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# Impact of Financial Penalties in Medicare's Hospital Readmissions Reduction Program

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February 29, 2016



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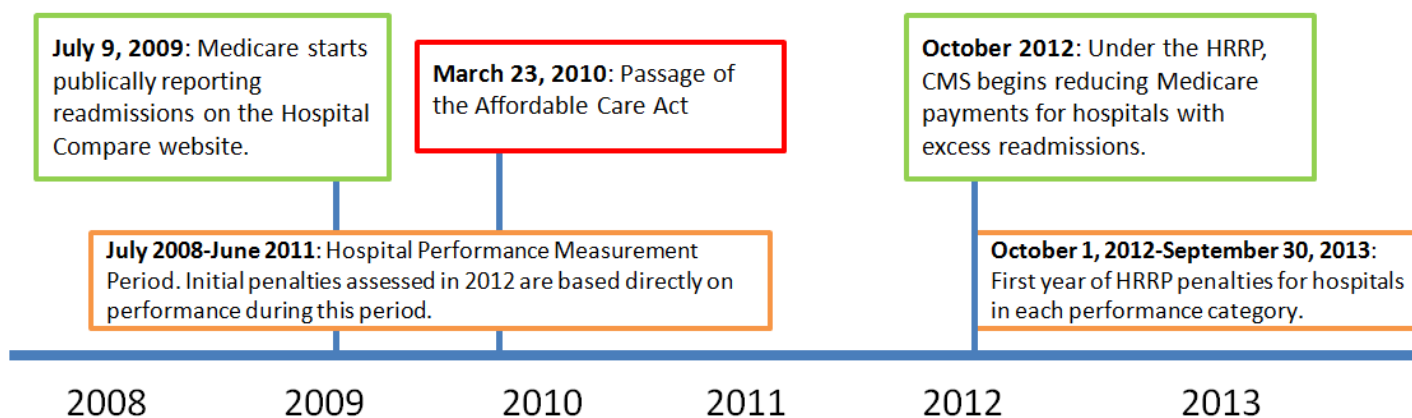
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# Disclosures

- Salary, Massachusetts General Physicians Organization
- Consulting, QPID Health
- Consulting, Gilead Sciences
- Member, New England Comparative Effectiveness Public Advisory Council

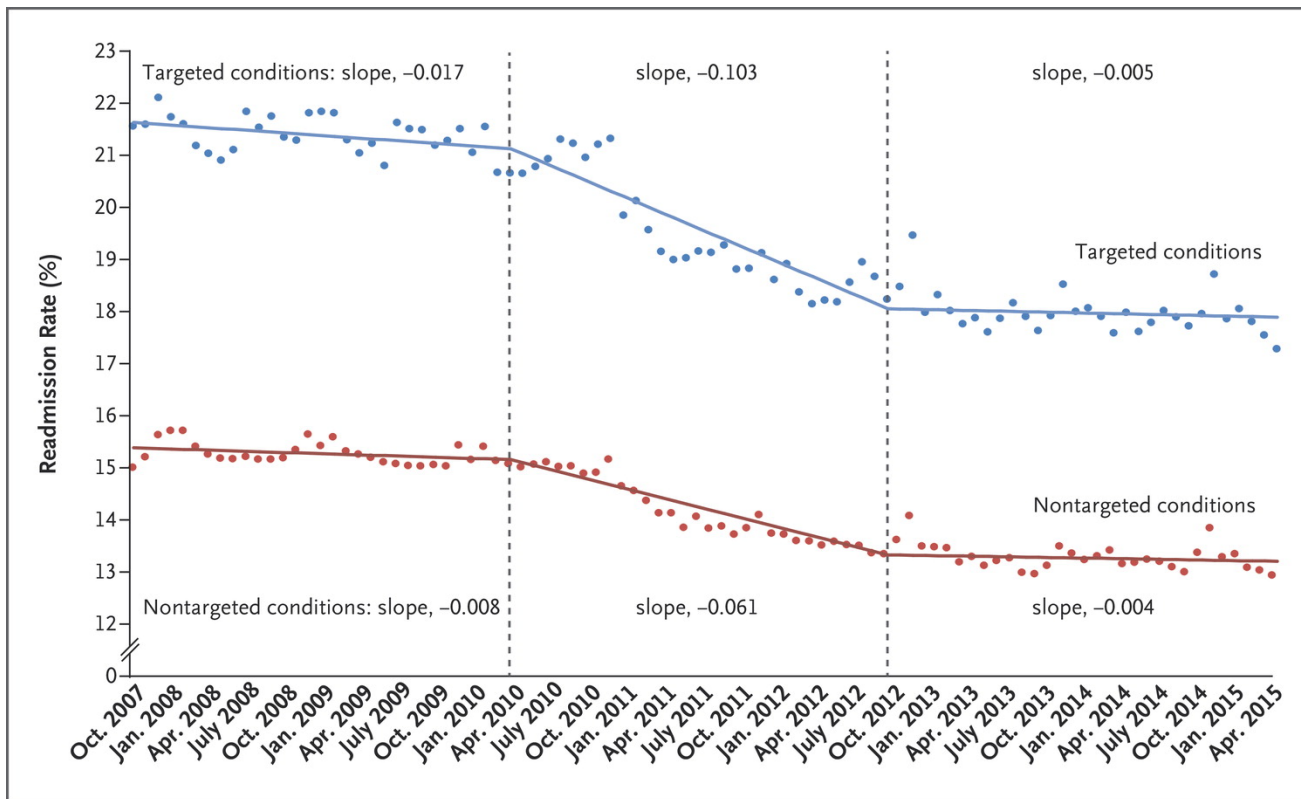
# Background

- Passage of the Affordable Care Act created the Hospital Readmissions Reduction Program (HRRP)
- Introduced the prospect of financial penalties based on performance on readmissions for AMI, CHF, pneumonia during 3 year period
- Uncertain effects – specific concerns regarding equity, competing priorities, vulnerable populations



