Developing an open source simulation model of physician supply and healthcare utilization

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This two-year project is funded by a grant from the Physicians Foundation.
Presentation Outline

- Project Goals (briefly)
- Overview of current model
  - Outline key questions
  - Solicit feedback
- Discussion
Main objective: Create open source physician projection model to be used by policy makers

Additional goals: Promote dialogue among physicians, policy makers, medical societies, state and federal workforce planners, health systems and others about need to:

- **Not** generate a single “right” answer
- Develop scenarios that allow users to simulate policy effects
- Engage clinicians in planning for the size, shape and specialty mix of the future workforce
A schematic view of how the three pieces fit together to produce a projection

- The following slide presents a high level, schematic view of how three key elements of our model fit together –
  - Utilization
  - Supply
  - Linking demand for health services with supply of providers

- to create estimates of

  A. Physician supply (by time, location, training, characteristic, e.g.) as a function of contextual elements
  B. Relative adequacy of supply for population health needs
Sociodemographics
(age, gender, race/ethnicity, income)

Health & Risk
(certain conditions, insurance status)

Demand
by type of service / condition (e.g. inpatient cardiovascular; outpatient mental)

Provider Sociodemographics
(age, gender, race/ethnicity, specialty)

Geographic factors
(rurality, malpractice environment)

Local Amenities
Socioeconomics of community

Supply & Policies
Current stock; residency slots; scope of practice

Utilization

“Plasticity”

Supply

Aim 1: How many physicians will be in each area?

PROVIDER SUPPLY
In an area by “type”
Sociodemographics (age, gender, race/ethnicity, income)

Health & Risk (certain conditions, insurance status)

Provider Sociodemographics (age, gender, race/ethnicity, specialty)

Geographic factors (rurality, malpractice environment)

Local Amenities Socioeconomics of community

Demand by type of service / condition (e.g. inpatient cardiovascular; outpatient mental)

Supply & Policies Current stock; residency slots; scope of practice

“Plasticity”

Aim 2: Will the physicians in the area be adequate??

PROVIDER SUPPLY In an area by “type”
Sociodemographics (age, gender, race/ethnicity, income)

Health & Risk (certain conditions, insurance status)

Demand for health care services

Demand by type of service / condition (e.g. inpatient cardiovascular; outpatient mental)

Provider

Sociodemographics (age, gender, race/ethnicity, specialty)

Geographic factors (rurality, malpractice environment)

Local Amenities Socioeconomics of community

PROVIDER SUPPLY In an area by “type”

Supply & Policies Current stock; residency slots; scope of practice

“Plasticity”
We are modeling **utilization**, not demand, not need

- What’s the difference?
  - Need – “biological”
  - Demand – incorporates ability and willingness to pay
  - Utilization – the demand that is realized – i.e. the number of services consumed

- The population uses thousands of different kinds of health services – can we aggregate these into a manageable number?

- Aggregation method: Clinical Classification System (CCS), AHRQ algorithm, defined by ICD-9 diagnoses
We are modeling utilization in four settings

- We are using four settings of services
  - Office-based provider
  - Hospital-based care: inpatient and outpatient settings
  - Emergency room

- Combined with the 18 CCS, we have $4 \times 18 = 72$ different kinds of services utilized
Sources for data on utilization

- Primary data source is Medical Expenditure Panel Survey (MEPS)
  - Annual survey by AHRQ, contains setting and CCS for approximately 30,000 individuals per year
  - We have combined multiple years

- Allows us to estimate the effect of key factors known to influence utilization, and then develop areal rates:
  - **Sociodemographics**: age, income, insurance coverage;
  - **Health & Risk**: obesity, smoking, etc. (e.g. BRFSS)
Area contextual data has differing effects across types of services.

Predicted Mental Health and Respiratory Office-Based Visits (OBV) Per Capita

North Carolina counties (N=100). Predicted utilization based on MEPS 2009 and county-level data.
Shifting to supply....

Factors affecting supply directly

Provider Sociodemographics
(age, gender, race/ethnicity, specialty)

Geographic factors
(rurality, malpractice environment)

Sociodemographics
(age, gender, race/ethnicity, income)

Health & Risk
(certain conditions, insurance status)

Demand by type of service / condition (e.g. inpatient cardiovascular; outpatient mental)

Local Amenities
Socioeconomics of community

Supply & Policies
Current stock; residency slots; scope of practice

“Plasticity”

In an area by “type”
Modeling supply like the real world

- **GME Pipeline**
- **Ratio HC/FTE**
- **Projected future workforce**
- **Current workforce**
- **Diffusion**
- **Retirements**
- **Attrition**

Overview | Utilization | Supply | Service-Specialty Linking
Agent-based model for physicians

- Use existing data, literature on physicians and their behavior to simulate the behavior of hundreds of thousands of physicians
  - My decision affects your decision
- Physician assistants and nurse practitioners included in model, but not as an “agent”
  - Quality of data, science on their behavior less well developed
How can decisions on location choice ("diffusion") be modeled?

