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Studies in Health Care and Economics

Public Reporting and Self-Regulation:
Hospital Compare's Effect on Sameday Brain and Sinus Computed Tomography Utilization

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Motivation

- Widespread concerns over rising health care costs[1]:

Year	Total Expenditures (billions)	Share of GDP
2008	2402.6	16.3%
2014	3031.3	17.5%

- Average annual growth rate 2008-2014: **4.06%**
- How to curb the growth?

1. Martin et al. (2016). Health Affairs 35: 150-160

CMS Efforts to Reduce Costs

- Reductions in physician and facility payments
  - Private payers usually follow CMS
- Encouraging managed care utilization
- Alternative payment models
  - Accountable Care Organizations
  - Episodic Bundled Payments
- Resource utilization as quality measure in PQRS/MIPS
- Regulation targeting potential over-utilization of specific procedures

Imaging Efficiency Metrics (IEM)

- Established by CMS under ACA
- Why?
  - 2014 Part B Imaging Expenditures: $9.52 billion[1]
- Targeted 6 imaging procedures seen as low value:
  - OP-8: MRI lumbar spine for low back pain
  - OP-9: Mammography follow-up rates
  - OP-10: Abdomen CT “Double scans” (with & without contrast)
  - OP-11: Thorax CT “Double scans”
  - OP-13: Cardiac stress tests before low risk outpatient surgery
  - OP-14: Simultaneous Brain & Sinus CT

[1] Neiman Almanac: http://www.neimanhpi.org/data_series/medicare-part-b-total-imaging-spending/#/graph/2003/2014/true

IEM: Public Reporting with Self Regulation

- Hospitals must report IEMs to CMS
  - Applied to outpatient and emergency departments
  - 2% penalty for failure to report
- Public reporting on *CMS Hospital Compare*
  - Allow comparisons between facilities
- Self-regulation: Hospitals decide whether and how to change behavior
  - No established benchmark for quality
  - No penalties to hospitals for IEM results

Interesting Questions

- Why do hospitals care about IEM?
  - No one knows the “appropriate” volume of these services
  - No penalties regardless of results
  - Reputation?
- If hospitals care about IEM, what can they do?
  - Physicians – not hospitals – order tests
  - Most hospitals have limited control over non-employee physicians

How effective is this kind of regulation?

Contributions

- First to examine public reporting without “report cards”:
  - Scores are not monotonic functions of quality
- Examine effects of IEMs on imaging utilization