# Background

- 30 day hospital readmissions after AMI, CHF, pneumonia decreased faster after passage of the Affordable Care Act



Zuckerman et al  
*NEJM* 2016



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# Background

- We don't know which hospitals drove improvement
- In particular, individual effects on higher and lower performing hospitals
- We sought to determine if the acceleration in improvement in readmission rates was greater in lowest-performing hospitals compared with the highest-performing hospitals

# Methods

- Queried MedPAR files, which contain Medicare beneficiaries' inpatient claims data
- Identified patients discharged alive 2000-November 2013 with AMI, CHF, pneumonia, and identified those readmitted to acute care facilities within 30 days
- Identified comorbidities and hospital characteristics

# Methods

- Estimated risk-standardized 30-day all-cause readmission rates (RSRRs) for each hospital (for all three conditions)
- Fitting a logistic regression to the 30-day all-cause readmissions as a function of patients' age, sex, and comorbidities
- We also calculated a combined-condition RSRR, reflecting readmissions for any of the three conditions

# Methods

We identified information regarding hospital penalties from CMS, and classified hospital performance based on initial penalty:

**Lowest performance** (greater than or equal to 99% maximum penalty)

**Low performance** (greater than or equal to 50%, less than 99% maximum penalty)

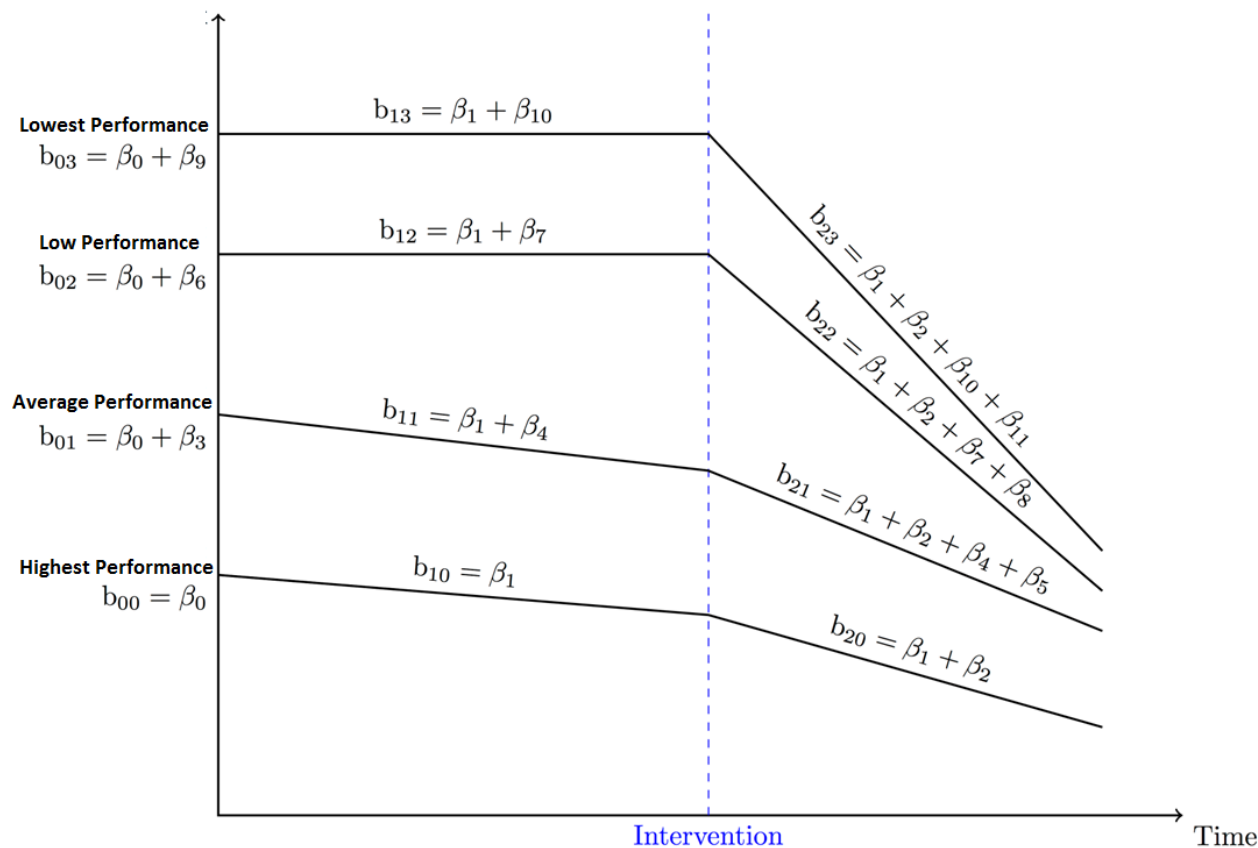
**Average performance** (less than 50% maximum penalty, but not zero)

**Highest performance** (zero penalty)



# Methods

- Pre-post analysis stratified by performance group
- Piecewise linear model with change point defined as passage of the law (March 2010)



