

The Supply of Hospital Care to Minority and Low-Income Communities and the Hospital Readmission Reduction Program

Appendices

Appendix 1: The following equations illustrate the main models.

$$\text{Model 1: } Y_{it} = B_0 + B_1 \text{Minority}_{it} + B_2 \text{Poverty}_{it} + B_3 \text{ExpectedPenalty}_{it} + B_z Z_{it} + e$$

$$\text{Model 2: } Y_{it} = B_0 + B_1 \text{Minority}_{it} + B_2 \text{Poverty}_{it} + B_3 \text{ExpectedPenalty}_{it} + B_4 \text{Minority} \# \text{ExpectedPenalty}_{it} + B_z Z_{it} + e$$

$$\text{Model 3: } Y_{it} = B_0 + B_1 \text{Minority}_{it} + B_2 \text{Poverty}_{it} + B_3 \text{ExpectedPenalty}_{it} + B_4 \text{Poverty} \# \text{ExpectedPenalty}_{it} + B_z Z_{it} + e$$

$$\text{Model 4: } Y_{it} = B_0 + B_1 \text{Minority}_{it} + B_2 \text{Poverty}_{it} + B_3 \text{ExpectedPenalty}_{it} + B_4 \text{Minority} \# \text{ExpectedPenalty}_{it} + B_5 \text{Poverty} \# \text{ExpectedPenalty}_{it} + B_z Z_{it} + e$$

Where;

i= Zipcode

t= 2006 or 2013

Y_{it} : Number of discharges for targeted conditions in zipcode i in year t

Minority_{it} : The percent of non-white residents in the zip code i in year t

Poverty_{it} : The poverty rate in the zip-code i in year t

$\text{ExpectedPenalty}_{it}$: The expected penalty for the HSA of zip code I in year t

Z_{it} : All other control variables in the models

Appendix 2. Descriptive Statistics of Variables used for the NBREG Models in 2006 & 2013

Variables	2006		2013		Unpaired T-test	
	n=6,564		n=6,564			
	Mean	St. Dev	Mean	St. Dev		
Total number of PN, HF and AMI	77.514	111.08	83.805	110.46	0.001**	
Total number of COPD, TKA and CABG	42.786	60.32	38.766	55.23	0.000***	
Expected penalty, USD (/10,000)¥	0.000	0.00	9.849	14.64	0.000***	
Population						
Population (/1000)	14.161	16.97	14.561	17.52	0.183	
Race/Ethnicity/Poverty						
% of Minority Population (/10)	2.698	2.62	2.924	2.71	0.000***	
% of Poverty Rate (/10)	1.299	1.01	1.493	1.17	0.000***	
Socio-Economic Variables						
Age Categories						
Percent of people age 0 - 17 years	22.759	7.33	21.015	7.85	0.000***	
Percent of people age 18 - 24 years	8.971	8.85	9.181	9.18	0.182	
Percent of people age 25 -44 years	26.010	7.58	23.793	8.55	0.000***	
Percent of people age 45 - 64 years	27.188	8.29	29.109	9.15	0.000***	
Percent of people age 65 - 79 years	8.269	5.46	9.675	6.86	0.000***	
Percent of people age 75 years and over	6.804	5.44	7.228	5.78	0.000***	
Education (25 years and over)						
Percent No High School Education	6.340	6.94	5.492	6.80	0.000***	
Percent Some High School Education	9.602	6.02	7.719	5.84	0.000***	
Percent High School Education	29.927	11.29	29.155	12.00	0.000***	
Percent Some College Education	23.372	7.72	21.148	8.29	0.000***	
Percent College Education	21.211	10.28	25.910	11.07	0.000***	
Percent Advanced Degree Education	9.549	8.77	10.576	9.49	0.000***	
Marital Status						
Percent Married	55.775	11.95	52.529	13.04	0.000***	
Percent Never Married	27.633	11.79	30.256	13.17	0.000***	
Percent Widowed	6.503	4.07	6.379	4.46	0.095	
Percent Divorced	10.089	5.32	10.836	6.03	0.000***	
Gender Distribution						
Percent Female	49.959	5.80	49.817	6.52	0.189	
Employment						
Percent Employed	56.865	12.22	54.497	12.95	0.000***	
Percent Unemployed	4.771	3.11	5.764	3.91	0.000***	
Market level Variables						

