Evaluating the VA Make-or-Buy Decision in Emergency Care

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Background

- An area of longstanding research and policy interest is how does the VA compare against non-VA alternatives?
- In recent years, this question has become relevant to efforts to redirect VA resources toward financing care for Veterans in non-VA facilities.
- This talk: What do we currently know? What are key barriers to learning more about this question? What [quasi-experimental] approaches can we take to learn more [in the emergency care setting]?

Poll Question #1

How would you primarily describe yourself?

1. Clinician
2. Researcher
3. Policymaker, manager, or administrator
4. Veteran
5. Other

Motivation

Answering this question is relevant from multiple points of view:

- Clinicians
  - Where and how do my patients receive better care?
  - If my patients receive care outside of the VA, what are the implications for coordination and outcomes?
- Researchers
  - How can we measure and compare meaningful outcomes between VA and non-VA care?
- Policymakers, managers, and administrators
  - Where should we invest in vs. outsource care?
- Veterans
  - Where can I get the best care for me? What does this depend on?

Poll Question #2

What do we currrently know about the quality of VA vs. non-VA care?

1. We know a lot: Veterans receive better care in the VA
2. We know a lot: Veterans receive worse care in the VA
3. The evidence is mixed: We know which Veterans benefit
4. The evidence is mixed: We don't know which Veterans benefit
5. We cannot compare systems with different patients

What Do We Currently Know?

- Many studies on process measures and outcomes in VA vs. non-VA settings (see, e.g., Trivedi et al, 2011)
  - On process measures, systematic reviews have concluded that VA care is generally better than non-VA care
  - On outcomes, findings have been mixed
- Fundamental questions remain
  - How do we know whether / which process measures are meaningful? Even VA thought-leaders have decried the multitude of process measures for management purposes
  - For outcomes, different patients in different scenarios choose the VA vs. the non-VA alternative
  - So how can we compare outcomes?

Specific Setting: Emergency Care

- Examples of potential confounds
  - Trauma patients may be directed away from the VA, since many VA EDs do not have trauma capabilities
  - Patients who are unconscious may not be delivered by ambulance to the VA, if the ambulance cannot ask them if they are Veterans
  - Veterans with lower socioeconomic status may choose the VA because it is cheaper for them
- Policy object of interest: What is the *causal effect* of VA care on outcomes? I.e., how would outcomes differ in a *counterfactual* world where Veterans received care in a different location?

The Gold Standard

- Randomized controlled trials (RCTs) are designed to estimate the causal effect
  - By random assignment, there is no "confounding by indication" (a.k.a., "endogeneity," "selection")
  - In this case, we need to randomly assign patients to VA vs. non-VA location
- However, doing so would be prohibitively costly, difficult, or otherwise undesirable

Previous Approaches

- No analysis of VA vs. non-VA outcomes based on an RCT (not surprising)
- Almost all analyses will "control" for patient characteristics
  - If sicker patients are more likely to go to non-VA (or VA) then it is important to control for characteristics that predict underlying health
- Assumption: Conditional on controls, patients will be as good as randomly assigned to the VA
- Problems:
  - We cannot observe many important things (especially in claims data outside the VA); controls are only as good as what we can observe
  - Even if we were to observe increasingly rich data, how does one control for all potential interactions for causal inference? Methods are far from clear

The Econometric Approach

- Mimic RCT by identifying a *randomizing device*, akin to a coin flip
  - Patients who receive "heads" are more likely to go to VA (**first stage**)
  - Getting "heads" is uncorrelated with anything about the patient, particularly underlying health (**exclusion restriction**)
- In this setting, we focus on two *instrumental variables (IV)*

Poll Question #3

How familiar are you with instrumental variables?

1. Very familiar. I have used them in analysis.
2. I have been taught them but not used them in analysis.
3. I have heard of them but have no formal training.
4. I have never heard of them.

Two Potential Instrumental Variables

1. Ambulance instrument (Doyle et al, 2015):
   - "Coin": which ambulance picks you up?
   - "Heads": the ambulance that picks you up tends to send patients to VA EDs
2. Differential distance instrument (McClellan et al, 1994):
   - "Coin": where do you live, differentially relative to VA vs. non-VA ED?
   - "Heads": You live closer to VA ED relative to non-VA ED

- Both instruments developed in literature considering effect of hospital spending / intensity
- In practice, controls still play an important role (i.e., *conditional* random assignment)

Study Design

Sample

- Link VA and Medicare data for a sample of elderly Veterans
- Nationwide ED visits over the years 2000 to 2014
  - 34 million visits at the VA, 24 million visits outside of the VA
- Restrict to elderly Veterans brought in by ambulance, in markets where Veterans could have been sent to either VA or non-VA ED
  - [Will become apparent why later]
  - Sample of 8 million ED visits for 2.7 million Veterans

Study Design

Data

- Veteran and ED (VA and non-VA) locations
- Veteran characteristics prior to ED visit
  - Previous diagnoses, previous health care utilization
- Ambulance identity
- Characteristics of VA and non-VA hospital (e.g., from AHA, Hospital Compare, SAIL)

Study Design

Outcomes

- Diagnoses made during ED visit
- Charges or costs associated with ED visit, subsequent hospitalization
- Follow-up visits after ED visit
- Mortality during and after ED visit

