Analysis the future shortage and maldistribution of physician by forecasting based on System Dynamics modeling approach

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Likes

Human resource management in health care
Focus area of our study

Proposing new methodology on forecasting the number of physicians
Providing information for decision making on policy
Our main contribution

Purpose

Photo | Place | Life event

To evaluate the absolute number and distribution of future physicians

Public | Post

Conclusion

Results of this study presented some findings…

- The absolute number shortage would be resolved at Japan in the future. But it takes 12 years from 2010 before the shortage is resolved.
- Regional maldistribution would be corrected by degrees. But, the correct is slight. Furthermore, there would be some areas evaluated as "shortage".

Findings suggested us necessity of strategic policy for …

- **Securing the absolute number of physicians: continually increasing medical school quota**
- **Distribution of physician by region: intensive allocation to areas evaluated as "shortage"**

Next step for our vision…

- More micro analysis:
Using geographical information system
- Redefinition of sufficiency:
Considering the needs by community resident

Results

Table shows increasing the number of physicians and the number of physician in Japan, Hokkaido would continue grow during 2010-2030. The number of physicians per 1000 persons in Japan would surpass the OECD average (3.1 in 2010) by 2030. Moreover, maldistirbution would correct slightly with time by decreasing of Gini coefficient. However, Figure 1 indicated luck of the absolute number would continue until 2026 from line plot of the sufficiency level. (In Hokkaido, the luck would continue until 2019) Moreover, Figure 2 showed that there would be areas evaluated as "shortage", even if the sufficiency level reached "1.0" in Japan and in Hokkaido as a whole.

Table: Results of the numberof physicians forecasted and Gini coefficient calculated

variables	2010	2015	2020	2025	2030
The number of physician					
Japan	281,282	303,056	326,768	349,181	370,346
Hokkaido	12,019	12,937	13,895	14,799	15,653
The number of physician per 1000 persons					
Japan	2.24	2.40	2.64	2.90	3.19
Hokkaido	2.18	2.33	2.58	2.87	3.18
Gini coefficient in Japan	0.227	0.225	0.223	0.221	0.219

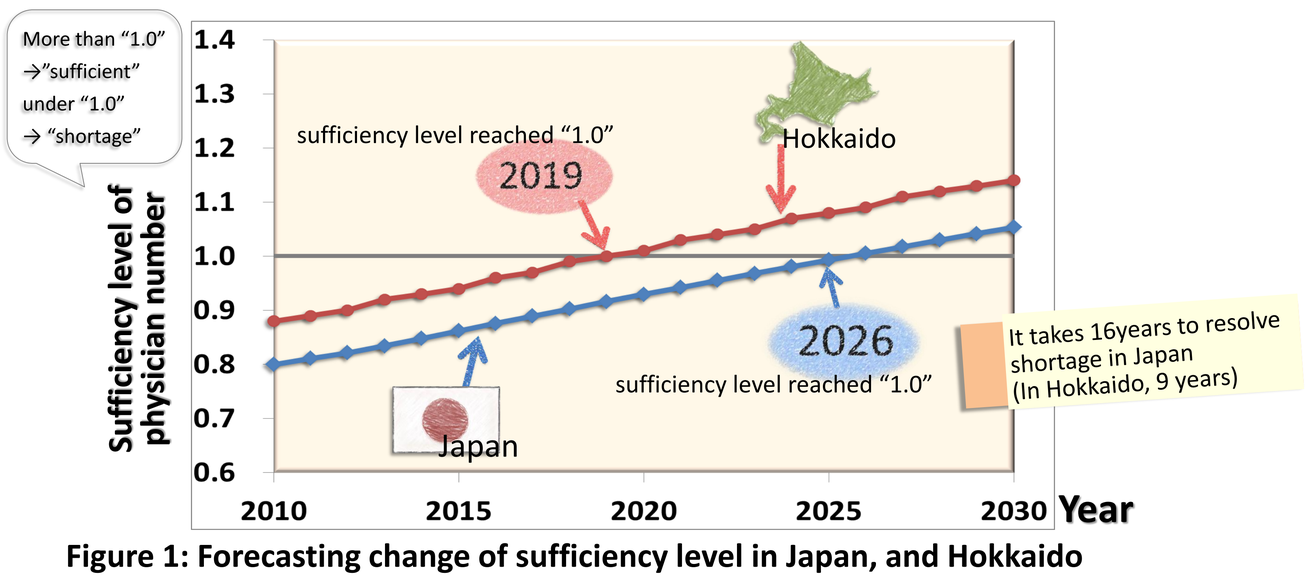

Figure 1: Forecasting change of sufficiency level in Japan, and Hokkaido during 2010- 2030