# Results

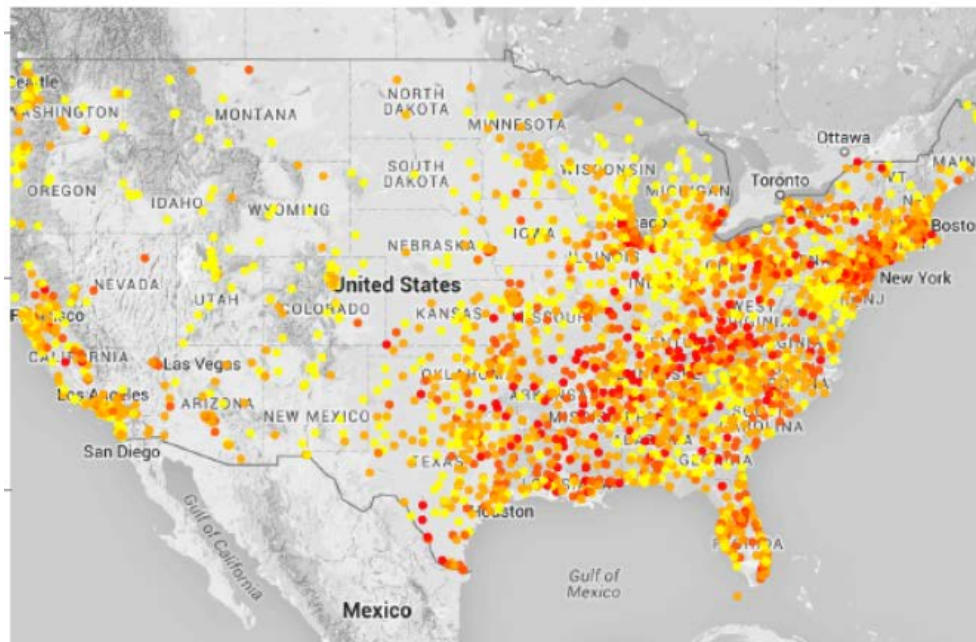
2868 hospitals met inclusion criteria

866 (30.1%) in **highest performance** group

1261 (44.0%) in **average performance** group

483 (16.8%) in **low performance** group

258 (9.0%) in **lowest performance** group



- Highest Performance
- Average Performance
- Low Performance
- Lowest Performance

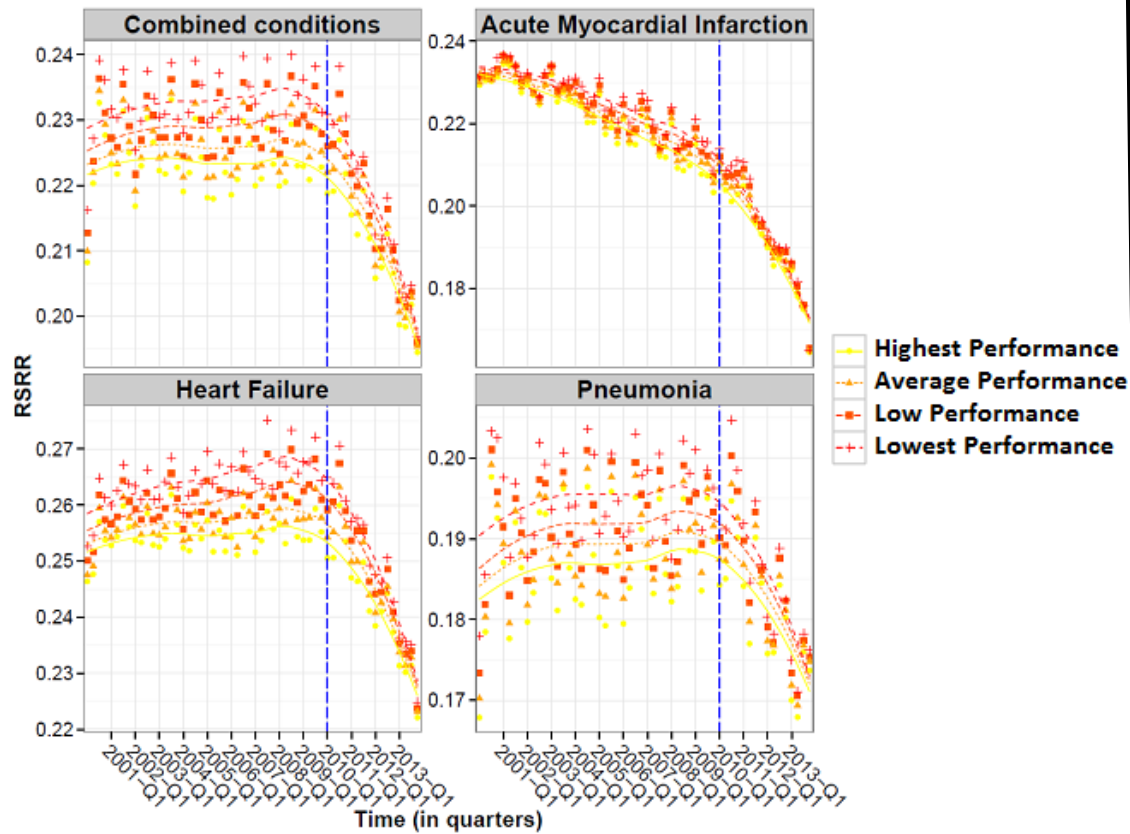
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# Results

- Given the size of the dataset, patient and hospital characteristics were different in every performance group
- In particular, highest performance hospitals served more white patients than lowest performance hospitals (87.9% vs. 85.2%,  $p < 0.001$ )
- Highest performance hospitals were more often rural than lowest performance hospitals (29.9% vs. 25.2%,  $p < 0.001$ )
- Highest performance hospitals served a lesser proportion of dual-eligibles than lowest performance hospitals (17.0% vs. 20.3%,  $p < 0.001$ )