Some Math and Terminology

- More general linear IV equation

$$Y_i = \mathbf{X}_i\beta + \rho D_i + \eta_i \tag{1}$$

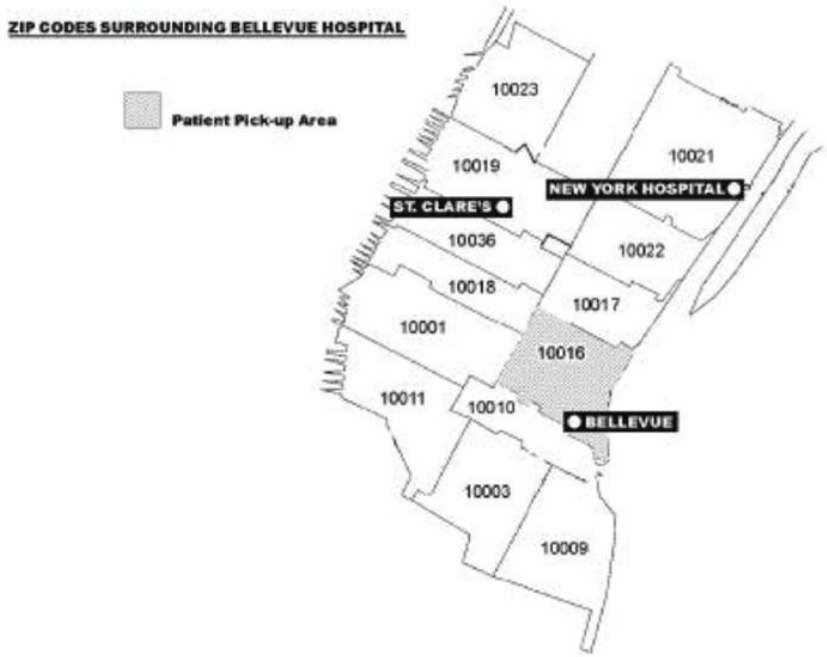
can be thought of as "two-stage least squares" (2SLS)

$$\begin{aligned} D_i &= \mathbf{X}_i\pi_{10} + \pi_{11}Z_i + \varepsilon_{1i}; & (2)\\ Y_i &= \mathbf{X}_i\pi_{20} + \pi_{21}Z_i + \varepsilon_{2i}. & (3) \end{aligned}$$

- Note: $\rho = \pi_{21}/\pi_{11}$; π_{21} and π_{11} can be estimated by OLS
- Terminology:
  - Y_i is dependent variable; $\mathbf{X}_i$ are (exogenous) covariates; D_i is endogenous variable; and Z_i is instrument
  - (1) is structural (or second-stage) equation; (2) is first-stage equation; and (3) is reduced-form equation

Ambulance Instrument

- Doyle et al (2015): Ambulance providers have different propensities to send to different hospitals. In New York:



Destination of Patients Picked Up In The Bellevue Hospital Zip Code Area

Destination	All Voluntary Hospital Ambulances	Fire Department Ambulances
Bellevue Hospital (HHC)	25%*	61%**
Any Voluntary Hospital	75%	39%

