Experiential Learning and Variation in Medical Practice

Qualitative, Simulation, and Quantitative Data-Based Models

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Introduction
Introduction

- Several indicators of abundant suboptimal decisions in medicine.
  - Mistakes - 98,000 people die in the United States hospitals every year.
  - Bias - Overuse of defensive medical practices such as medical tests.
  - Practice variation - Disagreement on diagnoses and treatments.

- Problem Significance.
STUDY 1: What is Practice Variation?

A Qualitative Literature Review Based Study

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Problem Definition

☐ This study:
  ◼ Focuses on decision making determinant of practice variation.

☐ Main questions:
  ◼ How has practice variation been studied?
  ◼ How can we make sense of the literature?

☐ Proposes an analytic framework of behavioral decision making determinants of practice variation.
Methods

☐ Literature Review
☐ Searched PubMed for "practice variation," which identified 333 articles.
☐ Narrowed articles to those published in core medical journals.
☐ Finally, we tracked key citations from the articles reviewed. Our final sample included 75 articles.
Methods

- The open coding revealed two key findings:
  - First, several behavioral decision making phenomena play important roles in practice variation.
  - Second, there is a conceptual difference across studies of practice variation in how researchers categorize, describe, and study practice variation.
Table (1): Different forms of practice variation among medically similar patients

<table>
<thead>
<tr>
<th></th>
<th>Within–physician</th>
<th>Between–physician</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Within–patient</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Between–patient</strong></td>
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<td></td>
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</tbody>
</table>
STUDY 2: Beyond Personality Trait and Financial Incentives, The Role of Experiential Learning

A Simulation Model

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Introduction

- Common explanations for bias and practice variation
  - Finance structures
  - Physician characteristics
  - Regional and organizational factors
- Theory and Policy Implications
Problem Definition

- Dynamic Hypothesis:

- Practice variation and bias do not have to be caused by personality traits, financial incentives, and regional variation, **but can endogenously emerge through daily practices and outcome learning even among physicians with similar training working in the same region.**
Research Design

☐ Theory:
  - Psychology
    - Experiential Learning
  - Medical Decision Making, Health policy

☐ Method: Simulation
  - Discrete, dynamic, feedback-based model of medical decision making. Our unit of analysis is a physician

☐ Case: Obstetricians
  - Then we investigate generalizability of the findings
Case

- Decision Making:
  - Vaginal Delivery vs. C-section
  - C-section side effects
    - Higher risks for mom
    - Higher risks for baby
    - Next delivery problems
- 34% of the cases in US
  - W.H.O.: suggests 10-15%
  - 20% UK
- Increasing trend
Case


Standard deviation = 6.5 percentage point

Epstein and Nicholson (2009)
Model

A physician's cognition

A causal diagram of obstetrics practice for a single obstetrician
Results (Base run)

Each line represents one physician. All lines together show disagreement (divergence) and bias from optimal threshold (i.e., 5/10).

optimal threshold

Threshold dynamics
STUDY 3: Can Simulation Results Replicate Real Data

A Data-Based Simulation Model

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** University of Pennsylvania
Research Design

- Case: Obstetricians

- Data on CS decisions of 100 randomly selected FL obstetricians who started practice between 1992 and 2000.

- Can We explain (replicate) CS trend in physicians during through practice?
A Sample of Data: One Doctor’s CS Rate through years of practice after residency
<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
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</thead>
<tbody>
<tr>
<td>Decision and Outcome</td>
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<tr>
<td>C-section</td>
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<td>0.458788</td>
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<td>1</td>
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<td>0.400069</td>
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<td>1</td>
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<tr>
<td>major complication</td>
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<td>0.125924</td>
<td>0.331764</td>
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<td>1</td>
</tr>
<tr>
<td>Patient Risk</td>
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<td></td>
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<td>previous C-section</td>
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<td>0.345401</td>
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<td>1</td>
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<tr>
<td>One of 12 risk factors</td>
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<td>0.273151</td>
<td>0.445579</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Patient Characteristics</td>
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<td></td>
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<tr>
<td>Minority</td>
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<td>0.435224</td>
<td>0.495787</td>
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<td>1</td>
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<td>poor payer</td>
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<td>0.439101</td>
<td>0.496278</td>
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<td>1</td>
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<tr>
<td>Physician Chr</td>
<td></td>
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<td></td>
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<tr>
<td>immigrant doctor</td>
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<td>0.170591</td>
<td>0.376152</td>
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<td>1</td>
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<tr>
<td>female doctor</td>
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<td>0.244378</td>
<td>0.429719</td>
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<td>1</td>
</tr>
</tbody>
</table>
Model

A causal diagram of obstetrics practice for a single obstetrician
Model

- Types of outcome feedback in data:
  - Some VD cases end up with emergency CS
    - False Negative
  - Major Complications Are reported. Major Complication for patient in labor
    - False Negative
  - Major Complication for a patient in CS
    - Maybe False Positive, Maybe True Positive?
Calibration

- What is the generic approach?
- What can we do here?
$x = \beta_0 + \beta_{1,i} (PyCh) + \beta_{2,j} (PatCh) + \beta_{3,j} (PatHl) + \beta_{4,j} (PastFB) + \beta_{5,j} (PastFB^2) + \beta_6 (Time)$
\[ x = \beta_0 + \beta_{1,j}(PyCh) + \beta_{2,j}(PatCh) + \beta_{3,j}(PatHl) + \beta_{4,j}(PastFB) + \beta_{5,j}(PastFB^2) + \beta_6(Time) \]
## Calibration (A sample of Results)

<table>
<thead>
<tr>
<th></th>
<th>Dependent Variable: Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td><strong>Total number of emergency CS</strong> ($\Sigma F1$)</td>
<td>-0.003242</td>
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<tr>
<td></td>
<td>(0.000054)</td>
</tr>
<tr>
<td><strong>Square of $\Sigma F1$</strong></td>
<td>1.07E-05</td>
</tr>
<tr>
<td><strong>Total Labor-with-Complication</strong> ($\Sigma F2$)</td>
<td>-8.7E-05</td>
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<tr>
<td></td>
<td>(7.76E-05)</td>
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<tr>
<td><strong>Square of $\Sigma F2$</strong></td>
<td>3.07E-06</td>
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<tr>
<td><strong>Total CS-with-Complication</strong> ($\Sigma F3$)</td>
<td>0.005804</td>
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<tr>
<td></td>
<td>(0.000382)</td>
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<tr>
<td><strong>Square of $\Sigma F3$</strong></td>
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<tr>
<td><strong>Pseudo R2</strong></td>
<td>0.3717</td>
</tr>
</tbody>
</table>
Base Run

C-sec Threshold Similar initial conditions

0 250 500 750 1000 1250 1500 1750 2000 2250 2500
Time (Month)
Base Run

C-sec Threshold Different Initials

Time (Month)

0 250 500 750 1000 1250 1500 1750 2000 2250 2500
Base Run

Scheduled C-section

Total C-section (Scheduled + After laboring)
Comparison with Data (Scheduled C-section rate)
Next steps of this paper

- Out of sample test.
- Can it replicate NY?
- Can it replicate newer Doctors?
Discussions

☐ Discussion about the papers? Especially the last paper.

☐ Discussion about the research path.

☐ What do you think?