Chasing ambulance productivity

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AEA 2016 – VERY PRELIMINARY
The paper aims to investigate the importance of management practices in healthcare

Note: Spread of management practices in hospitals evaluated on monitoring, targets and incentives. Europe is France, Germany, Italy, Sweden & the UK.

Source: Bloom, Lemos, Sadun & Van Reenen (2015)
These management practices appear to matter for healthcare outcomes – e.g. heart-attack death rates

Note: Correlation between management practices and AMI (heart attack) death rates in US hospitals.

Source: Bloom, Lemos, Sadun & Van Reenen (2015)
Decided to examine ambulance services - data rich, wide performance spread and open to an RCT

**Data:** Ambulance services measure everything in detail

**TFP spread:** Heterogeneous ownership and operation
- *Ownership:* Private, Emergency Agency (e.g. Fire), Hospital etc
- *Size:* Spread from small towns to entire cities
- *Geography:* Many serve their district and only their district
- *Contracting:* Complex service chosen by city officials

**RCT:** Largest US provider – AMR – recent rapid growth & very open
Agenda

Introduction

Data and summary statistics

Productivity estimation

Next steps
The Basics of an Ambulance Call

1. 911 call received at dispatch
2. Ambulance assigned
3. Ambulance departs waiting point
4. Arrives at patient scene
5. Crew reach patient
6. Determine whether to transport
7. Depart patient scene
8. Ambulance arrives at hospital
9. Transfers patient to ER
10. Checks in for next run

ER treatment not required

Time stamp recorded
On average a call takes about 70 min

Mean duration of call segments

- To Start: 1.8 min
- To Scene: 6.4 min
- To Patient: 1.3 min
- On Scene: 12.4 min
- To Hospital: 13.3 min
- To Close: 33.3 min
- Total: 68.6 min

We focus on:

- Regulated (e.g. within 10 minutes for 90% calls)
Most variation in last three steps of process

Inter-Quartile range

We focus on

To Start  To Scene  To Patient

On Scene  To Hospital  To Close

Minutes

0  5  10  15  20  25  30  35  40  45

Bloom, Chan and Gupta
Data from US Largest Ambulance Provider

Working with American Medical Response
  • Operates in 40 states with over 200 stations
  • Provides over 3 million patient transports per year

Obtained data so far for 20 stations in California
  • Operations – time stamps, location details
  • Clinical – crew member identity, patient characteristics, ‘primary impression’
  • HR – employee characteristics
  • Billing – insurer

Hospital/ER discharge records from California (not used today)
  • Observe outcome of ER visit/hospital stay
  • Can follow patients over time and across facilities
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Can look at *system* or *individual* productivity

Long run will evaluate both different stations (e.g. AMR has 200+ stations) within and across firms (e.g. Census Data has all firms)

Ambulance systems complex, and capital and labor intensive – so plenty of scope for TFP variation
Can look at firm, station or employee productivity
Model of ambulance journey productivity

\[ \log(T_{ips}) = \gamma_1 c + \gamma_2 H + \gamma_3 dw + \gamma_4 h + \gamma_5 m + \gamma_6 v + \delta_1 \log(d_i) + \delta_2 g_{iH} + \delta_3 g_{iH} * 1(h) + \delta_3 X_i + \alpha_p + \beta_s + \epsilon_{ips} \]

where,

i,p,s: patient, primary and secondary crew member on the call
T: Outcome (duration of specific sub-segments of call)
d: transported distance
c: Patient pickup city, H: Hospital
dw: Day of week, h: hour of day, m: Month-year
g_{iH}: Google suggested drive time from patient location to hospital
\( \dot{\theta} \): Vehicle
\( X \): Patient age categories, gender and interactions
Time on scene: top 15 cities and hospitals

For the top 15 origin cities

<table>
<thead>
<tr>
<th>City</th>
<th>Mean time on scene</th>
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<tbody>
<tr>
<td>WALNUT CREEK</td>
<td>15</td>
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<tr>
<td>CORONA</td>
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<tr>
<td>MORENO VALLEY</td>
<td>13</td>
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<tr>
<td>RIVERSIDE</td>
<td>12</td>
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<td>SAN BERNARDINO</td>
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<tr>
<td>PALMDALE</td>
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<td>PERRIS</td>
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<td>CONCORD</td>
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<td>VICTORVILLE</td>
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<td>LANCASTER</td>
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<td>ANTIoch</td>
<td>5</td>
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<tr>
<td>RICHMOND</td>
<td>4</td>
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<tr>
<td>PITTSBURG</td>
<td>3</td>
</tr>
<tr>
<td>LODI</td>
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<td>STOCKTON</td>
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For the top 15 hospitals