*157 taken to Bellevue/632 total. **815 taken to Bellevue/1,346 total

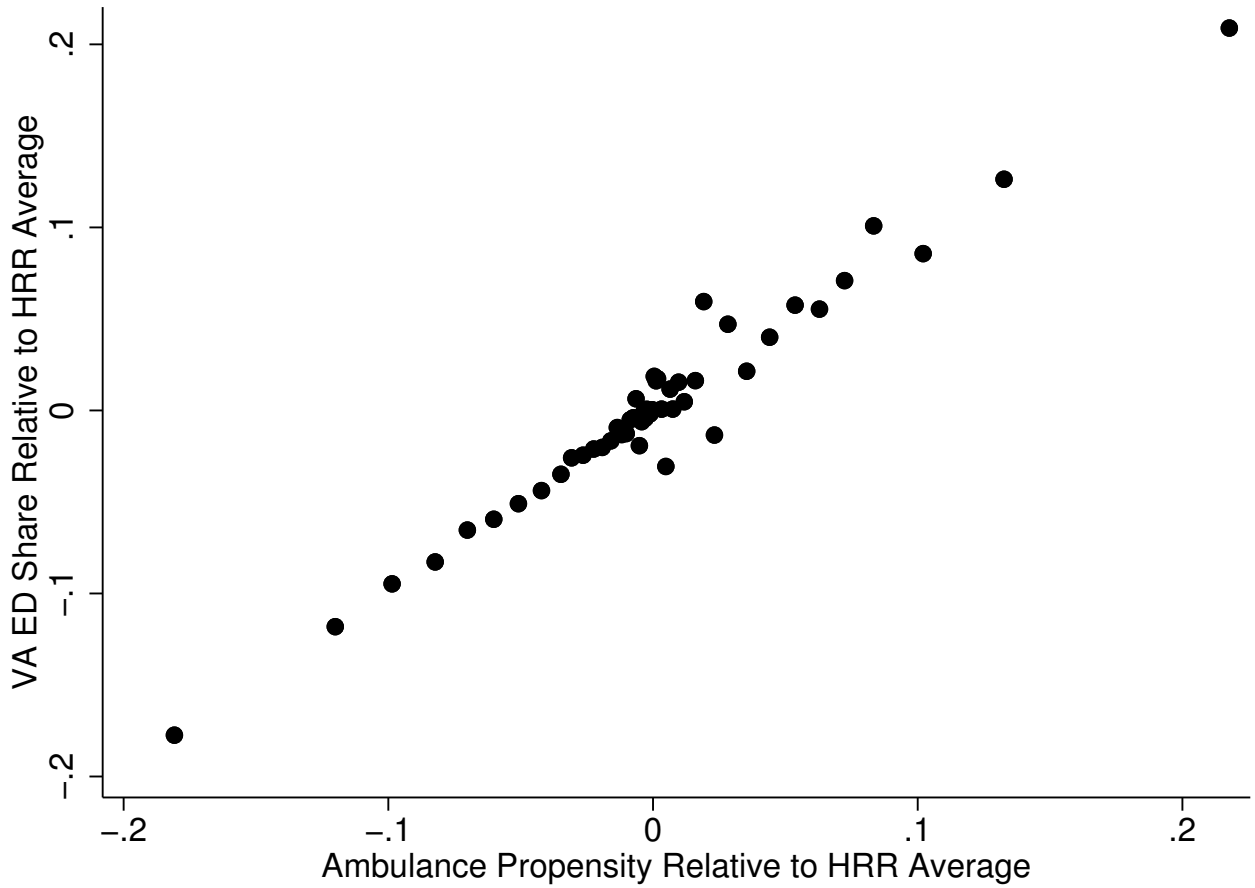
Ambulance Instrument

- Potential reasons for ambulance-specific propensities for VA vs. non-VA EDs (**first stage**):
  - Ambulance may be affiliated with certain hospitals
  - Ambulance may have different degrees to which they ascertain whether patient is a Veteran
  - Ambulance may have base of operation that is closer to VA or non-VA ED
- Important assumptions for quasi-experimental design (**exclusion restriction**):
  - Ambulance needs to be randomly assigned, *conditional* on zip code
  - Ambulance cannot directly affect patient health

Ambulance Instrument

Assessing First Stage

- Is VA vs. non-VA ED usage predicted by ambulance propensity to send to VA for *other patients*?



Ambulance Instrument

Assessing Exclusion Restriction

- Exclusion restriction is not fully testable, but we can ask whether predictable mortality differs by instrument

Balance Across Ambulance Propensity Quintiles (Abbreviated)

	Smallest				Largest
Ambulance propensity quintile	1	2	3	4	5
Ambulance propensity (zip code demeaned)	-0.030	-0.003	-0.001	0.001	0.033
Share with primary care visits in past year	0.403	0.422	0.435	0.441	0.413
Age	76.9	75.9	77.3	79.0	77.1
Predicted 28-day mortality	0.115	0.113	0.120	0.127	0.117
Congestive heart failure	0.424	0.397	0.403	0.496	0.442
Cardiac arrhythmias	0.519	0.497	0.487	0.580	0.532
Hypertension (uncomplicated)	0.470	0.478	0.479	0.526	0.480
Chronic pulmonary disease	0.834	0.809	0.82	0.887	0.844
Diabetes (uncomplicated)	0.438	0.418	0.426	0.470	0.448

Ambulance Instrument

Discussion

1. What about fact that ambulances serving patients in rural areas are less likely to go to VA?
   - We condition on zip codes. Instrument requires *conditional* random assignment.
2. What happens if patients demand to be taken to the VA (or non-VA) ED?
   - This is considered "non-compliance" with the instrument and reflected in the first stage
3. What happens if patients who demand to be taken to non-VA ED are sicker (or healthier)?
   - This is exactly why we use an instrument!
4. What causal effect are we identifying if some patients never are affected by instrument?
   - We identify the "local average treatment effect (LATE)" of *compliers*

Differential Distance Instrument

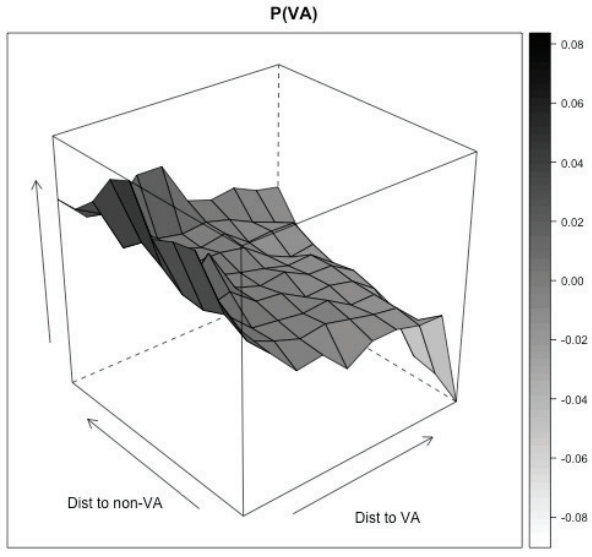
- Classic approach from McClellan et al (1994): Veterans who live differentially closer to VA ED are more likely to go to VA ED (**first stage**)
- Assumption: Veterans who live differentially closer to VA ED are no different than those who live farther (**exclusion restriction**)
- Note on differential distance:
  - Veterans who live are absolutely distant from VA ED are more likely to live in rural areas
  - But we are considering *differential distance*:

$$DD(i) = D_{VA}(i) - D_{Outside}(i)$$

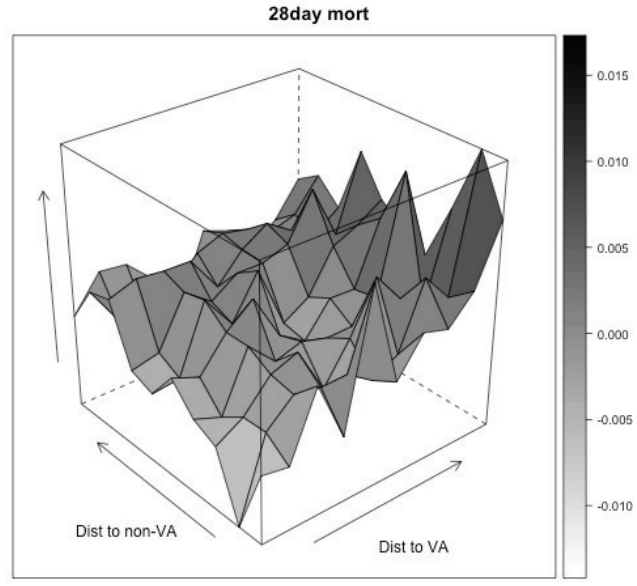
Veterans in rural areas have higher $D_{VA}(i)$ *and* $D_{Outside}(i)$. We take the difference.