# Results



	Slope	P value
<b>Pre-law slope:</b>		
Highest Performance	-0.00004	<0.0001
Average Performance	0.00000	1
Low Performance	0.00005	1
Lowest Performance	0.00006	1
<b>Post-law slope:</b>		
Highest Performance	-0.00171	<0.0001
Average Performance	-0.00185	<0.0001
Low Performance	-0.00206	<0.0001
Lowest Performance	-0.00230	<0.0001



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# Results – Combined conditions

<b>Differences in pre-post RSRR changes</b> (testing that the acceleration in the decline of RSRR post-law compared to RSRR pre-law is different across hospital performance groups)		
<b>Performance Groups Compared</b>	<b>Estimate</b>	<b>Pr(&gt; t )</b>
<b>Highest vs Average Performance</b>	<b>-0.00018</b>	<b>&lt;0.0001</b>
<b>Highest vs Low Performance</b>	<b>-0.00045</b>	<b>&lt;0.0001</b>
<b>Highest vs Lowest Performance</b>	<b>-0.00069</b>	<b>&lt;0.0001</b>



# Results – Acute Myocardial Infarction

<b>Differences in pre-post RSRR changes</b> (testing that the acceleration in the decline of RSRR post-law compared to RSRR pre-law is different across hospital performance groups)		
<b>Performance Groups Compared</b>	<b>Estimate</b>	<b>Pr(&gt; t )</b>
<b>Highest vs Average Performance</b>	<b>-0.00021</b>	<b>&lt;0.0001</b>
<b>Highest vs Low Performance</b>	<b>-0.00044</b>	<b>&lt;0.0001</b>
<b>Highest vs Lowest Performance</b>	<b>-0.00069</b>	<b>&lt;0.0001</b>



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# Results – Congestive Heart Failure

<b>Differences in pre-post RSRR changes</b> (testing that the acceleration in the decline of RSRR post-law compared to RSRR pre-law is different across hospital performance groups)		
<b>Performance Groups Compared</b>	<b>Estimate</b>	<b>Pr(&gt; t )</b>
<b>Highest vs Average Performance</b>	<b>-0.00022</b>	<b>&lt;0.0001</b>
<b>Highest vs Low Performance</b>	<b>-0.00057</b>	<b>&lt;0.0001</b>
<b>Highest vs Lowest Performance</b>	<b>-0.00085</b>	<b>&lt;0.0001</b>



# Results - Pneumonia

<b>Differences in pre-post RSRR changes</b> (testing that the acceleration in the decline of RSRR post-law compared to RSRR pre-law is different across hospital performance groups)		
<b>Performance Groups Compared</b>	<b>Estimate</b>	<b>Pr(&gt; t )</b>
<b>Highest vs Average Performance</b>	<b>-0.00011</b>	<b>&lt;0.0001</b>
<b>Highest vs Low Performance</b>	<b>-0.00026</b>	<b>&lt;0.0001</b>
<b>Highest vs Lowest Performance</b>	<b>-0.00042</b>	<b>&lt;0.0001</b>



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# Results – Sensitivity Analyses

Our main results were robust in sensitivity analyses:

- (1) Including hospital volume
- (2) Including other hospital characteristics
- (3) Changing the “pre-law” period to 15 months

# Discussion

- Hospitals with lower performance experienced greater acceleration of performance after the law was passed
- The rate of decrease in RSRRs for penalized conditions was one-third greater for the lowest-performing hospitals than for the highest performing hospitals

# Discussion

- A concerning potential outcome of the HRRP was that low-performing hospitals would not be able to improve
- Our analysis is reassuring with respect to that concern
- Our analysis is consistent with previously reported findings that HRRP penalties are applied disproportionately to hospitals that serve black patients, urban patients, and dual-eligibles

# Discussion

- Although this may be a form of regression to the mean (lower performing hospitals have more room for improvement) we present strong evidence that the reverse did not occur
- Our analysis minimizes confounding bias, a common threat to validity in policy analyses
- Highest performance group serving as a control for lower performance groups

# Limitations

- Analysis of billing codes
- We do not know that declines in RSRRs are related to genuine improvements in the quality of care
- We cannot detect effects on observation readmissions
- We cannot adjust for all confounding by hospital characteristics

# Conclusions

- Hospitals with relatively lower initial performance had greater acceleration of improvement in RSRRs compared with the highest performance group
- This effect persisted for all three conditions in the initial set of HRRP penalties

# Thanks!

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# Backup Slides – Sensitivity Analyses

- Refitted piecewise model weighted by hospital volume for each disease condition
- Varied the definition of “pre-law” to 15 quarters (40 quarters in the primary analysis)
- Included other hospital characteristics to adjust for differences between hospitals in performance categories



# Characteristics of Patients and Hospitals, by Initial Hospital Performance Group

Characteristics	Highest Performance	Average Performance	Low Performance	Lowest Performance	Overall
<b>Study population</b>					
Total hospitals (#)	866	1,261	483	258	2,868
Total annual discharges (#)	311,920	467,000	217,350	113,270	1,109,530
<b>Condition-specific discharges as proportion of whole population, %</b>					
AMI	20.8	18.7	18.5	16.4	19
CHF	42.8	44.9	47.1	47.7	45
Pneumonia	36.5	36.3	34.4	35.9	35.9
<b>Patient level</b>					
<b>Demographics, #, (%)</b>					
Age, years, mean (SD)	79.5 ( $\pm$ 8.4)	79.5 ( $\pm$ 8.5)	79.5 ( $\pm$ 8.5)	79.8 ( $\pm$ 8.6)	79.5 ( $\pm$ 8.5)
Female	53.1	54.6	55	56.7	54.5
White	87.9	85.8	81.9	81.6	85.2
Black	7.3	9.6	13.4	13.1	10.1
Other race	4.8	4.5	4.7	5.3	4.7