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Mean time on scene</th>
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<td>HENRY MAYO NEWHALL HOSP SCLR</td>
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<tr>
<td>JMMC - WALNUT CREEK</td>
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<td>CORONA REGIONAL MEDICAL CTR</td>
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<tr>
<td>RIVERSIDE COMMUNITY HOSPITAL</td>
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<tr>
<td>PALMDALE REGIONAL MEDICAL CENTER</td>
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<tr>
<td>RIVERSIDE CNTY REGIONAL MEDCCTR</td>
<td>10</td>
</tr>
<tr>
<td>INLAND VALLEY MEDICAL CNTR</td>
<td>9</td>
</tr>
<tr>
<td>CONCORD JOHN MUIR</td>
<td>8</td>
</tr>
<tr>
<td>SUTTER DELTA MEMORIAL HOSPITAL</td>
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<td>ANTELOPE VALLEY HOS LANC</td>
<td>6</td>
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<tr>
<td>REGIONAL MED CNT MARTINEZ</td>
<td>5</td>
</tr>
<tr>
<td>LODI MEMORIAL HOSPITAL</td>
<td>4</td>
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<tr>
<td>ST JOSEPHS MEDICAL CENTER</td>
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<tr>
<td>SAN JOAQUIN GENERAL HOSPITAL</td>
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</table>
Top of the box indicates 75\textsuperscript{th} percentile value. Bottom of the box indicates the 25\textsuperscript{th} percentile value and the central line indicates the median.
Results: Individual crew time on scene

Large performance spreads: 0.4 log points (50%) speed difference between top end and bottom end crew members (and this is AMR – probably most efficient operator so likely one of the lowest variance operators)
Results: Individual crew time on scene

Secondary crew fixed effects

Secondary crew member even shows large spread of about 0.25 log points (30%)
Individual and Site FEs each account for ≈ 5% of total time, similar to individual and plant FEs in manufacturing TFP.

Share of variation explained is the adjusted R-squared value calculated for each of the 8 specifications described. Note that fixed effects are estimated only for a subset of individuals (2088 unique individuals).

Conceptually similar to Chandra, Finkelstein, Sacarny and Syverson (2015) in highlighting similarities with private sector in dynamics of TFP.
Performance on-scene correlated across roles

Speed highly correlated for individuals across different roles (you can either be a primary or secondary crew member) – shows persistent speed variation

Note: 500 individuals in Top 5 stations
Performance in other segments also correlated with on scene time

Correlation with performance at scene

Speed highly correlated for individuals across different roles – here driving to and from the scene
No clear pattern in team formation

Conditional on shift individual call-out and team formation appear as good as random – calls dispatched to nearest ambulances and teams organized by LIFO

Note: 120-130 individuals in each decile
Performance appears u-shaped over tenure

Primary crew members

Secondary crew members

Note: Numbers on top of the bars indicate the number of personnel in that tenure bin for whom fixed effects were estimated.
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Next steps

1. Match AMR data to hospital outcomes data (Medicare)

2. Collect data on the entire AMR network to examine individual & site spreads

3. Evaluate cross-firms spreads using Census data

4. Use learnings to organize an AMR RCT
Impact of timing of call

Day of week

Hour of day

Day of week fixed effect estimated relative to Sunday. Hour of day fixed effect estimated relative to 1 AM.
Hospital fixed effects are estimated relative to those calls for which hospital is unknown. Similarly for patient cities.

Bayesian estimated std. deviation = .06

Bayesian estimated std. deviation = .04
Vehicle

Vehicle fixed effects

Bayesian estimated std. deviation = .12
Variation in other call segments explained by controls

Share of variation explained is the adjusted R-squared value calculated for each of the 8 specifications described. Note that fixed effects are estimated only for a subset
Summary statistics (I): Main sample

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<tr>
<th>Variable</th>
<th>Min</th>
<th>p10</th>
<th>Mean</th>
<th>Median</th>
<th>p90</th>
<th>Max</th>
<th>SD</th>
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<td>12.40</td>
<td>11.68</td>
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<td>90,576</td>
<td>105,603</td>
<td>641,812</td>
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</tr>
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</table>
Distribution of patient contact time and distance transported

Time on scene with patient

Transported distance

Bloom, Chan and Gupta
Sample selection

Only consider 911 (emergency) calls where patient was transported

Drop calls without identifier for primary/secondary crew member

Exclude calls from city with <100 calls or to hospital with <500 calls
Riverside County's proposed contract with American Medical Response for emergency ambulance service holds the company to standards for how long it takes an ambulance to arrive to a call. This map shows those standards. AMR's ability to meet response-time goals will determine whether its contract gets renewed.