Differential Distance Instrument

Effect of Differencing



(a) First Stage

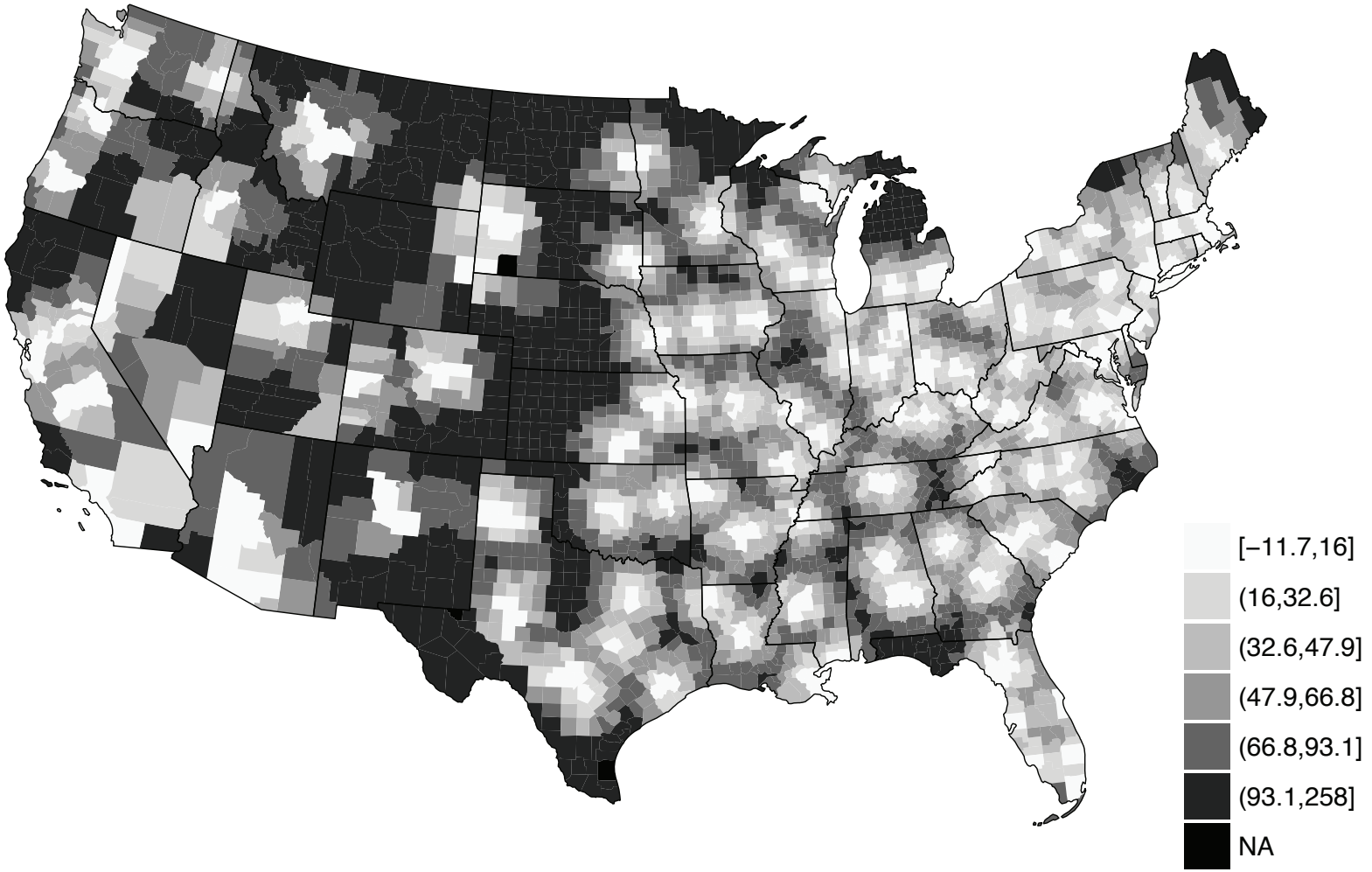


(b) Reduced Form

- Both first stage (choice of VA vs. non-VA) and reduced form (mortality) depend on differential distance, and not absolute distance

