

The Effects of Financial Integration with Hospitals on Physician Behaviors

Haizhen Lin & **Ian McCarthy** & Michael Richards

ASHEcon 2018, Emory University

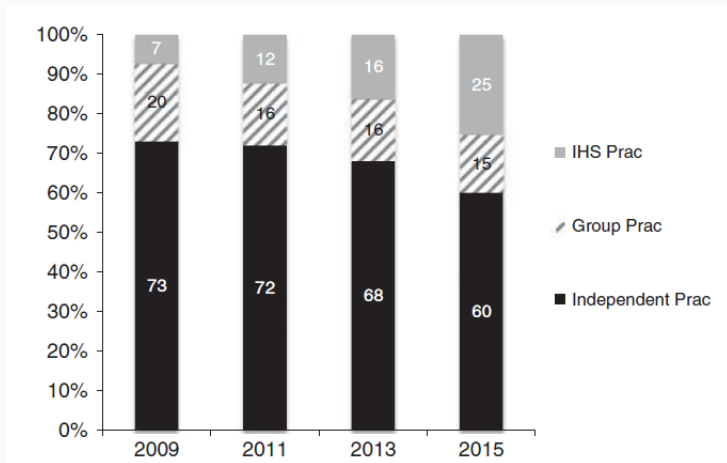
June 11, 2018

Motivation

How are hospitals and physicians related?

1. “Traditional” private practice with admitting privileges
2. Administrative support with or without admitting restrictions
3. Practice owned by hospital or hospital system

How are hospitals and physicians related?



Richards *et al.*, Medical Care, 2016

Anticipated effects on physicians

1. Focus on patient care
2. Less autonomy
3. More processes, checklists, etc.

1. Hospital outcomes (prices, quality, costs)
2. Physician practice prices
3. Integration and hospital choice

1. Hospital outcomes (prices, quality, costs)
2. Physician practice prices
3. Integration and hospital choice
4. Physician behaviors at purchasing hospital

Data

Data Sources

- CMS: 100% Medicare claims data (2008-2015)

Data Sources

- CMS: 100% Medicare claims data (2008-2015)
- SK&A: Hospital ownership of physician practices

Data Sources

- CMS: 100% Medicare claims data (2008-2015)
- SK&A: Hospital ownership of physician practices
- AHA, HCRIS, POS: Hospital characteristics

Data Sources

- CMS: 100% Medicare claims data (2008-2015)
- SK&A: Hospital ownership of physician practices
- AHA, HCRIS, POS: Hospital characteristics
- ACS: County-level demographics, education, income, and employment

Sample Construction

- Planned inpatient operations with observed NPI for the operating physician, defined as elective admissions initiated by a physician, clinic, or HMO referral

Sample Construction

- Planned inpatient operations with observed NPI for the operating physician, defined as elective admissions initiated by a physician, clinic, or HMO referral
- Drop physicians operating in hospitals more than 120 miles from primary office or outside of contiguous U.S.

Sample Construction

- Planned inpatient operations with observed NPI for the operating physician, defined as elective admissions initiated by a physician, clinic, or HMO referral
- Drop physicians operating in hospitals more than 120 miles from primary office or outside of contiguous U.S.
- Drop physicians with NPIs not matched in the SK&A data

Sample Construction

- Planned inpatient operations with observed NPI for the operating physician, defined as elective admissions initiated by a physician, clinic, or HMO referral
- Drop physicians operating in hospitals more than 120 miles from primary office or outside of contiguous U.S.
- Drop physicians with NPIs not matched in the SK&A data
- Require at least 15 operations in a given hospital/year

Sample Construction

- Planned inpatient operations with observed NPI for the operating physician, defined as elective admissions initiated by a physician, clinic, or HMO referral
- Drop physicians operating in hospitals more than 120 miles from primary office or outside of contiguous U.S.
- Drop physicians with NPIs not matched in the SK&A data
- Require at least 15 operations in a given hospital/year
- Balanced panel of physicians from 2008 through 2015

Sample Construction

- Planned inpatient operations with observed NPI for the operating physician, defined as elective admissions initiated by a physician, clinic, or HMO referral
- Drop physicians operating in hospitals more than 120 miles from primary office or outside of contiguous U.S.
- Drop physicians with NPIs not matched in the SK&A data
- Require at least 15 operations in a given hospital/year
- Balanced panel of physicians from 2008 through 2015