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# Characteristics of Patients and Hospitals, by Initial Hospital Performance Group

Characteristics	Highest Performance	Average Performance	Low Performance	Lowest Performance	Overall
<b>Co-morbidity, # (%)</b>					
History of CHF	33.2	36.1	39.1	41.8	36.5
History of AMI	6.9	7.3	7.9	8.3	7.4
Unstable angina	4.5	4.6	5.2	5.4	4.8
Chronic atherosclerosis	54.5	55.5	58	58.6	56
Hypertension	61.5	63.7	65.6	67.5	63.8
Stroke	2.3	2.5	2.7	2.9	2.5
Cerebrovascular disease other than stroke	5.6	6.2	6.4	6.8	6.1
Renal failure	17.1	18.7	20.7	21	18.9
COPD	38.2	40.3	41.2	43	40.2
Pneumonia	20.9	22.6	23.5	26	22.7
Protein calorie malnutrition	6.1	6.4	6.5	6.4	6.3
Dementia	12.3	13.7	14.3	16.2	13.7
Functional disability	3.4	3.9	4.3	4.7	3.9
Peripheral vascular disease	9.7	10.5	11.5	12	10.6
Metastatic cancer	9.5	9.8	10.2	10.4	9.9
Major psychiatric disorder	3	3.5	3.7	4.1	3.5
Chronic liver disease	1.1	1.2	1.3	1.4	1.2
Depression	8.7	9.2	9.2	9.7	9.1
Diabetes	34.8	36.1	37.9	39.1	36.4
Anemia	31.3	32.7	33.8	34.5	32.7
Asthma	3.7	3.7	3.9	4.3	

# Characteristics of Patients and Hospitals, by Initial Hospital Performance Group

Characteristics	Highest Performance	Average Performance	Low Performance	Lowest Performance	Overall
<b>Major discharge disposition and outcomes, # (%)</b>					
Discharged to home	56.2	52.2	50.1	47	52.4
Discharged to home with care	15.6	17.8	19.5	21.1	17.9
Discharged to nursing home	21.7	23.3	23.4	25.2	23
Length of stay, days, mean (SD)	6 ( $\pm$ 4.8)	6 ( $\pm$ 5.0)	6 ( $\pm$ 5.5)	6 ( $\pm$ 5.7)	6 ( $\pm$ 5.1)
Observed readmission rate	19.9	22	24.2	26.3	22.3
<b>Hospital level</b>					
Hospital located in a rural area, %	29.9	23.7	21.9	22.9	25.2
Private not-for profit hospital, %	70.6	62.4	66.2	61.6	65.4
Major teaching hospital, %	6.1	9.6	12.7	11.2	9.2
<b>All admitted Medicare fee-for-service population, %</b>					
Median annual volume	2,539,620	3,783,810	1,694,920	825,410	8,843,770
Age, years, mean (SD)	78.0 ( $\pm$ 8.0)	78.1 ( $\pm$ 8.1)	78.2 ( $\pm$ 8.1)	78.6 ( $\pm$ 8.2)	78.1 ( $\pm$ 8.1)
Female	56.7	57.8	57.8	59.3	57.6
White	88.6	86.5	82.3	81.1	85.8
Black	7.0	9.1	13.0	13.2	9.6
Other race	4.4	4.4	4.7	5.7	4.6
Dual-eligible (eligible for Medicaid and Medicare)	17.0	20.6	22.0	26.1	20.3
<b>Outcomes (all admitted Medicare fee-for-service population), %</b>					
30-day all-cause mortality rate	8.8	8.8	8.6	8.7	8.8
30-day all-cause readmission rate	13.3	14.4	15.8	17.2	14.6

All P values <0.001 for linear trends.



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# Combined Conditions

Readmission Trends, Improvement in Readmission Trends Pre-/Post-Law Within Each Performance Group, and Testing Differences in Pre-Post Changes Across All Performance Groups

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law slope:</i>				
Highest Performance	$b_{10} \geq 0$	-0.00004	-10.6250	<0.0001
Average Performance	$b_{11} \geq 0$	0.00000	0.7090	1
Low Performance	$b_{12} \geq 0$	0.00005	10.7341	1
Lowest Performance	$b_{13} \geq 0$	0.00006	9.1642	1
<i>Post-law slope:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00171	-149.0630	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00185	-194.3643	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00206	-134.3433	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00230	-109.2229	<0.0001
<i>Pre-post analysis (testing that post-law slopes are higher than pre-law slopes, more accelerated decline after the law within each performance group)</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00167	-120.4455	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00185	-160.9185	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00212	-113.9472	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00236	-92.7568	<0.0001
<i>Differences in pre-post RSRR changes (testing that the acceleration in the decline of RSRR post-law compared to RSRR pre-law is different across hospital performance groups)</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00018	-9.9395	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00027	12.2071	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00051	18.1943	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00045	-19.2264	<0.0001
Highest vs Lowest Performance	$b_{11} \geq 0$	-0.00069	-23.7127	<0.0001



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# Acute Myocardial Infraction

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law slope:</i>				
Highest Performance	$b_{10} \geq 0$	-0.00066	-116.5930	<0.0001
Average Performance	$b_{11} \geq 0$	-0.00060	-134.1979	<0.0001
Low Performance	$b_{12} \geq 0$	-0.00055	-77.0769	<0.0001
Lowest Performance	$b_{13} \geq 0$	-0.00050	-47.7443	<0.0001
<i>Post-law slope:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00227	-128.3233	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00242	-173.6928	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00260	-116.9248	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00280	-86.2326	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00161	-75.1432	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00182	-107.9846	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00205	-76.2150	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00230	-58.6266	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00021	-7.8400	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00023	7.1388	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00048	11.2190	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00044	-12.8125	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00069	-15.5004	<0.0001



