Physicians Treating Physicians: The Relational Advantage in Treatment Choice

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Previous Literature on Agency Problems

1. A growing literature in labor economics examines the question of whether complete information or strong social ties could solve agency problems.
   - −, + Bandiera, Barankay, and Rasul (2009)
   - + Jackson and Schneider (2011)
   - Social ties can reduce workers' moral hazards only if managers are paid performance bonuses.
2. Health economists recently join this investigation via
   - + cross-randomizing **doctors race** with **vaccine incentives** at the patient level (Alsan, Garrick, and Graziani 2019).
   - + exploiting rotating call schedules as an exogeneous variation in **doctor-patient clinical relationships** (Johnson et al. 2016); C-section
   - Communication
   - Doctor quality and patient selection

An Alternative Approach to Agency Problems in Health Care

Compare self-treatment versus treating others using observational data:

- Important examples:
  - **Primary-care physician**: Carrera and Skipper (2017)
  - **Pharmacist**: Bronnenberg et al. (2015)
  - Realtor: Levitt and Syverson (2008)
- This comparison may capture the difference in the susceptibility of self-treatment versus treating others, not necessarily a causal effect of attending physician-patients.
- Ubel et al. (2011); Shaban et al. (2011)

One Way to Avoid Susceptibility Bias

Compare the treatments received by physician-patients and nonphysician-patients in examining agency problems.

- This line of research has
  - focused mostly on C-section and
  - suggested mixed results and interpretations.

1. **Relational advantage:**
   - Physician-mothers *more* likely use C-section because of a closer relationship or better communication with attending doctors (Grytten, Skau, and Sørensen 2015).
2. **Informational advantage:**
   - Physician-mothers *less* likely use C-section because of being more informed (Chou et al. 2006; Johnson and Rehavi 2016).

Our Niche and Research Plan

- Study the distinct roles of **information** and **human relations** in health care.
- Address the questions of
  1. whether doctors **treat** physician-patients and other patients differently and
  2. whether such differences affect **patient survival**.

Using three sets of admin data from Taiwan's National Health Insurance

- AMI (only for the combined effects),
- the end-of-life invasive care, and
- the end-stage cancer treatments (in progress).

Institutional Settings

Taiwan's National Health Insurance Database is ideal for this study for several reasons:

1. Taiwan's **single payer** $\sim$ Canadian/German systems.
    - Mandatory for all citizens/residents with a uniform benefit package — **no issue of adverse selection** into insurance;
2. **Patient cost sharing** for hospital care is 14 dollars or less although rises with hospital size.
    - Minimal penalty for a hospital visit without first receiving a referral from primary care — almost all patients choose physicians **without going through a gatekeeper;**

Patient Cost Sharing and Reimbursement to Providers

3. The NHI admin manages health expenditure inflation via a **reimbursement mechanism to providers,** rather than charging deductibles or capping out-of-pocket expenses.
   - Global budgeting
   - Fee-for-service basis through a national fee schedule —**providers cannot select or price-discriminate patients**.
   - Hospitals pay doctors also by fees-for-services plus a basic salary that varies across hospitals, so doctors and hospitals share **similar financial incentives.**

National Health Insurance Database

Using NHID, we combine the following data sources:

1. Death Registry: 2000-2006
2. NHID Registry of Beneficiaries: sex, birthday, income, district, salary work
3. Reimbursement Claim Data: inpatient spending by procedure per admission, hospital type and district, and the attending doctor's unique ID
4. **Registry for Medical Personnel:** sex, birthday, date of certification
5. **Board-Certified Specialists:** each doctor's specialty, practice location and history
6. Details of Physician Orders for Inpatient: identify invasive procedure use for each admission, i.e., each matched doctor-patient pair by admission date

Estimating the Physician-Patient Effect on Outcomes/Treatment

- Patient i's outcome or treatment by doctor j in hospital h at time t is determined by

$$Y_{ijht} = \alpha_{ht} + \beta D_i + X_{iht}\gamma + \theta_{jh} + W_{jt}\delta + u_{ijht}. \quad (1)$$

D_i the physician-patient indicator;

α_{ht} hospital and year-month fixed effects;

X_{iht} patient i's attributes;

θ_{jh} the doctor-hospital fixed effect (the attending doctor j's skill and practice style specific to the hospital h).

W_{jt} doctor j's practicing experience since the initial certification.

- Previous studies
  - cannot observe doctor j so require $\theta_{jh} = \theta$ and $\delta = 0$;
  - include doctors who have never attended any physician-patient.
- We use matching methods and fixed-effect models.

