Research Workshop
Health Workforce Planning and Predictive Models
-Sharing the Japanese experience -

Tomoki Ishikawa, Ph.D., M.B.A
Institute for Health Economics and Policy, Hokkaido University Faculty of Health Sciences

Katsuhiko Ogasawara, Ph.D., M.B.A
Hokkaido University Faculty of Health Sciences
About us - Our Interest and Motivation

- **Suggestion for administrative measures on regional healthcare**
  - Health care policy and health care economics
  - Evidence-based, sustainable, and feasible
  - Particularly Resource management

- **Proposing new and explanatory modeling techniques**
  - Statistics data
  - Administrative healthcare claims data
  - Geospatial information
  - Integrating various available data
Agenda

1. **Our research background**
   Why did we need to make forecasting about health care workers?

2. **Introducing to our research**

3. **Limitations**

Purpose of this presentation

*Sharing our experience and major point of view*
Our research background

Before 1990s:
The Japanese government had curbed the number of doctors trained, fearing a surplus of them

Late 2000s:
The government recognized the shortage of doctors and changed its policy

The policy had changed, but the number of doctors continued to increase.

What had led to this situation?

*Ministry of Health, Labour, and Welfare. Survey of physicians, dentists and pharmacists
Our research background

**Breaking down the factors of the physician shortage**
There are several factors, not only shortage of absolute numbers, but also maldistribution.

The number of physicians in Japan has always been lower than the **OECD average**.

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OECD Average</strong></td>
<td>3.1</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Japan</strong></td>
<td>2.1</td>
<td>2.9</td>
</tr>
</tbody>
</table>

*OECD Health statistics

**Absolute shortage**

**Maldistribution**

- **Specialty Maldistribution**: Shortage of OB/GYN, pediatricians and emergency physician was pointed out, while a surplus of ophthalmologists were noted.
- **Regional Maldistribution**: The concentration of doctors in urban areas has led to the emergence of practices in rural areas.
Our research background

**Breaking down the factors of the physician shortage**
There is several factors, not only shortage of absolute numbers, but also maldistribution

<table>
<thead>
<tr>
<th>Factor</th>
<th>Relevant Measures</th>
<th>Measures</th>
<th>Interventions for post-qualification practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute shortage</td>
<td>Increase or decrease in trained physicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialty maldistribution</td>
<td>Interventions for post-qualification practice specialty selection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional maldistribution</td>
<td></td>
<td>Interventions for post-qualification practice work location selection</td>
<td></td>
</tr>
</tbody>
</table>

Model building in study is required to take each factor into account
Why did used system dynamics?

In Japan, the number of doctors trained and how to allocate them to clinical departments / regions were discussed.

• Based on the chain of stock & flow
  - Traceability the in/out flow of target human resources

• Simulatorable methods (e.g. equation-based models)
  - Quantitative evaluation of uncertainty and scenario analysis are possible

• Highly explanatory and strong in visualization
  - Visualization with causal relationship diagram

• Feedback can be considered
  - Adjustment in/outflow according to changes in the scale of target resources
Our case study

Case 1
Model considering the absolute shortage and specialty maldistribution


Case 2
Model considering the absolute shortage and regional maldistribution

Material and Methods

- Study area: Japan as a whole
- Time Span: 2008 – 2030
- Data Collection: Mainly using official statistical survey data
- Evaluation index:
  - Supply volume: The number of physician
  - Balance between supply and demand: Sufficiency level (based on national survey)

\[
sufficiency\ level = \frac{\text{the forecasted number of physician}}{\text{the required number of physician}} \times \text{corrective coefficient}
\]
The system dynamics model methodology used in this study

The framework of our analyzing process
Our models were constructed based on typical career path of Japanese physician
Causal loop and stock and flow

Figure 3 Diagram of the system dynamics model for forecasting the number of clinical physicians.
Forecasting results

Forecast numbers of all clinical physicians: 271,897 in 2018 and 370,345 in 2020.

Forecasting results - Absolute shortage and maldistribution
Sensitivity Analysis - grasping impact of uncertainty/Scenario analysis

Medical school quo

Comparison Medical school quo and choice rates of their specialty
Our case study

Case 1
Model considering the absolute shortage and **specialty** maldistribution


Case 2
Model considering the absolute shortage and **regional** maldistribution

Material and Methods

- Study area: Hokkaido prefecture in Japan
- Time Span: 2010 – 2030
- Data Collection: Mainly using official statistical survey data
- Evaluation index
  - Supply volume: The number of physician
  - Balance between supply and demand: Sufficiency level (based on national survey)

\[
sufficiency\ level = \frac{\text{the forecasted number of physician}}{\text{the required number of physician}} \times \text{corrective coefficient}
\]

Our forecasting value
National survey value
Analyzing Regional misdistribution

A regional analysis makes it possible to calculate gini coefficient as an index of regional maldistribution.

\[
\text{Gini coefficient} = \frac{1}{2n^2\mu} \sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j|
\]

\(y_i, y_j\): the number of physicians per 100,000 residents in each SMSA.
\(n\): number of SMSAs.
\(\mu\): average of the number of physicians per 100,000 residents.

SMSA: Secondary Medical Services area
Conceptual scheme of the Japanese physician career path

Our models were constructed based on typical career path of Japanese physician
Causal loop and stock and flow diagrams
Forecasting results - Absolute shortage and regional maldistribution

<table>
<thead>
<tr>
<th>Variables</th>
<th>Base year</th>
<th>Projected</th>
<th></th>
<th></th>
<th></th>
<th>% change from 2010 to 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
<td>2015</td>
<td>2020</td>
<td>2025</td>
<td>2030</td>
<td></td>
</tr>
<tr>
<td>Physician numbers in Hokkaido</td>
<td>12 019</td>
<td>12 684</td>
<td>13 650</td>
<td>14 575</td>
<td>15 449</td>
<td>28.5%</td>
</tr>
<tr>
<td>Sufficiency level in Hokkaido</td>
<td>0.88</td>
<td>0.93</td>
<td>1.00</td>
<td>1.06</td>
<td>1.13</td>
<td>28.4%</td>
</tr>
<tr>
<td>Physician numbers per 100 000 populations in Hokkaido</td>
<td>218.27</td>
<td>236.58</td>
<td>263.61</td>
<td>293.86</td>
<td>327.37</td>
<td>50.0%</td>
</tr>
<tr>
<td>Gini coefficient</td>
<td>0.140</td>
<td>0.139</td>
<td>0.132</td>
<td>0.125</td>
<td>0.121</td>
<td>-13.6%</td>
</tr>
</tbody>
</table>
Visualizing the forecasted sufficiency level by region
Limitation

• Sequential updating of model parameters or structural reorganization
• Model Validation
• Response to Shock
• Trade-offs of making the prediction granular
  
  pros of high
  - Makes detailed predictions possible
  
  cons of high
  - Reduced data acquisition potential
  - Decreased prediction accuracy
• The variables in the model contain many estimates.
  
  - If there is no survey, the rate of change is calculated from the trend
Our Research Experience - Application to other professions

Published articles related to human resource management

Thank you for your sincere listening