	(0.0088)	(0.0082)
TCohort×*Post*	−0.0334***	−0.0168***	−0.0159**	−0.0563***	−0.0302***	−0.0298**
	(0.0047)	(0.0038)	(0.0060)	(0.0091)	(0.0077)	(0.0115)
Marginal effect on treatment cohort	−0.0114***	−0.0053***	−0.0038***	−0.0115***	−0.0054***	−0.0040***
	(0.0010)	(0.0006)	(0.0010)	(0.0010)	(0.0006)	(0.0010)
Treatment cohort	A	B	C	A	B	C
Control cohort	D	D	D	D	D	D
Observations	13,366,960	23,538,191	12,060,288	13,366,960	23,538,191	12,060,288

Notes. The marginal effects shown are the mean marginal effect over all observations. All models include all controls in Equation (1), including condition fixed effects. Robust standard errors clustered by hospital-year in parentheses. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A5 Robustness: 30-day Readmissions Change after HRRP Implementation (DDD Model)

	(1)
Medicare	0.0141***
	(0.0007)
Target	−0.0084***
	(0.0010)
Post	−0.0017***
	(0.0005)
Medicare×*Target*	0.0223***
	(0.0009)
Medicare×*Post* (Effect on Cohort B)	−0.0052***
	(0.0007)
Target×*Post* (Effect on Cohort C)	−0.0043***
	(0.0011)
Medicare×*Target*×*Post*	−0.0018
	(0.0012)
Total Effect on Cohort A	−0.0113***
	(0.0010)
Treatment cohort	A
Spillover cohorts	B and C
Control cohort	D
Observations	25,834,053

Notes. Estimates are from linear regression models. All models include all controls in Equation (1), including condition fixed effects. Robust standard errors clustered by hospital-year in parentheses. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A6 Robustness: 30-day Readmissions Change after HRRP Implementation (with hospital-year FE)

	(1)	(2)	(3)
Effect:	Main	Spillover across	
		Condition	Insurance
TCohort	0.0294^{***}	0.0151^{***}	-0.0016
	(0.0012)	(0.0006)	(0.0012)
Post	-0.0001	0.0015^{*}	-0.0018^{**}
	(0.0006)	(0.0006)	(0.0006)
TCohort×*Post*	-0.0113^{***}	-0.0051^{***}	-0.0034^{***}
	(0.0010)	(0.0006)	(0.0010)
Treatment cohort	A	B	C
Control cohort	D	D	D
Observations	13,366,960	23,538,191	12,060,288

Notes. Estimates are from linear regression models. All models include all controls in Equation (1), including condition fixed effects, in addition to hospital-year fixed effects. Robust standard errors clustered by hospital-year in parentheses. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A7 Robustness: 30-day Readmissions Change after HRRP Implementation (with matched conditions in treatment and control cohorts)

	(1)	(2)
Effect:	Main	Spillover across insurance
TCohort	0.0005	-0.0316^{***}
	(0.0067)	(0.0042)
Post	0.0033	0.0002
	(0.0055)	(0.0021)
TCohort×*Post*	-0.0159^{**}	-0.0060^{**}
	(0.0055)	(0.0021)
Treatment cohort	A	C
Control cohort	D	D
Observations	1,827,028	600,713

Notes. Estimates are from linear regression models. All models include all controls in Equation (1), including condition fixed effects. Robust standard errors clustered by hospital-year in parentheses. Cohort D in column (1) is limited to cancer of pancreas, pathological fracture, and unspecified cancer, and in column (2) is limited to digestive congenital anomalies, unspecified cancer, and urinary tract infections. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A8 Robustness: HRRP Impact on 30-day Readmissions by Age Subgroups

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sample (Cohorts C and D):		40+			50+			60+	
Effect:	Main	Spillover across		Main	Spillover across		Main	Spillover across	
		Condition	Insurance		Condition	Insurance		Condition	Insurance
TCohort	0.0296^{***}	0.0152^{***}	0.0030^{*}	0.0282^{***}	0.0152^{***}	0.0042^{**}	0.0268^{***}	0.0149^{***}	0.0060^{**}
	(0.0013)	(0.0007)	(0.0014)	(0.0013)	(0.0007)	(0.0015)	(0.0016)	(0.0007)	(0.0021)
Post	-0.0028^{***}	-0.0026^{***}	-0.0028^{***}	-0.0030^{***}	-0.0028^{***}	-0.0030^{***}	-0.0035^{***}	-0.0033^{***}	-0.0035^{***}
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0009)	(0.0009)	(0.0008)
TCohort×*Post*	-0.0105^{***}	-0.0043^{***}	-0.0036^{**}	-0.0102^{***}	-0.0040^{***}	-0.0039^{**}	-0.0095^{***}	-0.0034^{***}	-0.0048^{**}
	(0.0011)	(0.0007)	(0.0011)	(0.0011)	(0.0007)	(0.0013)	(0.0011)	(0.0008)	(0.0017)
Treatment cohort	A	B	C	A	B	C	A	B	C
Control cohort	D	D	D	D	D	D	D	D	D
Observations	7,588,555	17,759,786	6,221,510	5,965,807	16,137,038	4,529,016	3,818,878	13,990,109	2,226,437

Notes. Estimates are from linear regression models. All models include all controls in Equation (1), including condition fixed effects. Robust standard errors clustered by hospital-year in parentheses. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A9 31-60-day Readmissions Change after HRRP Implementation

	(1)	(2)	(3)
Effect:	Main	Spillover across	
		Condition	Insurance
TCohort	0.0147^{***}	0.0097^{***}	0.0014^{*}
	(0.0007)	(0.0003)	(0.0007)
Post	0.0002	0.0014^{***}	$-0.0003^{\dagger}$
	(0.0002)	(0.0002)	(0.0002)
TCohort×*Post*	-0.0079^{***}	-0.0050^{***}	-0.0025^{***}
	(0.0005)	(0.0003)	(0.0006)
Treatment cohort	A	B	C
Control cohort	D	D	D
Observations	13,366,960	23,538,191	12,060,288

Notes. Estimates are from linear regression models. All models include all controls in Equation (1), including condition fixed effects. Robust standard errors clustered by hospital-year in parentheses. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.