Control for Doctor Selectivity and Patient Choosiness

- Doctor j's selectivity: the physician-patient percentage of the inpatient admissions attended by the doctor during 2000-2006.

X_{iht} includes

- patient demographics: sex, age, previous work and income, and district fixed effects;
- past utilization;
- patient's choosiness, measured by average selectivity of all the previous doctors attending patient i in the previous year.
- local density of providers and hospital beds in the hospital district upon patient i's admission at t.

Measure the Relational and Information Advantages of Physician-Patients

We exploit the variation in composition of medical specialties between the physician-patient and the attending doctor. Define

S_i whether patient i's specialty is concerned with the diagnosis;

S_j whether doctor j's specialty is concerned with the diagnosis;

- $\mathcal{R}_{ij} = I[S_i = S_j]$ as the relational indicator;
- $\mathcal{I}_i = I[S_i = 1]$ as the informational indicator;
- If data only contain doctors in **one single specialty** (e.g. AMI or OPGYN), it's **unlikely** to separate the two advantages.

$$S_j = 1 \iff \mathcal{R}_{ij} = \mathcal{I}_i.$$

A simple modification of model (1):

- replacing βD_i with $\beta_{ij} D_i$,

$$\beta_{ij} D_i = (\beta + \rho \mathcal{R}_{ij} + \eta \mathcal{I}_i) D_i \tag{2}$$

Separate Relational and Information Advantages of Physician-Patients

A simple modification of model (1):

- replacing βD_i with $\beta_{ij} D_i$,

$$\beta_{ij} D_i = (\beta + \rho \mathcal{R}_{ij} + \eta \mathcal{I}_i) D_i$$

- Consider the four possible patient-doctor specialty pairs:

		Physician i's specialty	
		$S_i = 0$	$S_i = 1$
Doctor j's specialty	$S_j = 0$	ρ	η
	$S_j = 1$		$\rho + \eta$

Sample Mean of Attending Doctors' Characteristics, by Whether Chosen by Physician-Patient

		Non-chosen doctors in		
Doctor's attributes:	Chosen doctors (1)	chosen hospitals (2)	nonchosen hospitals (3)	(1)-(2)
Number of doctor-hospital pairs	196	1,461	159	
Number of AMI patients	234	26	28	
Selectivity (AMI)	0.021	0.00	0.00	0.021*
Selectivity (all diagnoses)	0.005	0.002	0.001	0.003*
Experience	10.2	8.0	8.1	2.1*
Number of licenses	1.04	1.14	1.13	-0.10*
Female doctor	0.02	0.06	0.11	-0.04*
External medicine	0.05	0.28	0.19	-0.23*
Practice in multiple counties	0.18	0.12	0.14	0.06
Private hospital	0.34	0.28	0.38	0.06
Teaching hospital	0.26	0.20	0.00	0.06
Veteran hospital	0.14	0.08	0.00	0.05*

Note: We cluster standard errors at the doctor level.

Sample Mean of Admitted Patients' Attributes, by Whether the Attending Ever Chosen by Physician-Patient

		Non-chosen doctors in		
	Chosen doctors (1)	chosen hospitals (2)	nonchosen hospitals (3)	(1)-(2)
Attended patients' attributes:				
Same city	0.12	0.13	0.12	-0.014
Patients' choosiness	0.004	0.002	0.001	0.002*
Previously worked full time	0.70	0.65	0.66	0.05*
Male	0.74	0.67	0.60	0.07*
Age	65.3	68.0	68.4	-2.7*
Previous volume (points)				
Inpatient reimbursement	27017	58641	49353	-31624*
Inpatient OOP	1815	3102	2865	-1286*
Outpatient reimbursement	46336	85829	77683	-39493*
Outpatient OOP	3121	3406	3561	-285*

Note: We cluster standard errors at the doctor level.