Differential Distance Instrument

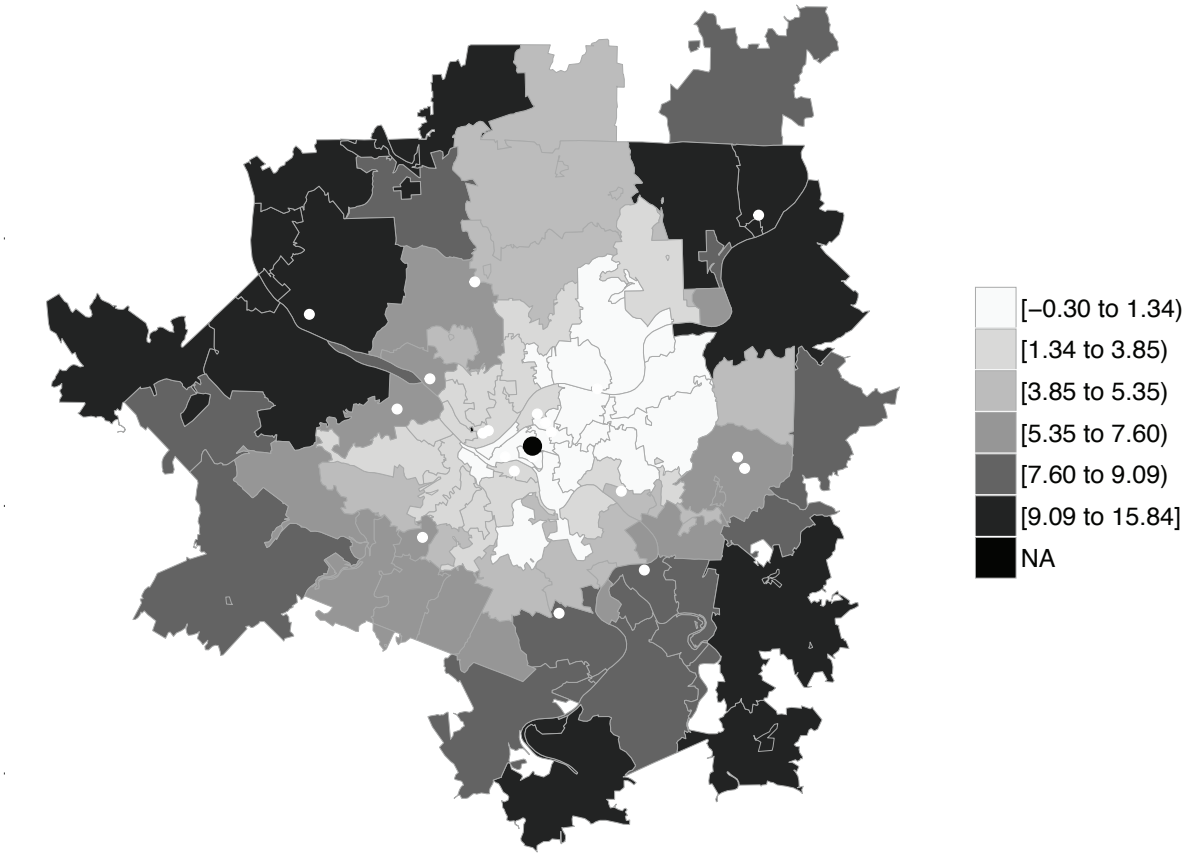
National Map



Differential Distance Instrument

Pittsburgh Example

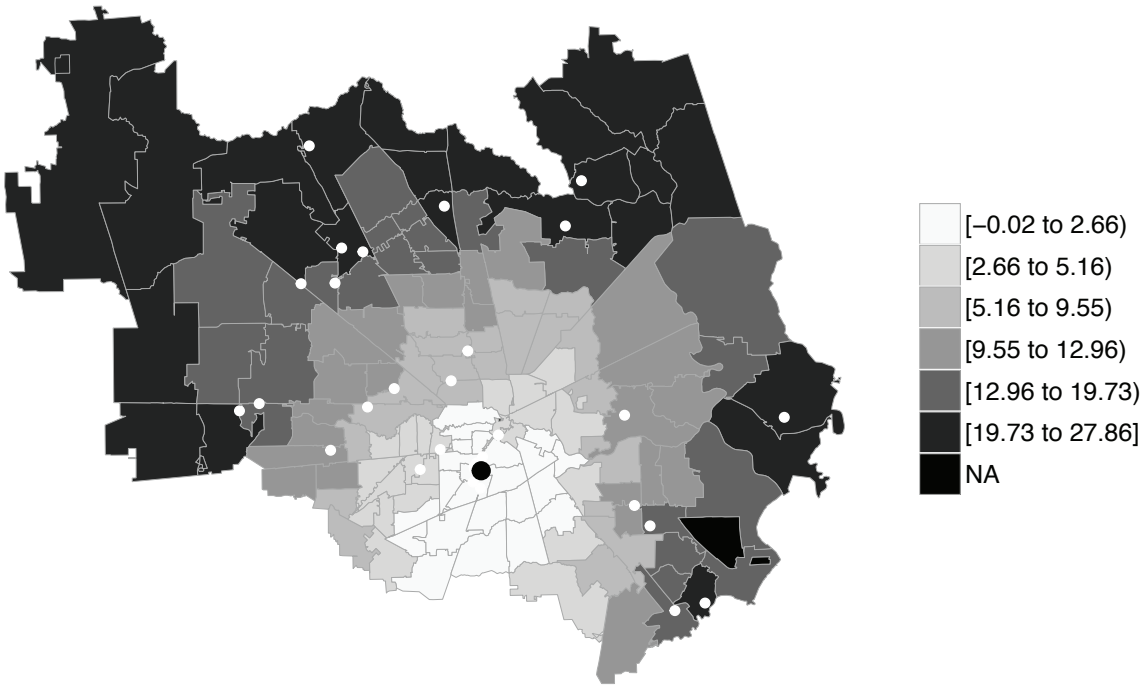
- Condition on Health Service Area (HSA), so only compare *within* HSA