# Congestive Heart Failure

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law slope:</i>				
Highest Performance	$b_{10} \geq 0$	0.00005	9.5679	1
Average Performance	$b_{11} \geq 0$	0.00011	25.0038	1
Low Performance	$b_{12} \geq 0$	0.00018	25.7388	1
Lowest Performance	$b_{13} \geq 0$	0.00021	21.1372	1
<i>Post-law slope:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00186	-108.6577	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00202	-145.1441	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00230	-103.2998	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00256	-83.4753	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00192	-92.3966	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00214	-126.6699	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00249	-92.2619	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00277	-74.6455	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00022	-8.2388	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00035	11.0680	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00063	15.4661	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00057	-16.8213	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00085	-20.0146	<0.0001



# Pneumonia

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	0.00007	13.6270	1
Average Performance	$b_{11} \geq 0$	0.00008	18.8280	1
Low Performance	$b_{12} \geq 0$	0.00009	13.8986	1
Lowest Performance	$b_{13} \geq 0$	0.00007	7.7242	1
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00108	-70.1762	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00118	-94.5132	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00131	-65.5789	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00150	-54.5870	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00115	-61.6526	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00126	-83.1599	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00140	-57.9230	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00157	-47.1929	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00011	-4.5770	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00015	5.1025	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00031	8.5386	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00026	-8.3624	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00042	-11.0651	<0.0001



# Sensitivity Analysis #1: Weighting RSRRs by hospital volume

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	-0.00006	-13.2687	<0.0001
Average Performance	$b_{11} \geq 0$	0.00001	1.6380	1
Low Performance	$b_{12} \geq 0$	0.00008	15.9822	1
Lowest Performance	$b_{13} \geq 0$	0.00011	15.4363	1
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00161	-106.7374	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00177	-143.9503	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00206	-114.1310	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00234	-93.2037	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00155	-86.8687	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00177	-121.8563	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00214	-100.3351	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00245	-82.6862	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00022	-9.6945	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00037	14.3095	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00068	20.6370	<0.0001

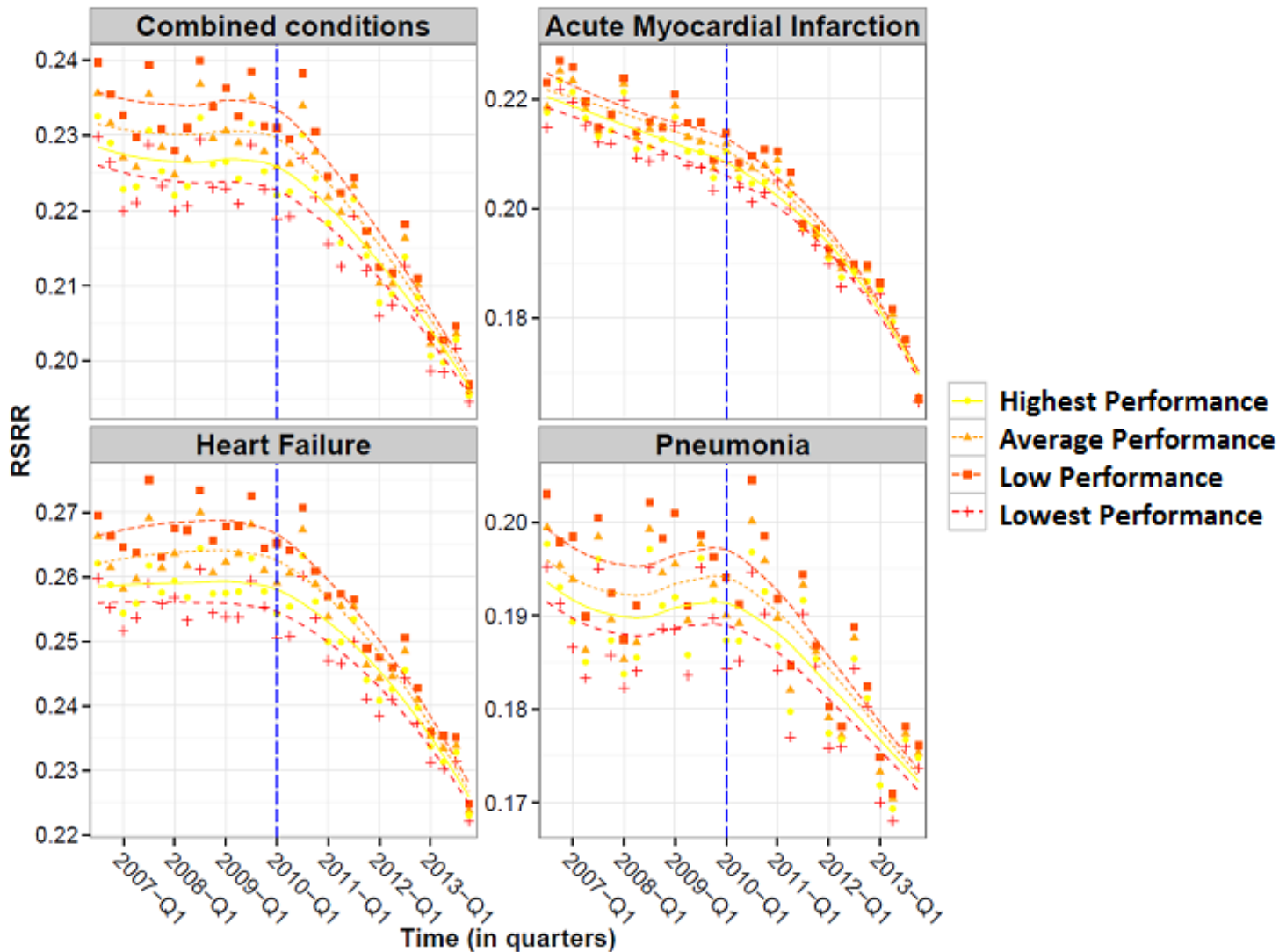


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# Sensitivity Analysis #2: Changing the “pre-law” time period to 15 months from 40 months