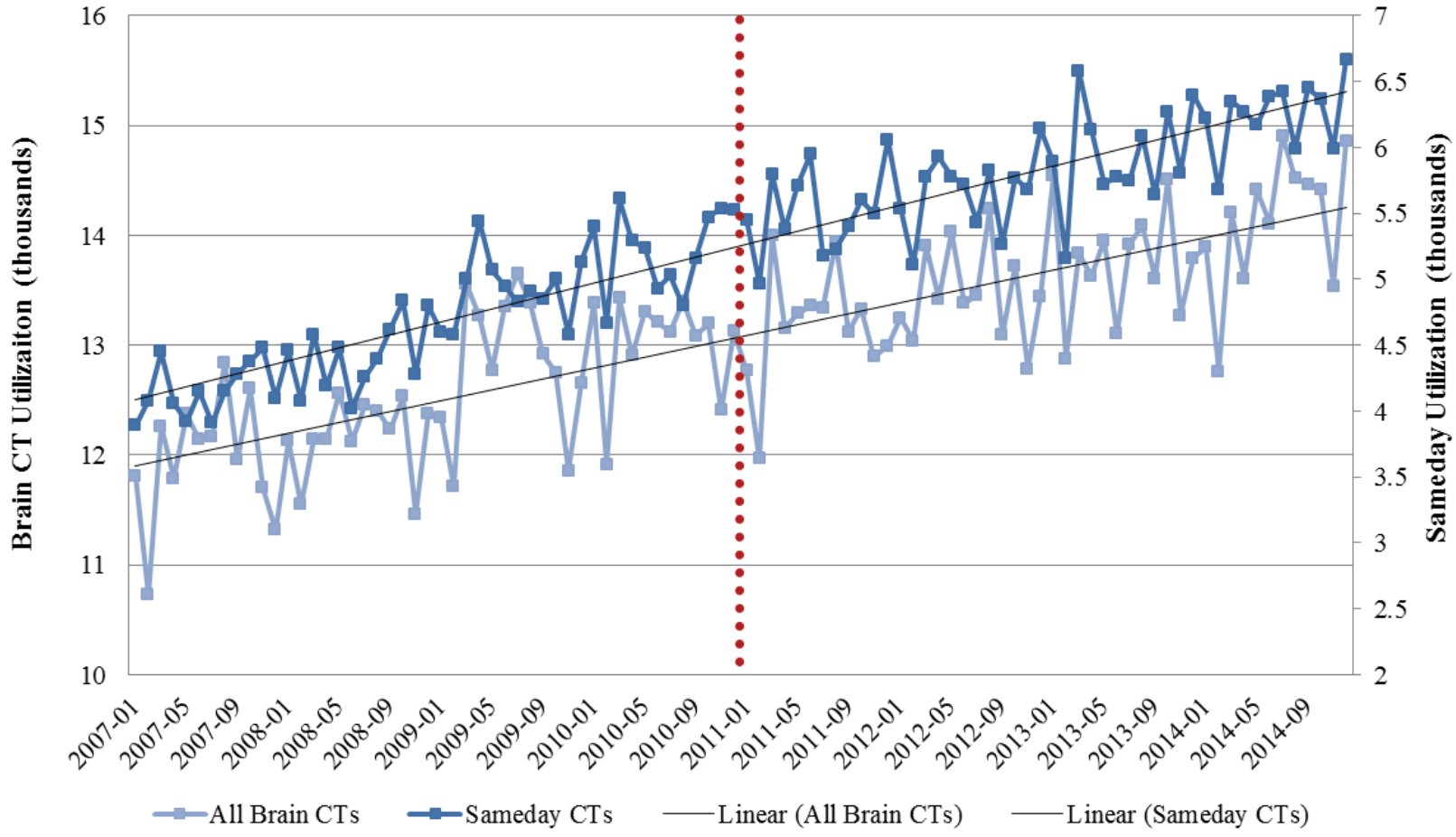
OP-14: Simultaneous Brain & Sinus CT

- Same patient undergoes same day brain & sinus CTs:

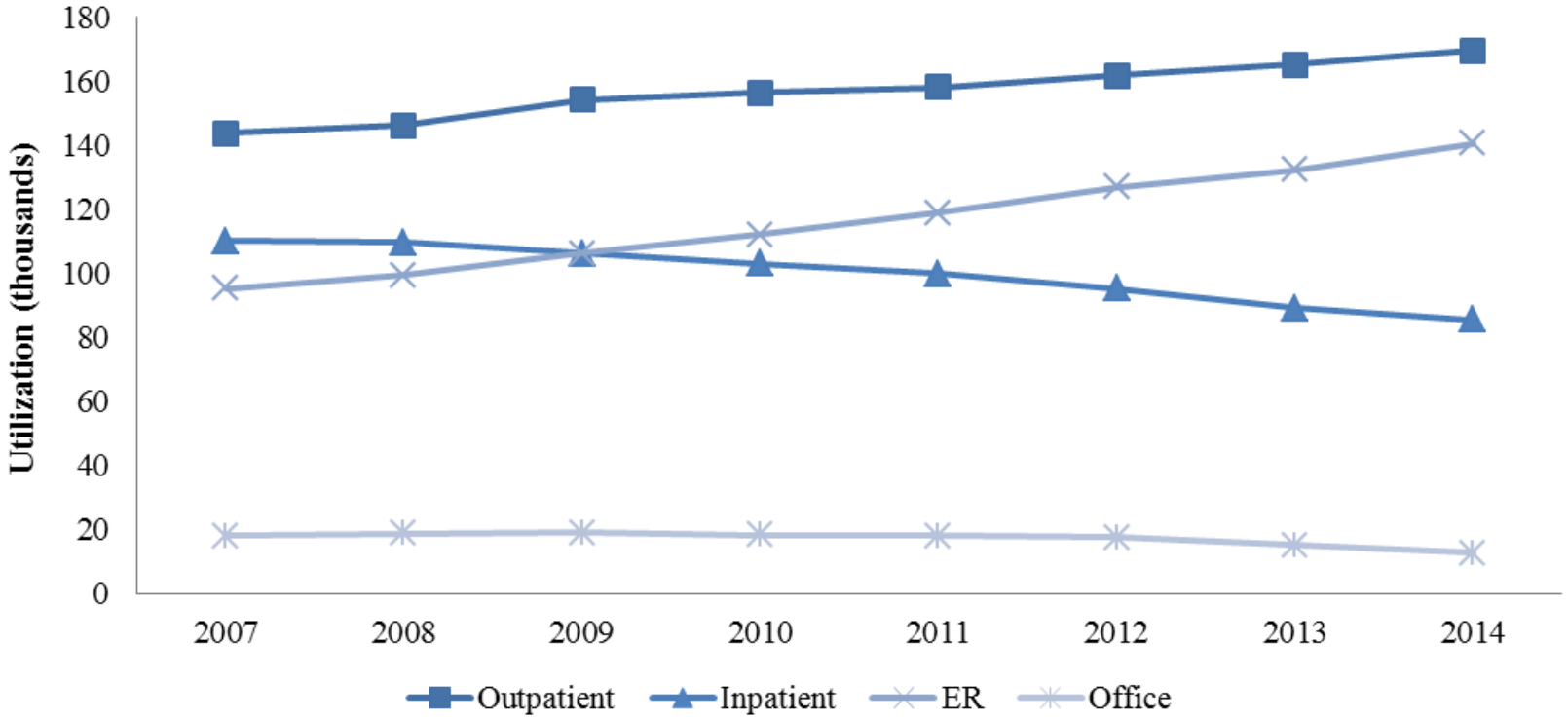
$$OP-14 = \frac{\#Same\ day\ brain\ and\ sinus\ CTs}{\#All\ brain\ CTs}$$

- Calculated by hospital and by state – not by physician!
- Incorporates known exclusions for appropriate use
- Only applies to hospital outpatient and ED claims

Comparison of Same day and Brain only CTs

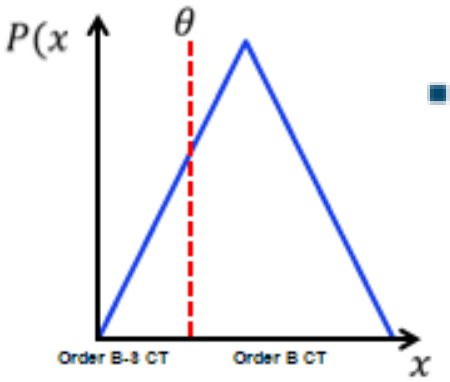


Brain CT Utilization by Place of Service



Game Theoretic Model

- Each individual in a population is assigned a rank, $x\epsilon[0,1]\ s.t.\ (100 * x)\%$ expects to be affected more severely by disease[1]:
  - $x \to 1$, individuals are healthier
  - $x \to 0$, individuals are sicker



- θ threshold for ordering additional tests[2]:
  - $x \leq \theta$ order same-day brain & sinus CT
  - $x \geq \theta$ order brain CT

[1]Yaesoubi & Roberts (2011). J Health Econ 30: 1188-1196
[2]Pauker & Kassirer (1980). NEJM 302: 1109-1117

Empirical Analysis

- Examine the effectiveness of OP-14 on reducing same day brain and sinus CT
- Two empirical approaches:
  - Aggregate ("Reduce B-S CT utilization?")
    - Interrupted time series (ITS) analysis
  - Physician Decisions ("Can hospitals influence?")
    - Multivariate difference-in-difference (DID) logistic regression
- Both exploit variation between outpatient and office place of service