Variables	2006		2013		Unpaired T-test
	n=6,564	Mean	n=6,564	Mean	
Herfindahl Index for hospitals					
HI<15		0.266		0.248	0.019*
15<HI<25		0.276		0.263	0.080
HI>25		0.458		0.490	0.000***
Herfindahl Index for health insurance					
HI<15		0.207		0.158	0.000***
15<HI<25		0.474		0.555	0.000***
HI>25		0.319		0.287	0.000***
Health Care Access and Availability					
PerCap Physician, Primary Care, Patient Care					
Non-Fed (at County Level)	0.068	0.03	0.070	0.03	0.000***
State					
NY		0.245		0.245	-
AZ		0.053		0.053	-
CO		0.071		0.071	-
CA		0.215		0.215	-
FL		0.120		0.120	-
NC		0.108		0.108	-
NJ		0.081		0.081	-
WI		0.108		0.108	-

* p<0.05, ** p<0.01, *** p<0.001

Notes:

- 1) Socio-economic variables reported at zip-code level.
 - 2) Number of readmissions computed by using SUM of readmissions for HF, AMI and PN using HRRP guideline at Hospital Service Areas (HSAs).
 - 3) Percentages of minority and poverty ratio and computed using Adjusted American Community Surveys 2007-2011 for 2006 and Average 2010-2014 for 2013.
 - 4) p-value reported unpaired t-test between 2006 & 2013
 - 5) Bonferroni correction ($\alpha = 0.05; 0.00157$) employed to determine the statistical differences in means between 2006 and 2013.
- ¥ Expected penalty at HSA=Likelihood of being penalized*1% of DRG amount other than outlier payments*share of hospital bed in HSA, summed over all hospitals in HSA.

Appendix 3. Estimated coefficients for expected penalty for excess readmissions, percentage minority residents and poverty rate and the number of hospital discharges for targeted conditions (PN, HF and AMI) at zip-code level, comparing 2006 to 2013

	Model 1	Model 2		Model 3		Model 4		
Herfindahl Index for hospitals (Ref: HI<0.15)								
0.15<HI<0.25	0.09194	(0.0632)	0.09173	(0.0631)	0.09325	(0.0626)	0.09274	(0.0621)
HI>0.25	0.06314	(0.0519)	0.06329	(0.0519)	0.06106	(0.0517)	0.06041	(0.0514)
Herfindahl Index for health insurance ((Ref: HI<0.15))								
0.15 <HI<0.25	0.23805***	(0.0509)	0.23812***	(0.0508)	0.23823***	(0.0509)	0.23872***	(0.0505)
HI>0.25	0.19980***	(0.0504)	0.19983***	(0.0504)	0.19954***	(0.0501)	0.19960***	(0.0498)
Health Care Access and Availability								
PerCap Phys,Primary Care,Patient Care								
Non-Fed at County Level	1.45149*	(0.6623)	1.45144*	(0.6621)	1.43827*	(0.6625)	1.42832*	(0.6624)
Year (Ref: 2006)								
Calendar year=2013	0.16307***	(0.0324)	0.16438***	(0.0327)	0.15815***	(0.0319)	0.16321***	(0.0317)
State (Ref:NY)								
AZ	-0.24785*	(0.0972)	-0.24698*	(0.0975)	-0.25726**	(0.0968)	-0.25789**	(0.0962)
CO	-0.39841***	(0.0733)	-0.39837***	(0.0734)	-0.40307***	(0.0730)	-0.40602***	(0.0731)
CA	0.16436	(0.0873)	0.16448	(0.0872)	0.15614	(0.0872)	0.15202	(0.0869)
FL	0.10314	(0.0680)	0.10314	(0.0680)	0.09548	(0.0673)	0.09095	(0.0670)
NC	-0.05617	(0.0735)	-0.0563	(0.0735)	-0.05979	(0.0731)	-0.06303	(0.0730)
NJ	0.38969***	(0.0660)	0.38927***	(0.0660)	0.38676***	(0.0658)	0.38247***	(0.0658)
WI	0.11039	(0.0632)	0.11016	(0.0632)	0.11196	(0.0627)	0.11121	(0.0625)
constant	-1.13598**	(0.3462)	-1.13538**	(0.3461)	-1.13278**	(0.3462)	-1.12522**	(0.3453)
/lnalpha	-0.35726***	(0.0433)	-0.35729***	(0.0434)	-0.35849***	(0.0434)	-0.35942***	(0.0438)
Pseudo R2	0.10580		0.10580		0.1059		0.10600	
N	13,014		13,014		13,014		13,014	

* p<0.05, ** p<0.01, *** p<0.001

Notes:

- 1) All models controlled by socio economic variables such as age-categories, education, Marital Status, gender Status, Employment status at zip code level.
 - 2) All models controlled by market level variables such as Herfindahl index for hospitals, Herfindahl index for health insurance, health care access and availability at zipcode level.
 - 3) All models controlled by year (2006 as a ref.) and state dummies for AZ, CO, CA, FL, NC, NJ & WI (NY as a reference).
 - 4) Models clustered at county level.
 - 5) Number of readmissions computed by using SUM of readmissions for HF, AMI and PN using HRRP guideline at Hospital Service Areas (HSAs).
 - 6) Percent of minority and poverty ratio and computed using American Community Surveys 2007-2011 for 2006 and 2010-2014 for 2013.
 - 7) Parentheses report clustered SE for a negative binomial regression model
 - 8) Likelihood of being penalized in 2013 computed using a weighted by squared adjusted admission GLM model (link-logit) after controlled by race/ethnicity, socio-economic, hospital and market variables.
 - 9) NA reports not applicable for that specific model.
- ¥ Expected penalty at HSA=Likelihood of being penalized*1% of DRG amount other than outlier payments*share of hospital bed in HSA, summed over all hospitals in HSA.