⇒ 63,532 unique observations at the physician/hospital/year

⇒ 3.9mm inpatient stays

Empirical Approach

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

Main Independent Variables

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
l_{jht}	0.152	0.209	0.237	0.249	0.333	0.210

Main Independent Variables

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
l_{jht}	0.152	0.209	0.237	0.249	0.333	0.210
l_{ht}	0.507	0.576	0.601	0.654	0.749	0.585

Main Independent Variables

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
l_{jht}	0.152	0.209	0.237	0.249	0.333	0.210
l_{ht}	0.507	0.576	0.601	0.654	0.749	0.585
l_{jt}	0.310	0.328	0.450	0.432	0.542	0.372

Physician Affiliation Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
Hospital Share	0.864 (0.225)	0.878 (0.217)	0.882 (0.216)	0.884 (0.215)	0.909 (0.184)	0.879 (0.216)

Physician Affiliation Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
Hospital Share	0.864 (0.225)	0.878 (0.217)	0.882 (0.216)	0.884 (0.215)	0.909 (0.184)	0.879 (0.216)
Operations	60.80 (43.50)	62.16 (43.90)	62.02 (45.08)	60.45 (45.10)	61.68 (45.95)	61.64 (44.45)

Mortality Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
90-day Mortality	0.0290 (0.0404)	0.0260 (0.0385)	0.0250 (0.0380)	0.0246 (0.0377)	0.0252 (0.0416)	0.0263 (0.0391)

Mortality Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
90-day Mortality	0.0290 (0.0404)	0.0260 (0.0385)	0.0250 (0.0380)	0.0246 (0.0377)	0.0252 (0.0416)	0.0263 (0.0391)
60-day Mortality	0.0237 (0.0350)	0.0211 (0.0334)	0.0204 (0.0329)	0.0203 (0.0328)	0.0200 (0.0358)	0.0214 (0.0340)

Mortality Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
90-day Mortality	0.0290 (0.0404)	0.0260 (0.0385)	0.0250 (0.0380)	0.0246 (0.0377)	0.0252 (0.0416)	0.0263 (0.0391)
60-day Mortality	0.0237 (0.0350)	0.0211 (0.0334)	0.0204 (0.0329)	0.0203 (0.0328)	0.0200 (0.0358)	0.0214 (0.0340)
30-day Mortality	0.0173 (0.0286)	0.0152 (0.0271)	0.0144 (0.0264)	0.0144 (0.0260)	0.0140 (0.0285)	0.0153 (0.0273)

Spending and Treatment Intensity Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
Payment	14,152 (6,190)	16,238 (7,230)	16,593 (7,296)	16,789 (7,369)	16,796 (7,541)	15,792 (7,010)

Spending and Treatment Intensity Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
Payment	14,152 (6,190)	16,238 (7,230)	16,593 (7,296)	16,789 (7,369)	16,796 (7,541)	15,792 (7,010)
Charge	50,004 (25,953)	64,442 (35,413)	68,093 (38,170)	71,637 (41,208)	73,732 (42,881)	62,437 (35,695)

Spending and Treatment Intensity Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
Payment	14,152 (6,190)	16,238 (7,230)	16,593 (7,296)	16,789 (7,369)	16,796 (7,541)	15,792 (7,010)
Charge	50,004 (25,953)	64,442 (35,413)	68,093 (38,170)	71,637 (41,208)	73,732 (42,881)	62,437 (35,695)
DRG	2.377 (0.764)	2.539 (0.777)	2.572 (0.776)	2.698 (0.917)	2.689 (0.937)	2.529 (0.818)

Spending and Treatment Intensity Outcomes

$$y_{jht} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

	2008	2012	2013	2014	2015	Overall
Payment	14,152 (6,190)	16,238 (7,230)	16,593 (7,296)	16,789 (7,369)	16,796 (7,541)	15,792 (7,010)
Charge	50,004 (25,953)	64,442 (35,413)	68,093 (38,170)	71,637 (41,208)	73,732 (42,881)	62,437 (35,695)
DRG	2.377 (0.764)	2.539 (0.777)	2.572 (0.776)	2.698 (0.917)	2.689 (0.937)	2.529 (0.818)
LOS	5.659 (1.578)	5.620 (1.869)	5.560 (1.894)	5.644 (2.017)	5.624 (2.075)	5.572 (1.783)