Data

- CMS 5% Research Identifiable Files (RIF)
  - Covers 5% national sample of Medicare enrollees
  - All Part A & Part B claims associated with sample
  - ~ 1.8 million fee-for-service enrollees per year
  - Spans 2007-2014 (DID analysis covers 2008-2014)
- Study cohort: All patients receiving a brain CT
- Excluded:
  - Patients < 65 years old
  - Patients meeting same day exclusion criteria (n=942)

ITS Analysis

- Segmented regression:

$$Y = \beta_0 + \beta_1 Time + \beta_2 IEM + \beta_3 Time\ post\ IEM + \varepsilon_{time}$$

Where:

Y = Rate of same day brain sinus CTs per month

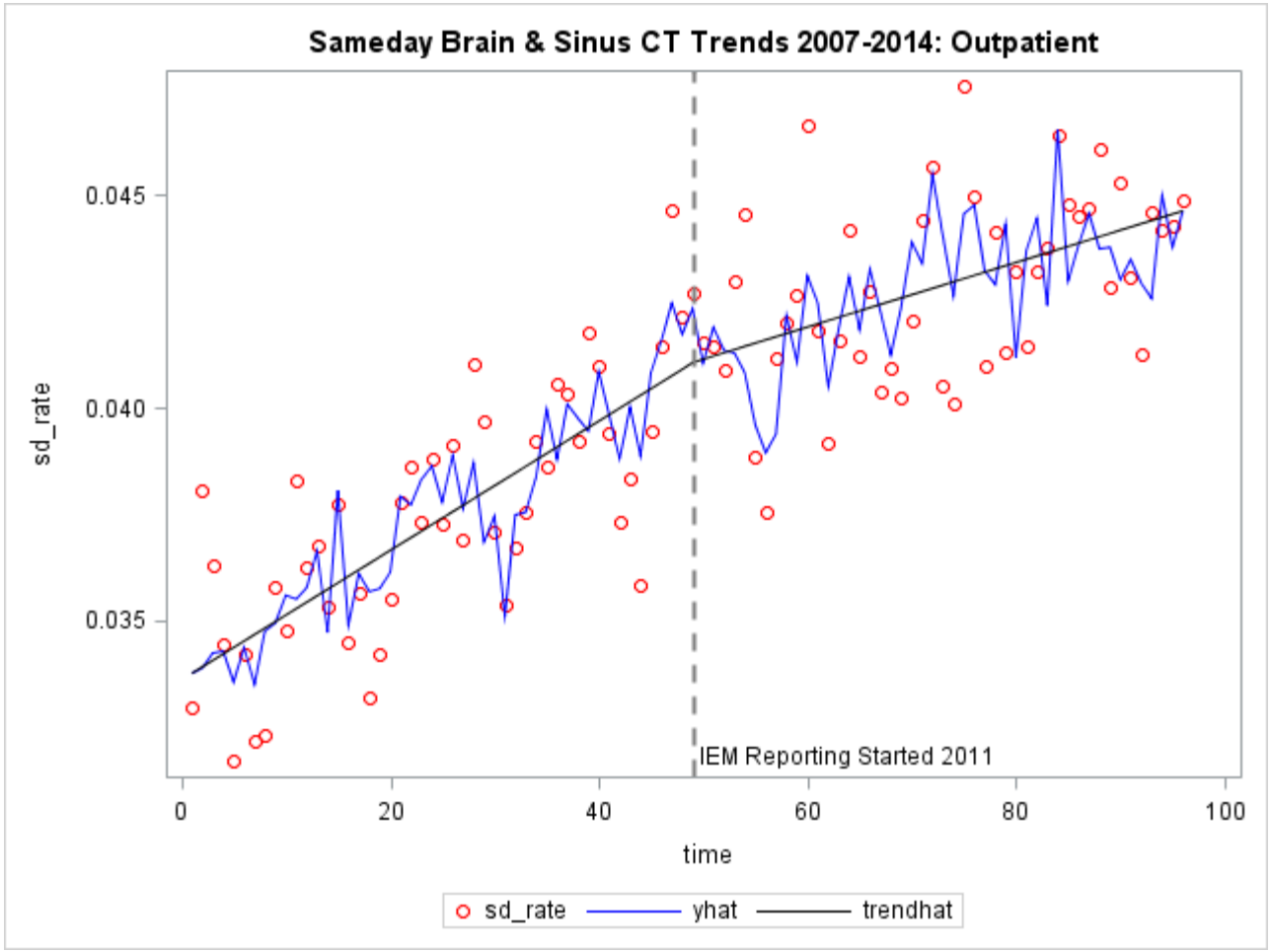
β_0 estimates baseline rate at beginning of study period