AMI First-Time Patients (Before Matching)

	Physician-patients	Others	Difference
Number of patients	304	88,257	
Sorting			
Attended by a chosen doctor	1	0.52	0.48*
Patient's choosiness	0.006	0.002	0.003*
Doctor's selectivity (AMI)	0.019	0.003	0.015*
Doctor's experience	11.1	9.7	1.4*
Hospital in local district	0.16	0.12	0.04*
Private hospital	0.44	0.28	0.16*
Teaching hospital	0.31	0.14	0.17*
Demographics			
Age	66.7	65.5	1.2
Male	0.99	0.72	0.27*
Worked full time	0.93	0.72	0.20*
Previous volume (points)			
Inpatient reimbursed	24003	25708	-1705
Inpatient OOP	1270	1779	-509*
Outpatient reimbursed	39172	49457	-10285*
Outpatient OOP	2210	3141	-931*

Matching AMI Patients

We consider 3 matching schemes by nearest neighbor (Abadie and Imbens, 2011):

1. Match on patient attributes & hospital;

   32,936 patients
2. Match on patient attributes & hospital & **doctor attributes**;

   24,576 patients
3. Match on patient attributes & **hospital-doctor** & **doctor experience & local number of hospital beds;**

   2,537 patients

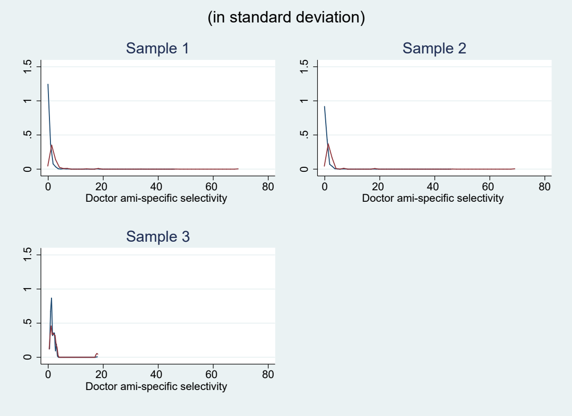
- t-test
- Kolmogorov-Smirnov (KS) equality-of-distributions test

Balance Test on a Selection of Covariates

Either sample only keeps male surgeons with only one specialty.

	Sample 2 (N=24,576)			Sample 3 (N=2,537)		
	t-test		KS	t-test		KS
	diff	p-value	p-value	diff	p-value	p-value
Doctor attributes:						
Doctor's selectivity (SD)	1.45	0.00	0.00	0.84	0.29	0.05
Doctor's experience (SD)	0.30	0.00	0.00	0.22	0.00	0.00
Female	0.00	1.00	1.00	0.00	1.00	1.00
Surgical specialized doctor	0.00	1.00	1.00	0.00	1.00	1.00
Only one specialty	0.00	1.00	1.00	0.00	1.00	1.00
Veteran hospital	0.02	0.52	1.00	-0.01	0.85	1.00
Number local beds (SD)	0.04	0.11	0.05	0.12	0.00	0.18
Number of local providers (SD)	-0.07	0.27	0.98	0.00	0.99	0.55
Patient attributes:						
Patient's choosiness (SD)	1.01	0.00	0.00	1.51	0.06	0.00
Hospital spending last year (SD)	-0.04	0.52	0.36	-0.03	0.81	0.08
Age (in SD)	0.29	0.00	0.01	0.29	0.09	0.10
Male	0.00	1.00	1.00	0.00	1.00	1.00
Worked full time	0.01	0.47	1.00	0.00	1.00	1.00
Income top 75 percentile+	0.02	0.65	1.00	-0.04	0.52	1.00

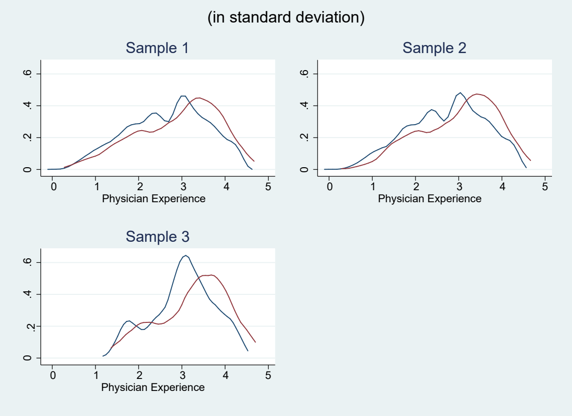
Density Plots of Physician Selectivity



1 to 2: **drop nonphysician-patients attended by doctors with low selectivity**

2 to 3: drop physician-patients attended by doctors with super high selectivity

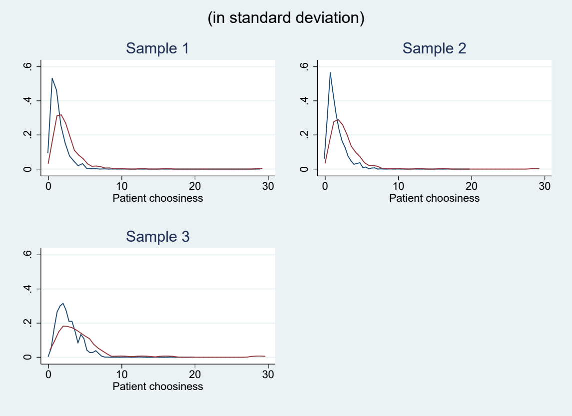
Density Plots of the Attending Doctor's Experience*