Differential Distance Instrument

Houston Example

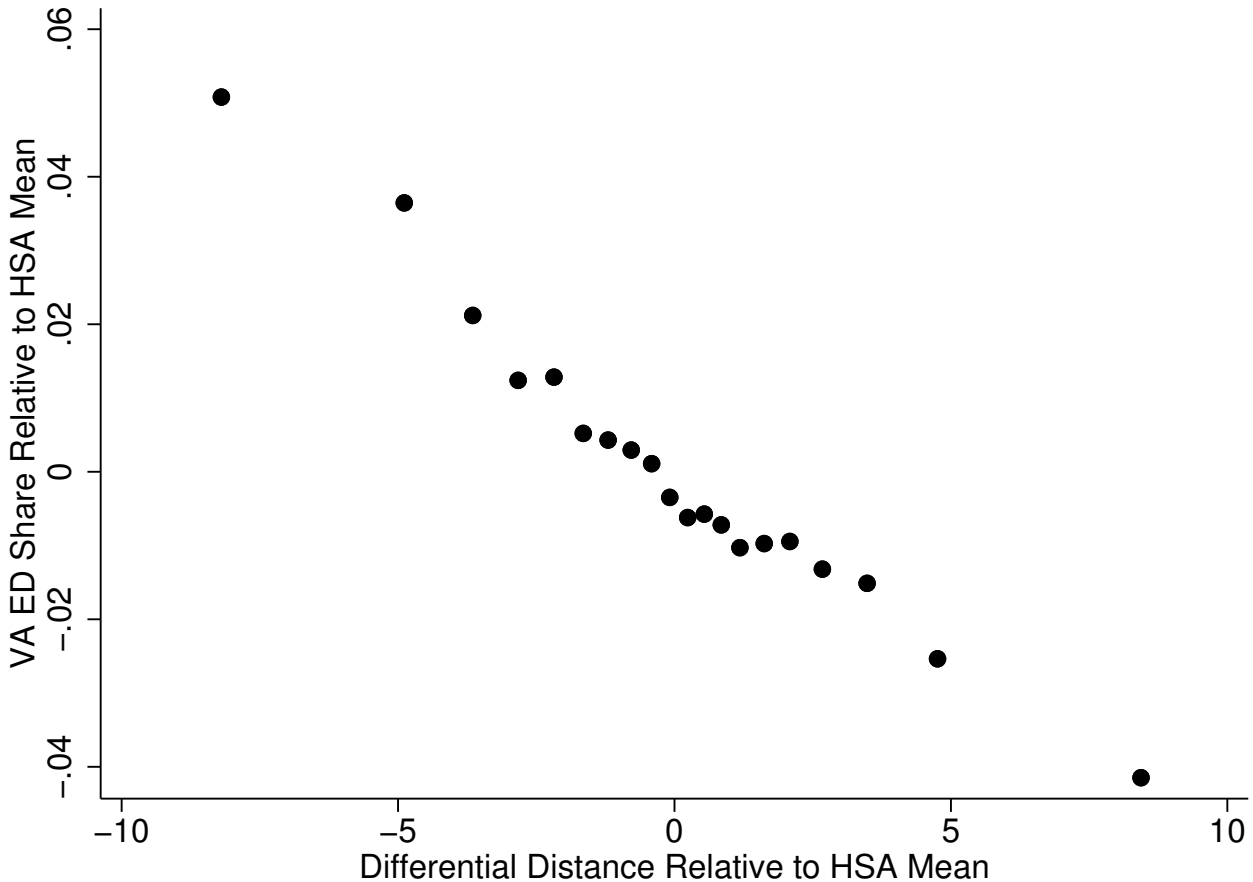
- Condition on Health Service Area (HSA), so only compare *within* HSA



Differential Distance Instrument

Assessing First Stage

- Is VA vs. non-VA ED usage predicted by differential distance?



Differential Distance Instrument

Assessing Exclusion Restriction

- Does predictable mortality vary by differential distance?

Balance Across Differential Distance Quintiles (Abbreviated)

Distance relative to VA ED	Closest				Farthest
Differential distance quintile	1	2	3	4	5
Differential distance (HSA demeaned)	-4.89	-1.45	0.07	1.44	4.84
VA ED share	0.111	0.099	0.077	0.055	0.047
Primary care visits in past year	10.1	10.4	10.6	10.7	10.6
Age	76.6	77.1	77.4	77.5	77.6
Predicted 28-day mortality	0.111	0.110	0.111	0.113	0.113
Congestive heart failure	0.420	0.422	0.434	0.437	0.431
Cardiac arrhythmias	0.520	0.531	0.540	0.543	0.533
Hypertension (uncomplicated)	0.840	0.835	0.837	0.839	0.840
Chronic pulmonary disease	0.464	0.463	0.473	0.472	0.474
Diabetes (uncomplicated)	0.438	0.433	0.440	0.442	0.443

Interpretation of IV Design

- Quasi-experimental variation is different for ambulance instrument than for differential distance instrument
  - Ambulance instrument is *within 9-digit zip code*: Two Veterans who live in same zip code who are picked up by different ambulance companies
  - Differential-distance instrument is across small-area location (e.g., zip code) but within HSA: Two Veterans that live in different locations in the same HSA
  - May interpret ambulance instrument as using within-area variation, while differential-distance instrument as using across-area variation
- Thus, no reason why results should mechanically be the same across instruments