β_1 estimates baseline trend (slope) before IEM

β_2 estimates change in rate (level) after IEM

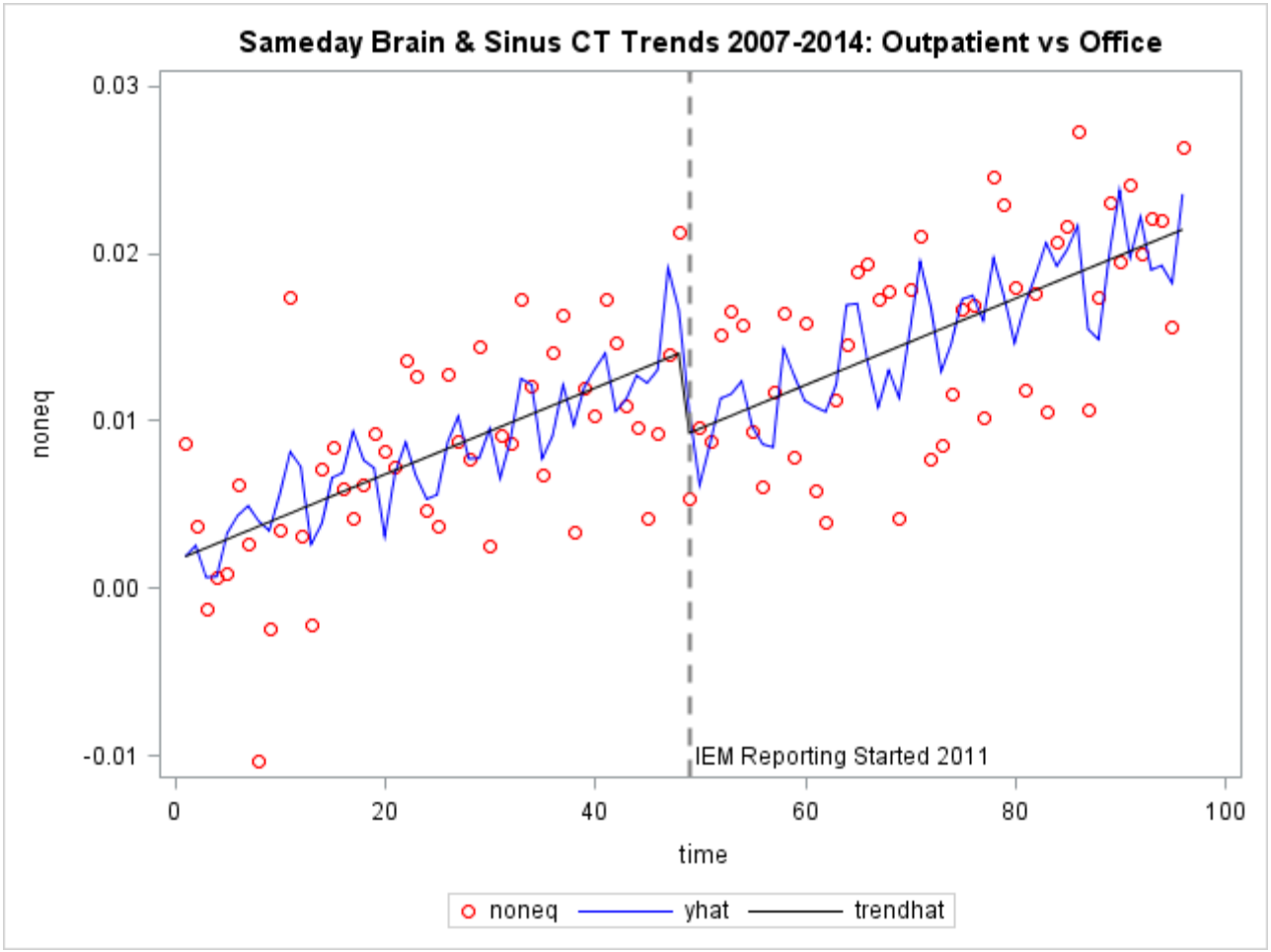
β_3 estimates change in trend (slope) after IEM