1 to 2: **drop some patients attended by inexperienced doctors**

2 to 3: drop all patients attended by inexperienced doctors

Density Plots of Patient Choosiness*



1 to 2: **drop mostly nonphysician-patients who are not very choosy**

2 to 3: drop patients who are not very choosy

Matching Estimates (Bias-Adjusted)

Dependent	Sample 1		Sample 2				
variables:	Coef	SE	Coef	SE	CI		Mean
Any stent	-0.07	0.03	-0.13	0.03			0.23
Stent number	-0.10	0.04	-0.16	0.04			1.21
Stent cost	-3971	1620	-6646	1283			10706
Lived 1 days+	0.002	0.003	0.003	0.002	0.000	0.006	
Lived 7 days+	-0.006	0.008	0.002	0.006	-0.009	0.013	
Lived 30 days+	0.002	0.011	0.005	0.010	-0.014	0.025	0.971
Lived 90 days+	0.006	0.011	0.011	0.011	-0.011	0.033	0.954
Lived 180 days+	-0.004	0.018	0.003	0.013	-0.022	0.028	0.935
Lived 365 days+	-0.001	0.021	0.018	0.013	-0.007	0.043	0.908
Lived 730 days+	0.031	0.021	0.043	0.020			0.869
Lived 1095 days+	0.002	0.023	0.037	0.019	-0.001	0.075	0.831
Lived 1523 days+	0.012	0.023	0.063	0.022			0.788
Died of AMI	0.008	0.014	-0.010	0.010	-0.029	0.010	0.023
Died of cancer	-0.022	0.001	-0.022	0.006			0.021
Died of acute	-0.007	0.029	-0.005	0.035	-0.074	0.063	0.817
Died of chronic	0.013	0.029	0.011	0.035	-0.057	0.079	0.177

Invasive Procedures in the Last Six Months of Life

- Past studies have examined a list of causes to **overuse**, but **few have focused on end-of-life health care.**
- One important exception: Einav et al. (2018) show **death timing is highly unpredictable**, suggesting
  - end-of-life medical spending is not necessarily a waste;
  - proximity to death is an arguably plausible control for morbidity.
- **Agency problems** with end-of-life hospital care:
  - Do doctors use the same amount of invasive treatment for physician-patients and nonphysician-patients in the last six months of life?
  - Nasogastric intubation, urinary catheterization, endotracheal intubation, or tracheostomy intubation

Summary Statistics of Beneficiaries in the Last Six Months of Life

	Nonphysicians' mean	Physicians minus Nonphysicians	Standard Error
Number of beneficiaries	765,649	766,638	-
Number of hospital admissions	1,366,507	1,364,840	-
Hospital utilization			
Ever checked into a hospital	0.75	0.10	0.011*
Number of admissions	1.53	0.21	0.041**
Number of days per admission	32.5	8.59	1.016**
Any invasive procedure	0.51	0.08	0.013**
Used volume in percentile if > 0			
Total reimbursement	61.8	6.01	0.775**
Out-of-pocket payment	57.3	-6.93	0.957**
Invasive care volume in percentile	60.1	3.58	0.885**
Demographics			
Male	0.62	0.36	0.005
Age at death	69.10	6.11	0.444
Worked full time	0.68	0.12	0.013**
Sorting			
Beneficiary checked into a chosen hospital	0.64	0.21	0.011**
Beneficiary saw a chosen doctor	0.21	0.65	0.011**

Overall vs Matched Nonphysician Patients (Only by Chosen Doctor) at the End of Life

	Nonphysician-patients' admissions:			
	All patients		Matched only	
Covariates:	Mean	SD	Mean	SD
Patient characteristics:				
Male	0.63	0.48	0.65	0.48
Age	70.17	14.24	69.68	14.14
Salaried worker	0.68	0.47	0.68	0.47
Utilization in penultimate 6 months:				
Check in frequency	0.47	0.50	0.49	0.50
Days in hospital per admission	19.69	27.31	21.32	29.06
Time-varying factors:				
Attending doctor's experience in years	9.03	4.47	9.87	4.21
Number of NHI providers in district	154	106	174	101
Number of hospital beds in district	106	74	108	64
Number of admissions	1,152,248		321,655	