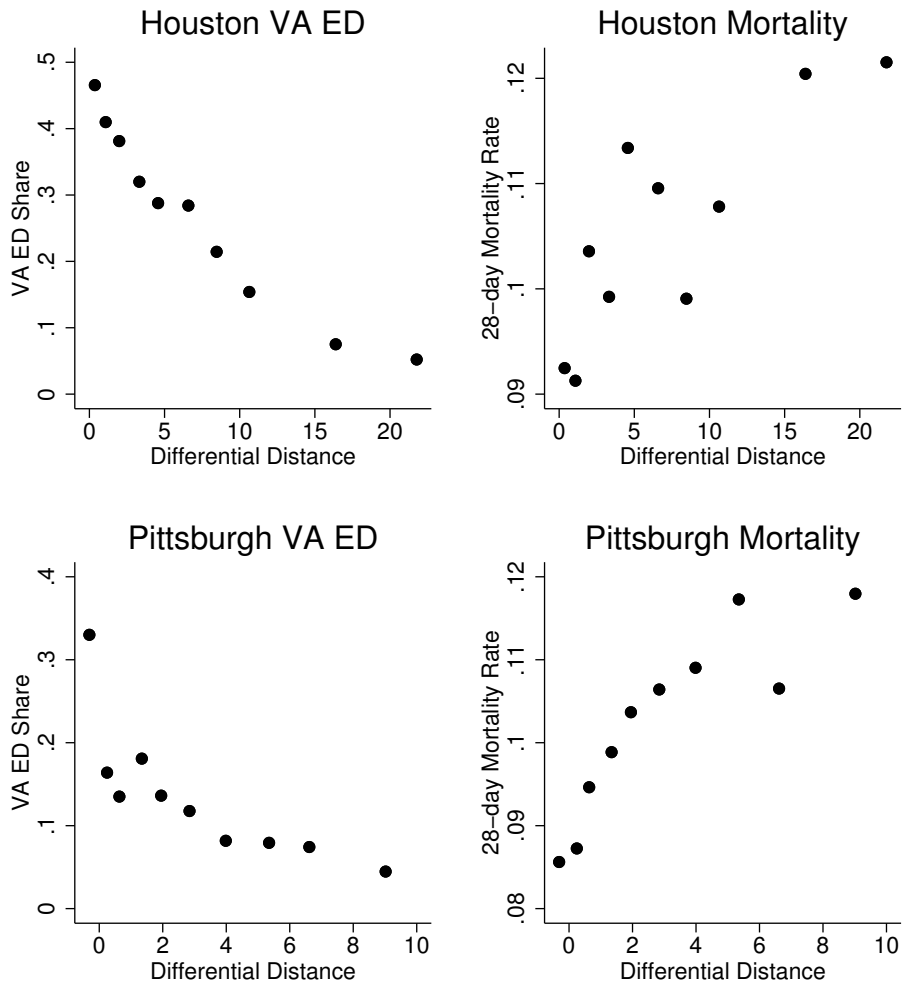
Mortality Results

- 30-day mortality effect of VA ED is 5 p.p. reduction from baseline 10 p.p.; effect is essentially identical regardless of instrument
- Baseline results are all *within HSA* (Houston example), averaged across 908 HSAs
- But results also hold in between-HSA design: HSAs with average greater distance to VA vs. non-VA have higher mortality

Mortality Results

Within-HSA Examples

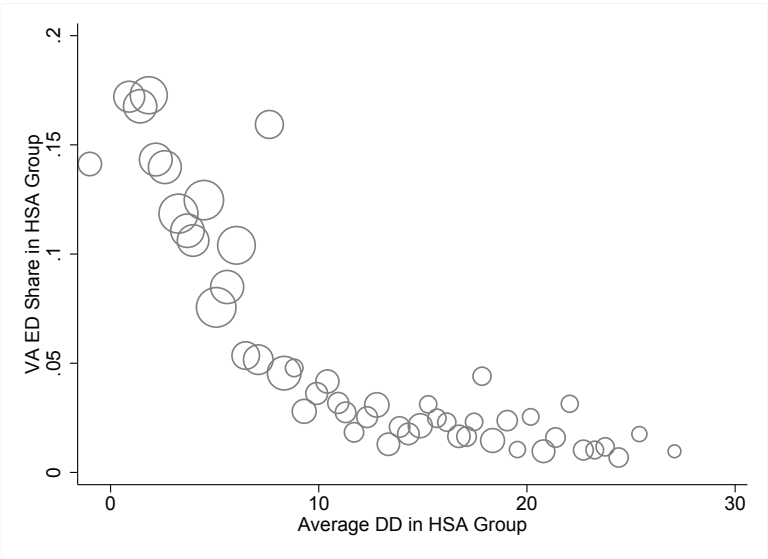
Veterans differentially closer to VA have lower mortality