Risk adjustment and physician-hospital “match values”

- Isolate variation from physician-hospital interaction
- Adjust for patient characteristics

Risk adjustment and physician-hospital “match values”

1. Estimate γ_{jh}

$$y_{ijh} = \gamma_j + \gamma_{jh} + \beta x_{ih} + \varepsilon_{ijh}$$

Risk adjustment and physician-hospital “match values”

1. Estimate γ_{jh}

$$y_{ijh} = \gamma_j + \gamma_{jh} + \beta x_{ih} + \varepsilon_{ijh}$$

2. Use $\hat{\gamma}_{jh}$ as outcome

$$\underbrace{y_{jht}}_{\hat{\gamma}_{jh}} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

Risk adjustment and physician-hospital “match values”

1. Estimate γ_{jh}

$$y_{ijh} = \gamma_j + \gamma_{jh} + \beta x_{ih} + \varepsilon_{ijh}$$

2. Use $\hat{\gamma}_{jh}$ as outcome

$$\underbrace{y_{jht}}_{\hat{\gamma}_{jh}} = \delta_1 l_{jht} + \delta_2 l_{ht} + \delta_3 l_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

- Combined $\gamma_j + \gamma_{jh}$ from full sample
- Separately identify γ_{jh} from physician “movers”

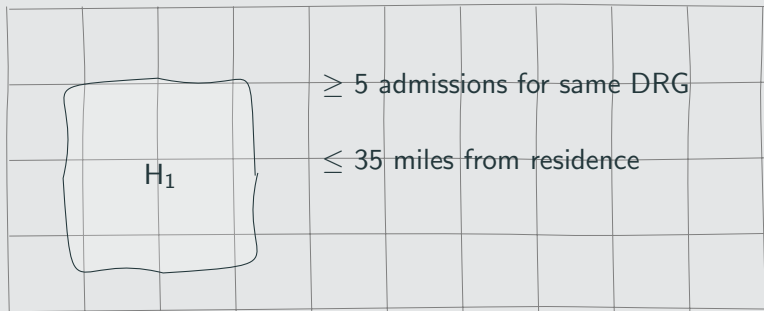
Endogeneity of physician-hospital integration

Integration could be driven by:

- Existing physician behaviors
- Unobserved, time-varying practice characteristics

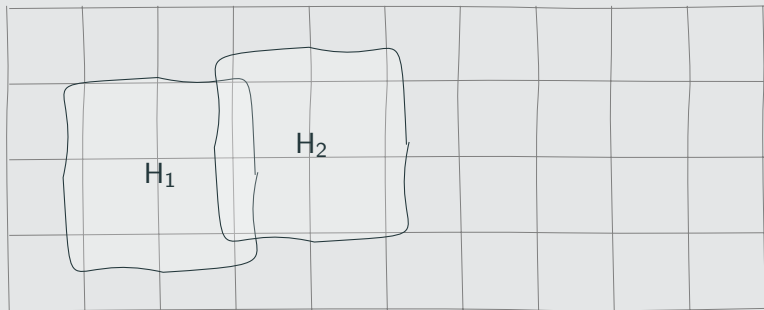
Endogeneity of physician-hospital integration

1. Set of possible physician-hospital pairs



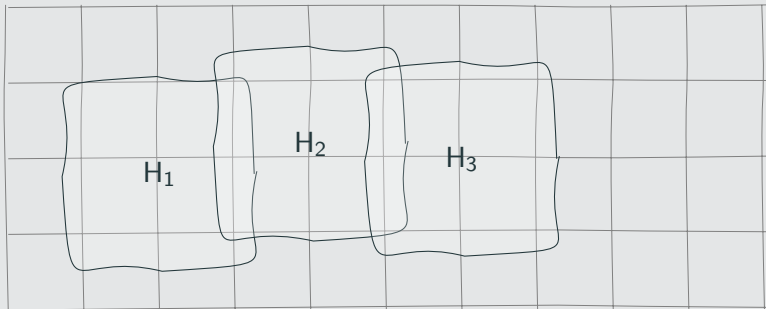
Endogeneity of physician-hospital integration