Results Using All vs Matched Patients

	Within doctor-hospital			
	All patients		Matched patients	
Dependent variables:	SD	Coefficient (SD)	SD	Coefficient (SD)
Days in hospital	23.78	0.999 (0.762)	25.94	0.826 (0.762)
Any invasive procedure	0.45	0.041 (0.013)**	0.45	0.018 (0.013)
Nasogastric intubation	0.46	0.052 (0.013)**	0.46	0.032 (0.013)**
Urinary catheterization	0.47	0.039 (0.013)**	0.47	0.022 (0.013)*
Endotracheal intubation	0.39	0.034 (0.010)**	0.38	-0.002 (0.010)
Tracheostomy intubation	0.41	0.040 (0.010)**	0.40	0.007 (0.010)
Volume in percentile				
Any invasive procedure	25.65	2.917 (0.740)**	25.82	1.436 (0.740)*
Nasogastric intubation	26.50	3.200 (0.764)**	26.84	2.520 (0.762)**
Urinary catheterization	27.34	2.550 (0.751)**	27.42	1.700 (0.751)**
Endotracheal intubation	27.67	1.007 (0.684)	27.60	-0.839 (0.684)
Tracheostomy intubation	26.16	2.986 (0.668)**	26.14	1.564 (0.670)**
Reimbursement	25.86	1.267 (0.771)	26.28	0.472 (0.770)
Out of pocket	26.17	-3.094 (0.747)**	25.81	-3.912 (0.744)**
Number of admissions		1,153,915		321,655

Informational vs Relational Effects on Utilization

	Dummy for any invasive procedure			
	(1)	(2)	(3)	(4)
Physician-patient	0.041	0.057	0.041	0.045**
	(0.013)	(0.038)	(0.038)	(0.046)
More informed		-0.018	-0.043	-0.035
Physician-patient ($\mathcal{I}$)		(0.040)	(0.046)	(0.051)
Professional relationship				
Same specialty ($\mathcal{R}$)			0.051*	0.055*
			(0.029)	(0.029)
Same cohort				-0.002
				(0.024)
Less experienced				-0.017
				(0.032)
Strong preexisting				-0.083**
clinical relationship				(0.002)
Within doctor-hospital standard deviation			0.45	

Note: The data contains 1,153,915 hospital admissions. We cluster standard errors at the patient level in (.). * and ** indicate the 90 and 95 percent significance levels.

Information vs Relational Effects on Volume in Percentile

	Invasive care volume			
	(1)	(2)	(3)	(4)
Physician-patient	2.92**	2.35	1.20	1.67
	(0.74)	(2.12)	(2.12)	(2.73)
More informed		0.71	-1.13	-0.13
Physician-patient ($\mathcal{I}$)		(2.26)	(2.61)	(2.88)
Professional relationship				
Same specialty ($\mathcal{R}$)			3.76**	4.03**
			(1.82)	(1.81)
Same cohort				0.35
				(1.47)
Less experienced				-2.15
				(1.93)
Strong preexisting				-4.62**
clinical relationship				(0.08)
Within doctor-hospital standard deviation			25.65	

Note: The data includes 1,153,915 hospital admission.We cluster standard errors at the patient level in (.). * and ** indicate the 90 and 95 percent significance levels.

Remark I

Data: We overcome data limitations and adjusts selection bias (doctor quality/patient selection) in estimating physician-patient effects via

1. holding constant doctor selectivity and experience and past choice of doctors; or,
2. matching patients treated by the same doctor-hospital (if given sufficient data supports).

Model: Physician-patient premiums in health care may vary with their relational and informational advantages, depending on the doctor's and the patient's medical specialties.

- Only one single diagnosis (e.g., OPGYN or AMI) is unlikely to separate relational and informational advantages.

Remark II

AMI Physician-patients

- use significantly less stent (by 13ppt, 56%);
- have 4%-8% higher survival rates than other patients at the 2nd/3rd/5th years after the onset.

EOL We find physician-patients use more invasive care volumes in the last six months of life.

- **Relational advantages** explain most of the positive effects of physician-patients on care volumes.
- The information advantage of physician-patients cannot explain why they use more invasive care, consistent with Frakes, Gruber, and Jena's (2019) finding concerning recommended guidelines for specific care.
- However, restricting the data to patients at the final six months of life might have caused sample selection problems.

Ongoing: We are looking into **end-stage cancer patients.**

- differences in treatment
- differences in survival