# Sensitivity Analysis #2: Combined Conditions

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	-0.00006	-4.6060	<0.0001
Average Performance	$b_{11} \geq 0$	0.00001	0.5952	1
Low Performance	$b_{12} \geq 0$	0.00006	3.1532	1
Lowest Performance	$b_{13} \geq 0$	0.00003	1.4417	1
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00175	-145.7843	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00190	-189.8664	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00211	-129.5209	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00233	-104.4657	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00169	-75.5710	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00190	-102.2564	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00216	-71.3536	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00236	-56.9100	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00021	-7.2036	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00026	7.3160	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00046	10.1068	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00047	-12.4694	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00067	-14.1942	<0.0001



# Sensitivity Analysis #2: Acute Myocardial Infraction

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	-0.00070	-32.1951	<0.0001
Average Performance	$b_{11} \geq 0$	-0.00065	-38.2389	<0.0001
Low Performance	$b_{12} \geq 0$	-0.00059	-21.5692	<0.0001
Lowest Performance	$b_{13} \geq 0$	-0.00058	-14.6941	<0.0001
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00225	-112.0764	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00241	-154.0793	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00257	-102.1953	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00274	-75.2282	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00155	-41.4350	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00176	-60.4654	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00198	-42.3103	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00216	-31.8338	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00021	-4.4323	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00022	4.0256	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00040	5.3758	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00043	-7.2079	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00061	-7.8369	<0.0001



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# Sensitivity Analysis #2: Congestive Heart Failure

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	0.00005	9.5679	1
Average Performance	$b_{11} \geq 0$	0.00011	25.0038	1
Low Performance	$b_{12} \geq 0$	0.00018	25.7388	1
Lowest Performance	$b_{13} \geq 0$	0.00021	21.1372	1
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00186	-108.6577	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00202	-145.1441	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00230	-103.2998	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00256	-83.4753	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00192	-92.3966	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00214	-126.6699	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00249	-92.2619	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00277	-74.6455	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00022	-8.2388	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00035	11.0680	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00063	15.4661	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00057	-16.8213	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00085	-20.0146	<0.0001

# Sensitivity Analysis #2: Pneumonia

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	0.00002	1.4310	1
Average Performance	$b_{11} \geq 0$	0.00006	4.3563	1
Low Performance	$b_{12} \geq 0$	0.00010	4.5480	1
Lowest Performance	$b_{13} \geq 0$	0.00007	2.3691	1
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00111	-72.2234	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00122	-97.1453	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00136	-67.1342	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00154	-55.4687	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00114	-39.5979	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00127	-54.6757	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00146	-38.6788	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00161	-31.1503	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00014	3.6917	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00018	4.1178	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00034	5.9228	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00032	-6.7333	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00047	-7.9882	<0.0001

# Sensitivity Analysis #3: Including hospital characteristics, combined conditions

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law: Highest Performance</i>	$b_{10} \geq 0$	0.00001	3.2830	1
Average Performance	$b_{11} \geq 0$	0.00005	17.5900	1
Low Performance	$b_{12} \geq 0$	0.00010	20.8261	1
Lowest Performance	$b_{13} \geq 0$	0.00011	16.6044	1
<i>Post-law: Highest Performance</i>	$b_{20} \geq 0$	-0.00177	-151.1803	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00190	-197.1479	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00212	-135.4318	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00235	-110.1394	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00178	-126.6670	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00196	-168.6317	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00222	-118.1063	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00246	-95.9651	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00018	-9.7920	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00027	11.9974	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00050	17.8811	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00044	-18.8947	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00068	-23.3174	<0.0001
<i>Hospital characteristics</i>				
Rural hospital	$= 0$	-0.00036	-6.7225	<0.0001
Major teaching hospital	$= 0$	0.00193	20.5682	<0.0001
Minor teaching hospital	$= 0$	-0.00027	-4.7520	0.00017
Public hospital	$= 0$	-0.00049	-6.2806	<0.0001
Private, Non-profit hospital	$= 0$	-0.00009	-1.4838	0.75844
Patient age (mean)	$= 0$	0.00006	3.1840	0.01518
Proportion of white patients	$= 0$	-0.00415	-17.3360	<0.0001
Proportion of black patients	$= 0$	0.00092	3.4997	0.00501
Male (%)	$= 0$	-0.00753	-11.7533	<0.0001
Patient volume	$= 0$	0.00000	-6.7169	<0.0001
Proportion of dual-eligibles	$= 0$	0.00122	6.1705	<0.0001



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# Sensitivity Analysis #3: Acute Myocardial Infraction