Appendix 4. Falsification Test: Estimated coefficients for expected penalty for excess readmissions, percentage minority residents and poverty rate and the number of hospital discharges for conditions targeted after 2013 (TKA/THR, COPD and CABG) at Zip Code level comparing 2006 to 2013

	Model 1		Model 2		Model 3		Model 4
0.15<HI<0.25	0.23647** (0.0750)	0.23566** (0.0746)	0.23714** (0.0749)	0.23599** (0.0743)			
HI>0.25	0.15836* (0.0705)	0.15861* (0.0705)	0.15726* (0.0703)	0.15640* (0.0700)			
Herfindahl Index for health insurance ((Ref: 0.15<HI))							
0.15 <HI<0.25	0.02511 (0.0757)	0.0252 (0.0755)	0.02597 (0.0752)	0.02716 (0.0744)			
HI>0.25	0.01597 (0.0679)	0.01617 (0.0678)	0.01683 (0.0673)	0.01821 (0.0665)			
Health Care Access and Availability							
PerCap Phys,Primary Care, Patient Care Non-Fed at County Level	1.95686* (0.7688)	1.96017* (0.7672)	1.94518* (0.7682)	1.93785* (0.7643)			
Year (Ref: 2006)							
Calendar year=2013	-0.00216 (0.0414)	0.00096 (0.0413)	-0.0043 (0.0414)	0.00093 (0.0412)			
State (Ref:NY)							
AZ	-0.31069** (0.1140)	-0.30801** (0.1136)	-0.31630** (0.1133)	-0.31648** (0.1125)			
CO	-0.79692*** (0.0960)	-0.79634*** (0.0961)	-0.80014*** (0.0956)	-0.80277*** (0.0956)			
CA	-0.38127*** (0.0989)	-0.37993*** (0.0984)	-0.38627*** (0.0990)	-0.38874*** (0.0988)			
FL	0.35416*** (0.0751)	0.35528*** (0.0748)	0.35006*** (0.0750)	0.34800*** (0.0747)			
NC	0.22114** (0.0748)	0.22109** (0.0747)	0.21813** (0.0747)	0.21424** (0.0744)			
NJ	0.43838*** (0.0658)	0.43850*** (0.0658)	0.43642*** (0.0656)	0.43437*** (0.0658)			
WI	0.39205*** (0.0630)	0.39192*** (0.0630)	0.39169*** (0.0626)	0.39066*** (0.0624)			
constant	-1.55629*** (0.3760)	-1.55160*** (0.3772)	-1.55474*** (0.3760)	-1.54053*** (0.3784)			
/Inalpha	-0.20924*** (0.0377)	-0.20948*** (0.0378)	-0.20955*** (0.0378)	-0.21051*** (0.0382)			
Pseudo R2	0.1008	0.1008	0.1008	0.1009			
N	13,014	13,014	13,014	13,014			

* p<0.05, ** p<0.01, *** p<0.001

Notes:

- 1) All models controlled by socio economic variables such as age-categories, education, Marital Status, gender Status, Employment status at zip code level.
 - 2) All models controlled by market level variables such as Herfindahl index for hospitals, Herfindahl index for health insurance, health care access and availability at zip code level.
 - 3) All models controlled by year (2006 as a ref.) and state dummies for AZ, CO, CA, FL, NC, NJ & WI (NY as a ref.).
 - 4) Models clustered at county level.
 - 5) Number of readmissions computed by using sum of readmissions for HF, AMI and PN using HRRP guideline at Hospital Service Areas (HSAs).
 - 6) Percent of minority and poverty ratio and computed using American Community Surveys 2007-2011 for 2006 and 2010-2014 for 2013.
 - 7) Parentheses report clustered SE for a negative binomial regression models.
 - 8) Likelihood of being penalized in 2013 computed using a weighted by squared adjusted admission GLM model (link-logit) after controlled by race/ethnicity, socio-economic, hospital and market variables.
 - 9) NA reports not applicable for that specific models.
- ¥ Expected penalty at HAS=Likelihood of being penalized*1% of DRG amount other than outlier payments*share of hospital bed in HSA, summed over all hospitals in HSA.