ITS Results: Monthly Outpatient Utilization



Variable	Estimate	P-value
Intercept	0.0336	<.0001
	(0.0002)	
Trend pre-IEM	0.0002	<.0001
	(0.0000)	
Rate change (IEM)	0.0001	0.7495
	(0.0003)	
Trend change (IEM)	-0.0001	<.0001
	(0.0000)	

ITS Results: Outpatient vs Office



Variable	Estimate	P-value
Intercept	0.0016	0.0646
	(0.0009)	
Trend pre-IEM	0.0003	<.0001
	(0.0000)	
Rate change (IEM)	-0.0050	<.0001
	(0.0012)	
Trend change (IEM)	0.0000	0.9870
	(0.0000)	

DID Logistic Regression

- Multivariate logistic regression on lengthy panel of Medicare claims data:
  - Likelihood a brain CT patient also receives a sinus CT on the same day
  - Difference-in-difference model
  - Controls for patient demographics, risk, geographic variation in care
  - Robustness checks with different treatment and control groups

DID Identification Strategy

- Sample: All patient claims for brain CT

$$Y_{ist} = Outpatient_{is}\beta_1 + OP14_t\beta_2 + Interaction_{st}\beta_3 + \boldsymbol{Z\beta} + u_{ist}$$

- Dependent Variable: Patient received same day sinus CT (binary)
- Treatment Group: Outpatient facility patients
- Control group: Physician office patients
- Treatment: Implementation of OP-14 metric
- Appropriate control variables

Data: Control Variables

- ACA Indicator (June 2010-2014)
- Beneficiary demographics
  - Age
  - Race
  - Sex
  - Prospective Charlson Comorbidity Index (required 2007 data)
- Provider state indicator: geographic variation
- State Leading Index[1] (2008-2014): macro trends
- Year: volume growth
- Month: seasonality

1. Philadelphia Federal Reserve

Summary Statistics

Variable	Mean	SD	Min	Max
IEM Indicator (January 1, 2011)	0.52	0.5	0	1
DiD Indicator	0.47	0.5	0	1
Same Day Rate	0.03	0.03	0	1
ACA (June 23, 2010)	0.58	0.49	0	1
Charlson Comorbidity Index	0.72	1.64	0	20
Beneficiary Age	79.73	8.21	65	110
Beneficiary Race				
White	0.82	0.39	0	1
Black	0.08	0.27	0	1
Other	0.1	0.3	0	1
Beneficiary Sex				
Male	0.33	0.47	0	1
Female	0.67	0.47	0	1
Leading Index	0.6	1.81	-11.13	6.32

Stats: Treatment & Control Groups

Place of Service	Total Brain CT Scans	Sameday (SD) Scans	% SD Scans	Total SD Growth (%)	Avg. Annual Growth (%)
Outpatient	1,255,325	50,487	4.0	50.4	6.0
Inpatient	799,333	11,885	1.5	-6.6	-0.8
ER	931,600	41,532	4.5	108.8	11.2
Office	137,268	3,939	2.9	-48.2	-8.3