1. Set of possible physician-hospital pairs



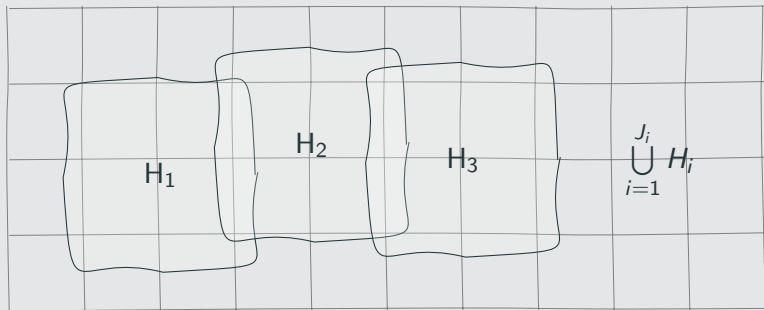
Endogeneity of physician-hospital integration

1. Set of possible physician-hospital pairs



Endogeneity of physician-hospital integration

1. Set of possible physician-hospital pairs



2. Estimate probability of integration

$$I_{ph} = \lambda_1 z_h + \lambda_2 z_{ph} + \omega_{ph}$$

- Average choice set size
- Average differential distance (relative to nearest hospital)

2. Estimate probability of integration

$$I_{ph} = \lambda_1 z_h + \lambda_2 z_{ph} + \omega_{ph}$$

- Average choice set size
- Average differential distance (relative to nearest hospital)

$$y_{jht} = \delta_1 \underbrace{I_{jht}}_{\hat{I}_{jht} = \Pr(I_{jht}=1)} + \delta_2 I_{ht} + \delta_3 I_{jt} + \beta_1 x_{jt} + \beta_2 z_{ht} + \beta_3 w_{mt} + \Theta_{jhmt} + \varepsilon_{jht}$$

Results

Fixed Effects Estimator

	Hospital Share	Operations
I_{jht}	0.046*** (0.004)	4.574*** (0.510)
I_{ht}	0.005*** (0.002)	0.670*** (0.232)
I_{jt}	-0.012*** (0.002)	-1.127*** (0.285)
Net	0.0392*** (0.0036)	4.1180*** (0.4394)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Integration and physician affiliation

Fixed Effects Estimator

	Hospital Share	Operations
I_{jht}	0.046*** (0.004)	4.574*** (0.510)
I_{ht}	0.005*** (0.002)	0.670*** (0.232)
I_{jt}	-0.012*** (0.002)	-1.127*** (0.285)
Net	0.0392*** (0.0036)	4.1180*** (0.4394)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

With Instrument, \hat{I}_{jht}

	Hospital Share	Operations
	0.072*** (0.017)	11.885*** (4.170)
	0.004** (0.002)	0.489* (0.256)
	-0.019*** (0.005)	-3.175*** (1.223)
	0.0573*** (0.0119)	9.1988*** (2.8800)

Fixed Effects Estimator

	90-day	60-day	30-day
Overall	0.0016** (0.0008)	0.0010 (0.0007)	0.0009 (0.0006)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fixed Effects Estimator

	90-day	60-day	30-day
Overall	0.0016** (0.0008)	0.0010 (0.0007)	0.0009 (0.0006)
Match Value	0.0011 (0.0009)	0.0006 (0.0008)	0.0010 (0.0006)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fixed Effects Estimator

	90-day	60-day	30-day
Overall	0.0016** (0.0008)	0.0010 (0.0007)	0.0009 (0.0006)
Match Value	0.0011 (0.0009)	0.0006 (0.0008)	0.0010 (0.0006)
"Movers"	0.0042 (0.0034)	0.0037 (0.0029)	0.0008 (0.0024)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Integration and mortality

Fixed Effects Estimator

	90-day	60-day	30-day
Overall	0.0016** (0.0008)	0.0010 (0.0007)	0.0009 (0.0006)
Match Value	0.0011 (0.0009)	0.0006 (0.0008)	0.0010 (0.0006)
"Movers"	0.0042 (0.0034)	0.0037 (0.0029)	0.0008 (0.0024)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

With Instrument, \hat{l}_{jht}

	90-day	60-day	30-day
	0.0030 (0.0022)	0.0014 (0.0019)	0.0010 (0.0016)