Results of the analysis will provide parameters that can be used to determine the probabilities of moving to each county.

Table 4: Conditional Logit Model Results for Physician Location Choice

<table>
<thead>
<tr>
<th>Malpractice premiums (US$1,000s)</th>
<th>OB/GYNs</th>
<th>Surgeons</th>
<th>PCPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0076 (0.0087)</td>
<td>-0.0235 (0.0073)**</td>
<td>0.0264 (0.0158)</td>
<td></td>
</tr>
<tr>
<td>Damage award cap</td>
<td>0.1482 (0.6248)</td>
<td>1.3004 (0.4051)**</td>
<td>0.0561 (0.2417)</td>
</tr>
<tr>
<td>Health professional shortage area</td>
<td>0.4580 (1.4424)</td>
<td>-0.8410 (1.0801)</td>
<td>1.2158 (0.3798)**</td>
</tr>
</tbody>
</table>

Source: Chou and LoSasso, 2009

<table>
<thead>
<tr>
<th>County</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autauga County, AL</td>
<td>0.3%</td>
</tr>
<tr>
<td>Baldwin County, AL</td>
<td>0.6%</td>
</tr>
<tr>
<td>Barbour County, AL</td>
<td>0.4%</td>
</tr>
<tr>
<td>Bibb County, AL</td>
<td>1.4%</td>
</tr>
<tr>
<td>Blount County, AL</td>
<td>0.8%</td>
</tr>
</tbody>
</table>
Diffusion

- Model attractiveness of location by
  - Age
  - Gender
  - Specialty
  - Area characteristics

**Example:** I’m a 45 year old male surgeon with a 25% chance of staying here, 5% chance of going to Charlotte, 1% chance of Nashville, .002% chance of Michigan’s Upper Peninsula
Provider “Clinical Service Areas”

- Key question: How many different types of physicians can we model?
  - Too few – aggregating dissimilar specialties
  - Too many – model loses precision

- Our target was 8-10

- Current list = 34
Mapping services to providers

- Key decision: no silo-based modeling
  - Recognize the “fungibility” of services across specialties
- How to model a specialist’s range of services?
Translating utilization against supply

- We refer to this concept as the “transmission” or “plasticity”
- For example, family and general practitioners* have considerable heterogeneity in the distribution of visits by CCS...

* We recognize that these specialties are different, but NAMCS groups them.
A random sample of ten GPs/FPs has heterogeneous scopes of services.

Scopes of services for 10 GP/FP in NAMCS

Services Provided
- Other
- Symptoms & signs
- Musculoskeletal
- Skin
- Respiratory
- Circulatory
- Nervous system
- Mental
- Endocrine/immunity

Overview | Utilization | Supply | Service-Specialty Linking

This project is funded by a grant from the Physicians Foundation.
...But dermatologists provide relatively similar scopes of services.

Scopes of services for 10 Dermatologists in NAMCS

...mostly “skin” and cancer.
Takeaway

- Heterogeneity in scope of service varies within specialty (not all doctors have similar scope of service)
- Degree of heterogeneity varies across specialty (some specialties have more similar doctors)

Key question: What determines the specific scope of services among physicians with similar training?

- Are they responsive to relative local demands? How much?
- What factors modify a physician’s “responsiveness” – e.g., age?
Things the model (as we currently envision it) can model

Appeal of this (and all other supply models) is ability to “sandbox” policies and trends:

- Change in FTEs by cohort
- Demand for specific services
- Tort reform
- Changes in scope of services
- GME changes
- Increase in retirement age
- New payment models
Things the model (as we currently envision it) CANNOT do

There are some things the model does not have a “hook” for – cannot bring in:

- **Differences in physician quality**
  *(e.g. differential pay for performance)*

- **Changes in medical school graduate preferences**
  *(e.g. more recruitment from rural communities)*

- **Feedback from physicians to area health status**
  *(e.g. underserved area with undermanaged diabetes leads to higher rates of complications)*
The appeal of our open source design

- Intentional design and implementation to enable extensions to the model for alternative tasks

**Example:** You could tailor for surgical workforce focus by disaggregating surgical specialties and utilization (and aggregating non-surgical specialties). Operationally, with new parameters and data, the model could adapt relatively easily.
Model deployment

- Vision: web-based, but also platform-independent model
  - (eg downloadable Java program calls data stored at central server)
- Temporal, geographic projections
  - Tables, figures, maps(?)
- Computational issues:
  - One year of a physician’s life take approx .002 seconds
    - Times 500,000 physicians
    - Times 20 years
    - = 14 hours
    - If we want confidence intervals, * 100? = 8 weeks!!
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Discussion