

Research Workshop

Health Workforce Planning and Predictive Models

-Sharing the Japanese experience -



DISQUE 136

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



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Our research background

Why did we need to make forecasting about health care workers?

Introducing to our research



Purpose of this presentation

Sharing our experience and major point of view

Our research background



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.

*OECD Health statistics

-Shortage of OB/GYN, pediatricians and emergency physician was pointed out, while a surplus of ophthalmologists were noted.

- 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



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

Case 1

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



Ishikawa, T., Fujiwara, K., Ohba, H. et al. Forecasting the regional distribution and sufficiency of physicians in Japan with a coupled system dynamics—geographic information system model. Hum Resour Health 15, 64 (2017). <u>https://doi.org/10.1186/s12960-017-0238-8</u>

Tomoki Ishikawa¹, Hisateru Ohba², Yuki Yokooka³, Kozo Nakamura¹ and Katsuhiko Ogasawara⁴⁴

Case 2

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

 bibliswa et al. Human Resources for Health (2017) 15:64

 DOI 10.1186/s12960-017-0238-8

 Human Resources for Health

 RESEARCH
 Open Access

 Forecasting the regional distribution and sufficiency of physicians in Japan with a coupled system dynamics—geographic information system model

 Tomoki Ishikawa¹³, Kensuke Fujiwara¹, Hisateru Ohba², Teppei Suzuki³ and Katsuhiko Ogasawara^{3*}

Ishikawa, T., Ohba, H., Yokooka, Y. et al. Forecasting the absolute and relative shortage of physicians in Japan using a system dynamics model approach. Hum Resour Health 11, 41 (2013). https://doi.org/10.1186/1478-4491-11-41

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)



The system dynamics model methodology used in this study

The framework of our analyzing process



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



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

Forecasting results

Forecast numbers of all clinical physicians



Forecast numbers of OB/GYN specialists



Forecasting results - Absolute shortage and maldistribution



Sensitivity Analysis - grasping impact of uncertainty/Scenario analysis



Comparison Medical school quo and choice rates of their specialty

Case 1

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



Ishikawa, T., Fujiwara, K., Ohba, H. et al. Forecasting the regional distribution and sufficiency of physicians in Japan with a coupled system dynamics—geographic information system model. Hum Resour Health 15, 64 (2017). <u>https://doi.org/10.1186/s12960-017-0238-8</u>

Case 2

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

Ishikawa, T., Ohba, H., Yokooka, Y. et al. Forecasting the absolute and relative shortage of physicians in Japan using a system dynamics model approach. Hum Resour Health 11, 41 (2013). https://doi.org/10.1186/1478-4491-11-41

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

: Mainly using official statistical survey data



Analyzing Regional misdistribution

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



Location of Hokkaido within Japan; each secondary medical service area (SMSA) in Hokkaido

$$ext{Gini coefficient} = rac{1}{2n^2\mu}\sum_{i=1}^n\sum_{j=1}^n \left|y_i-y_j
ight|$$

 y_i , y_j : the number of physicians per 100 000 residents in each SMSA.

n: number of SMSAs.

 μ : 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



Forecasting results - Absolute shortage and regional maldistribution

Table 3 Forecasted results for 20 years to come

Variables	Base year 2010	Projected				% change from
		2015	2020	2025	2030	2010 to 2040
Physician numbers in Hokkaido	12 019	12 684	13 650	14 575	15 449	28.5%
Sufficiency level in Hokkaido	0.88	0.93	1.00	1.06	1.13	28.4%
Physician numbers per 100 000 populations in Hokkaido	218.27	236.58	263.61	293.86	327.37	50.0%
Gini coefficient	0.140	0.139	0.132	0.125	0.121	-13.6%

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

Morii, Y., Furuta, S., Ishikawa, T. *et al.* Projecting supply and demand for pharmacists in **pharmacies** based on the number of prescriptions and **system dynamics modeling**. *Hum Resour Health* **18**, 85 (2020). <u>https://doi.org/10.1186/s12960-020-00524-5</u>

Morii et al. Hum Resour Health (2020) 18:85 https://doi.org/10.1186/s12960-020-00524-5 Human Resources for Health

RESEARCH



Projecting supply and demand for pharmacists in pharmacies based on the number of prescriptions and system dynamics modeling

Yasuhiro Morii¹, Seiichi Furuta², Tomoki Ishikawa^{1,3}, Kensuke Fujiwara^{1,4}, Hiroko Yamashina¹ and Katsuhiko Ogasawara^{1*}¹⁰

Our Research Experience - Application to other professions

Yasuhiro Morii, Tomoki Ishikawa, Teppei Suzuki, Shintaro Tsuji, Masanori Yamanaka, Katsuhiko Ogasawara, H. Y. (2019). Projecting future supply and demand for physical therapists in Japan **using system dynamics**. Health Policy and Technology, 8(2). <u>https://doi.org/10.1016/j.hlpt.2019.05.003</u>



Health Policy and Technology Volume 8, Issue 2, June 2019, Pages 118-127



Projecting future supply and demand for physical therapists in Japan using system dynamics

Yasuhiro Morii ^a, Tomoki Ishikawa ^{b, c}, Teppei Suzuki ^{b, d}, Shintaro Tsuji ^{b, e}, Masanori Yamanaka ^b, Katsuhiko Ogasawara ^b A ⊠, Hiroko Yamashina ^b

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https://doi.org/10.1016/j.hlpt.2019.05.003

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