Integration and mortality

Fixed Effects Estimator

	90-day	60-day	30-day
Overall	0.0016** (0.0008)	0.0010 (0.0007)	0.0009 (0.0006)
Match Value	0.0011 (0.0009)	0.0006 (0.0008)	0.0010 (0.0006)
"Movers"	0.0042 (0.0034)	0.0037 (0.0029)	0.0008 (0.0024)

* p<0.1, ** p<0.05, *** p<0.01

With Instrument, \hat{l}_{jht}

	90-day	60-day	30-day
Overall	0.0030 (0.0022)	0.0014 (0.0019)	0.0010 (0.0016)
Match Value	0.0012 (0.0023)	0.0001 (0.0021)	0.0023 (0.0018)

Integration and mortality

Fixed Effects Estimator

	90-day	60-day	30-day
Overall	0.0016** (0.0008)	0.0010 (0.0007)	0.0009 (0.0006)
Match Value	0.0011 (0.0009)	0.0006 (0.0008)	0.0010 (0.0006)
"Movers"	0.0042 (0.0034)	0.0037 (0.0029)	0.0008 (0.0024)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

With Instrument, \hat{l}_{jht}

	90-day	60-day	30-day
Overall	0.0030 (0.0022)	0.0014 (0.0019)	0.0010 (0.0016)
Match Value	0.0012 (0.0023)	0.0001 (0.0021)	0.0023 (0.0018)
"Movers"	0.0041 (0.0296)	0.0028 (0.0272)	0.0071 (0.0212)

Fixed Effects Estimator

	Payment	Charge	DRG
Overall	245*** (71.33)	3,076*** (450)	0.0369*** (0.0091)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fixed Effects Estimator

	Payment	Charge	DRG
Overall	245*** (71.33)	3,076*** (450)	0.0369*** (0.0091)
Match Value	102 (68.26)	2,094*** (452)	0.0197** (0.008)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fixed Effects Estimator

	Payment	Charge	DRG
Overall	245*** (71.33)	3,076*** (450)	0.0369*** (0.0091)
Match Value	102 (68.26)	2,094*** (452)	0.0197** (0.008)
"Movers"	201 (245.97)	2,086** (1,217)	0.0642** (0.0276)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Integration and spending/treatment

Fixed Effects Estimator

	Payment	Charge	DRG
Overall	245*** (71.33)	3,076*** (450)	0.0369*** (0.0091)
Match Value	102 (68.26)	2,094*** (452)	0.0197** (0.008)
"Movers"	201 (245.97)	2,086** (1,217)	0.0642** (0.0276)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

With Instrument, \hat{l}_{jht}

Payment	Charge	DRG
321 (267.62)	4,415*** (1,625)	0.0392 (0.0340)

Integration and spending/treatment

Fixed Effects Estimator

	Payment	Charge	DRG
Overall	245*** (71.33)	3,076*** (450)	0.0369*** (0.0091)
Match Value	102 (68.26)	2,094*** (452)	0.0197** (0.008)
"Movers"	201 (245.97)	2,086** (1,217)	0.0642** (0.0276)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

With Instrument, \hat{l}_{jht}

Payment	Charge	DRG
321 (267.62)	4,415*** (1,625)	0.0392 (0.0340)
-588*** (216.77)	683 (1,461)	-0.0619** (0.0261)

Integration and spending/treatment

Fixed Effects Estimator

	Payment	Charge	DRG
Overall	245*** (71.33)	3,076*** (450)	0.0369*** (0.0091)
Match Value	102 (68.26)	2,094*** (452)	0.0197** (0.008)
"Movers"	201 (245.97)	2,086** (1,217)	0.0642** (0.0276)

* p<0.1, ** p<0.05, *** p<0.01

With Instrument, \hat{l}_{jht}

	Payment	Charge	DRG
Overall	321 (267.62)	4,415*** (1,625)	0.0392 (0.0340)
Match Value	-588*** (216.77)	683 (1,461)	-0.0619** (0.0261)
"Movers"	-1,251 (1,951)	-3,564 (9,141)	-0.3938* (0.2316)

Summary of Results

- Increase in shares of 4-6 percentage points (4-9 operations)

Summary of Results

- Increase in shares of 4-6 percentage points (4-9 operations)
- No improvement in mortality

Summary of Results

- Increase in shares of 4-6 percentage points (4-9 operations)
- No improvement in mortality
- Evidence that integration changes both coding behaviors (upcoding) and patient selection (healthier patients)