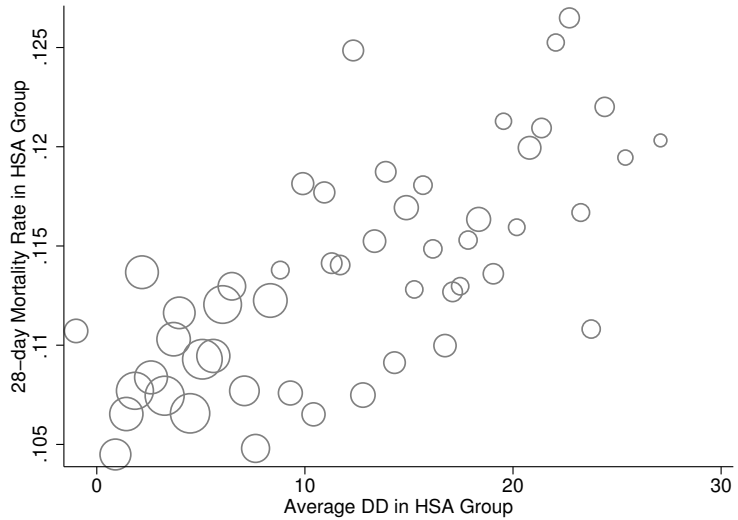
Mortality Results

Between-HSA Patterns

HSAs with average lower distance to VA vs. non-VA have lower mortality



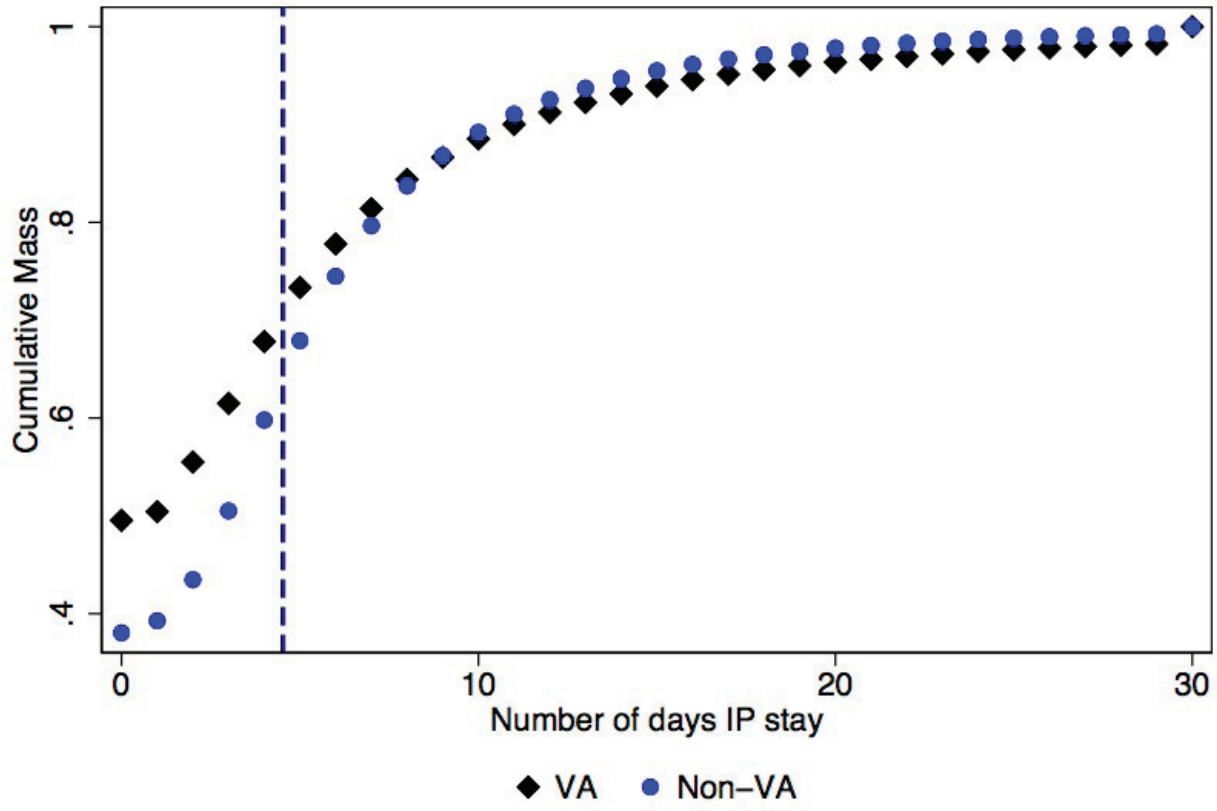
(c) First Stage



(d) Reduced Form

Hospitalization and Length of Stay

- Outside of the VA, patients more likely to be admitted, but conditional on admission, LOS shorter



Dashed black and blue vertical lines denote mean LOS for VA and non–VA visits, respectively

Diagnosis and Billing

- Non-VA EDs more likely to bill at higher level for Evaluation and Management CPT

		All rides		Admitted rides		Unadmitted rides	
		Medicare (n=7,611,436)	VA (n=357,779)	Medicare (n=4,484,270)	VA (n=209,105)	Medicare (n=3,127,166)	VA (n=148,674)
Emergency level	1	0.2%	4.5%	0.1%	3.2%	0.4%	6.3%
	2	1.4%	9.7%	0.2%	6.2%	3.2%	14.6%
	3	9.7%	37.0%	3.0%	33.8%	19.2%	41.4%
	4	20.6%	25.4%	11.5%	29.9%	33.7%	19.2%
	5	44.6%	9.2%	52.3%	12.7%	33.6%	4.2%
	Critical care	10.0%	1.5%	15.7%	2.2%	1.8%	0.4%
	Missing	13.5%	12.8%	17.2%	12.0%	8.2%	13.8%

- Will later turn to cost / charges, and upcoding for specific diagnoses

Summary and Policy Implications

- We introduce quasi-experimental methods to identify the effect of VA vs. non-VA emergency care on patient outcomes
- Appears that there are large health benefits, and potential cost savings, on average
- Implications for how VA can optimize Veteran health

Future Work

- For which Veterans is the VA health benefit largest? For which Veterans might non-VA care be better?
- What characterizes VA hospitals that perform better relative to their non-VA alternatives? What about the non-VA alternatives determines this?
- What are the mechanisms that lead to this effect?
  - Follow-up care, continuity of care
  - Veteran-specific resources in the ED
  - Any others?

References

- Doyle, Joseph J., et al. 2015. "Measuring Returns to Hospital Care: Evidence from Ambulance Referral Patterns." *Journal of Political Economy* 123 (1): 170–214.
- McClellan, Mark, et al. 1994. "Does More Intensive Treatment of Acute Myocardial Infarction in the Elderly Reduce Mortality?: Analysis Using Instrumental Variables." *JAMA* 272 (11): 859.
- Trivedi, Amal N., et al. 2011. "Systematic Review: Comparison of the Quality of Medical Care in Veterans Affairs and Non-Veterans Affairs Settings." *Medical Care* 49 (1): 76–88.