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>	$b_{10} \geq 0$	-0.00064	-170.9225	<0.0001
Highest Performance	$b_{11} \geq 0$			
Average Performance	$b_{12} \geq 0$	-0.00059	-194.4766	<0.0001
Low Performance	$b_{13} \geq 0$	-0.00056	-113.4513	<0.0001
Lowest Performance		-0.00052	-76.3794	<0.0001
<i>Post-law:</i>	$b_{20} \geq 0$	-0.00233	-188.2349	<0.0001
Highest Performance				
Average Performance	$b_{21} \geq 0$	-0.00244	-244.1526	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00256	-158.4160	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00269	-118.6734	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00169	-114.6344	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00185	-154.7056	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00200	-103.6301	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00217	-80.1406	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00015	-8.1604	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00015	6.7378	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00032	10.8069	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00031	-12.6695	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00047	-15.3988	<0.0001
<i>Hospital characteristics</i>				
Rural hospital	$= 0$	-0.00009	-1.6166	0.65648
Major teaching hospital	$= 0$	0.00104	11.1836	<0.0001
Minor teaching hospital	$= 0$	-0.00033	-5.8298	<0.0001
Public hospital	$= 0$	0.00017	2.1226	0.28686
Private, Non-profit hospital	$= 0$	0.00017	2.5648	0.09992
Patient age (mean)	$= 0$	0.00012	6.2197	<0.0001
Proportion of white patients	$= 0$	-0.00395	-14.4037	<0.0001
Proportion of black patients	$= 0$	-0.00052	-1.7628	0.54145
Male (%)	$= 0$	-0.00369	-5.3865	<0.0001
Patient volume	$= 0$	0.00000	-3.2668	0.01134
Proportion of dual-eligibles	$= 0$	-0.00095	-4.5770	<0.0001



# Sensitivity Analysis #3: Congestive Heart Failure

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	0.00008	15.2699	1
Average Performance	$b_{11} \geq 0$	0.00013	32.4597	1
Low Performance	$b_{12} \geq 0$	0.00021	30.8679	1
Lowest Performance	$b_{13} \geq 0$	0.00023	25.1938	1
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00190	-117.5308	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00205	-154.0767	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00233	-108.2854	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00258	-87.9183	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00197	-101.8319	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00218	-136.6942	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00254	-98.1405	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00281	-79.7041	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00021	-8.4409	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00036	11.6861	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00062	16.1422	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00057	-17.5526	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00084	-20.8032	<0.0001
<i>Hospital characteristics</i>				
Rural hospital	$= 0$	-0.00026	-3.5360	0.00435
Major teaching hospital	$= 0$	0.00229	17.7105	<0.0001
Minor teaching hospital	$= 0$	-0.00050	-6.3873	<0.0001
Public hospital	$= 0$	-0.00062	-5.7756	<0.0001
Private, Non-profit hospital	$= 0$	-0.00038	-4.3805	0.00015
Patient age (mean)	$= 0$	0.00012	4.7372	<0.0001
Proportion of white patients	$= 0$	-0.00644	-19.3862	<0.0001
Proportion of black patients	$= 0$	-0.00063	-1.7251	0.57426
Male (%)	$= 0$	-0.00999	-11.2950	<0.0001
Patient volume	$= 0$	0.00000	-12.3906	<0.0001
Proportion of dual-eligibles	$= 0$	0.00127	4.6705	<0.0001



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# Sensitivity Analysis #3:Pneumonia

		Estimate	t value	Pr(> t )
<i>Estimation of trends</i>				
<i>Pre-law:</i>				
Highest Performance	$b_{10} \geq 0$	0.00012	26.0915	1
Average Performance	$b_{11} \geq 0$	0.00013	33.8971	1
Low Performance	$b_{12} \geq 0$	0.00014	22.5689	1
Lowest Performance	$b_{13} \geq 0$	0.00012	13.7194	1
<i>Post-law:</i>				
Highest Performance	$b_{20} \geq 0$	-0.00115	-76.4339	<0.0001
Average Performance	$b_{21} \geq 0$	-0.00124	-100.6287	<0.0001
Low Performance	$b_{22} \geq 0$	-0.00137	-68.5551	<0.0001
Lowest Performance	$b_{23} \geq 0$	-0.00155	-56.8436	<0.0001
<i>Pre-post analysis</i>				
Highest Performance	$\beta_2 \geq 0$	-0.00127	-70.4034	<0.0001
Average Performance	$\beta_2 + \beta_5 \geq 0$	-0.00137	-92.5484	<0.0001
Low Performance	$\beta_2 + \beta_8 \geq 0$	-0.00151	-62.9134	<0.0001
Lowest Performance	$\beta_2 + \beta_{11} \geq 0$	-0.00167	-50.8664	<0.0001
<i>Differences in pre-post RSRR changes</i>				
Highest vs Average Performance	$\beta_5 \geq 0$	-0.00011	-4.5230	<0.0001
Average vs Low Performance	$\beta_5 - \beta_8 \leq 0$	0.00014	4.9424	<0.0001
Low vs Lowest Performance	$\beta_8 - \beta_{11} \leq 0$	0.00029	8.1437	<0.0001
Highest vs Low Performance	$\beta_8 \geq 0$	-0.00025	-8.1616	<0.0001
Highest vs Lowest Performance	$\beta_{11} \geq 0$	-0.00040	-10.6580	<0.0001
<i>Hospital characteristics</i>				
Rural hospital	$= 0$	-0.00042	-6.2202	<0.0001
Major teaching hospital	$= 0$	0.00214	17.8148	<0.0001
Minor teaching hospital	$= 0$	-0.00009	-1.2689	0.88700
Public hospital	$= 0$	-0.00040	-4.0285	0.00060
Private, Non-profit hospital	$= 0$	0.00014	1.7035	0.59162
Patient age (mean)	$= 0$	0.00002	0.6555	0.99907
Proportion of white patients	$= 0$	-0.00211	-6.8838	<0.0001
Proportion of black patients	$= 0$	0.00215	6.4015	<0.0001
Male (%)	$= 0$	-0.00587	-7.1394	<0.0001
Patient volume	$= 0$	0.00000	3.9225	0.00092
Proportion of dual-eligibles	$= 0$	0.00118	4.6447	<0.0001



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