Comparison Between Treatment and Control Groups

Variable	Mean	Outpatient	Office	[t-test]
OP-14 Indicator	0.52 (0.50)	0.52 (0.00)	0.46 (0.00)	-41.54
ACA Indicator	0.58 (0.49)	0.58 (0.00)	0.53 (0.00)	-39.83
Charlson Comorbidity Index	0.72 (1.64)	0.73 (0.00)	0.62 (0.00)	-26.23
Beneficiary Age	79.73 (8.21)	79.86 (0.01)	78.60 (0.02)	-56.55
Beneficiary Race				
White	0.82 (0.39)	0.82 (0.00)	0.76 (0.00)	-52.95
Black	0.08 (0.27)	0.08 (0.00)	0.06 (0.00)	-37.27
Other	0.10 (0.30)	0.09 (0.00)	0.18 (0.00)	82.63
Beneficiary Sex				
Male	0.33 (0.47)	0.33 (0.00)	0.36 (0.00)	21.26
Female	0.67 (0.47)	0.67 (0.00)	0.64 (0.00)	-21.26
Leading Index	0.60 (1.81)	0.62 (0.00)	0.46 (0.00)	-29.03

Note: Standard errors are listed below mean values.

Logistic DID Model: Marginal Effects

	Full Sample
Introduction of OP-14	-0.006***
	(0.001)
Outpatient	0.011***
	(0.001)
DiD	0.006***
	(0.001)
ACA	0.002**
	(0.001)
Leading Index	0.000
	(0.000)
Year	0.001***
	(0.000)
N	1,281,687

Note: Robust standard errors are in parentheses. * P < .10; ** P < .05; *** P < .01.

Logistic DID Model: Marginal Effects

	Full Sample	Pre-OP14 High	Pre-OP14 Low
Introduction of OP-14	-0.006***	-0.009***	-0.002
	(0.001)	(0.002)	(0.001)
Outpatient	0.011***	0.033***	-0.007***
	(0.001)	(0.001)	(0.001)
DiD	0.006***	0.000	0.012***
	(0.001)	(0.002)	(0.001)
ACA	0.002**	0.003***	0.000
	(0.001)	(0.001)	(0.001)
Leading Index	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.000)
Year	0.001***	0.001***	0.000
	(0.000)	(0.000)	(0.000)
N	1,281,687	696,475	833,377

Note: Robust standard errors are in parentheses. * P < .10; ** P < .05; *** P < .01.

Robustness Tests: Inpatient Control Group

- Inpatients not subject to OP-14 measure
- More comparable sample size
- Secondary hypothesis:
  - Test for independence in hospital department management
  - Global vs. departmental utilization policies

Marginal Effects: Inpatient Control Group

	Full Sample
Introduction of OP-14	0.000
	(0.001)
Outpatient	0.030***
	(0.000)
DiD	0.000
	(0.001)
ACA	0.002***
	(0.001)
Leading Index	0.000
	(0.000)
Year	0.001***
	(0.000)
N	1,860,936

Note: Robust standard errors are in parentheses. * P < .10; ** P < .05; *** P < .01.

Marginal Effects: Inpatient Control Group

	Full Sample	Pre-OP14 High	Pre-OP14 Low
Introduction of OP-14	0.000	-0.001	0.001
	(0.001)	(0.001)	(0.001)
Outpatient	0.030***	0.042***	0.010***
	(0.000)	(0.001)	(0.000)
DiD	0.000	-0.005***	0.005***
	(0.001)	(0.001)	(0.001)
ACA	0.002***	0.002***	0.001
	(0.001)	(0.001)	(0.001)
Leading Index	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Year	0.001***	0.001***	0.000***
	(0.000)	(0.000)	(0.000)
N	1,860,936	1,358,428	1,495,146

Note: Robust standard errors are in parentheses. * P < .10; ** P < .05; *** P < .01.

Other Robustness Tests

- False announcement of IEM
  - Not a result of a time trend
- Smaller time windows (6 months, 1 year)
  - Qualitatively similar results to original model of outpatient and office claims
- Emergency Departments
  - Large growth regardless of treatment and control groups

Conclusions

- ITS: OP-14 associated with small but significant reduction in same day outpatient B-S CT
  - Drop in level but rate unchanged
- Outpatient B-S CT increases after OP-14
  - Incentives matter: Driven by increases from low utilizers
  - ~$138 million of additional imaging
- Find independent management of hospital inpatient & outpatient departments

Thank You!

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