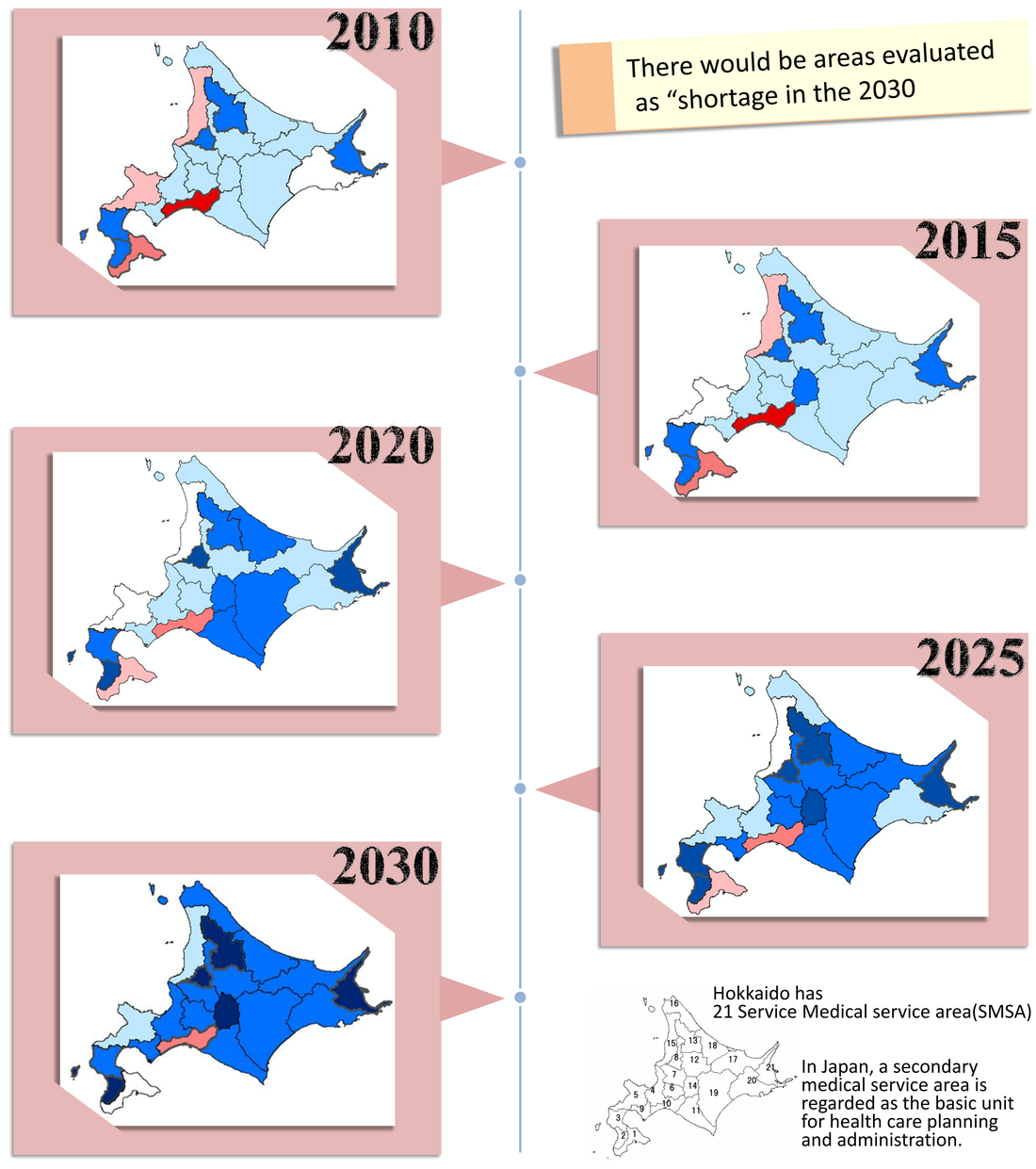

Figure 2: Time line of change sufficiency level in each SMSA at Hokkaido

Background

Suffering from physician shortage in Japan

There is lack of the absolute number…

In addition!!

Regional maldistribution arise at once…

(Ministry of Health, and Labour and Welfare,2010)

hmm…

Policy change to address these matter

The Japanese government

We increase the quota of medical schools!(2007)

We set the admission frame designed to force enrollee to work specific area!(2006)

The policy change may affect the supply-needs balance for physicians in the future

Methods

Modeling based on System Dynamics (SD) approach

SD is methodology of modeling and computed simulation. When SD model describes process of social change, the model consist of combination of differential equation. Strength of SD is permitting to add in the model dynamic factor. We performed retrospective comparison with simulation data and historical data to test the validity of the forecasting model.

Time point: 2010, 2015, 2020, 2025, and 2030
Analysis target: all clinical physicians
Spatial units: Japan, Hokkaido, and
Secondary Medical Services Area(SMSA)

Evaluation of distribution in the future

$$\text{Gini coefficient} = \frac{1}{n(n-1)\cdot \bar{x}} \sum_{i \geq j} \left| x_i - x_j \right|$$

n : the number of SMSA
$\bar{x}$:average of the number of physician per 10,000
x_i, x_j : the number of physician per 1000 at areas assigned as "i", "j"

Gini coefficient was calculated to evaluate inequity of distribution. The Gini coefficient can theoretically range from 0 to 1. A low Gini coefficient indicates a more equality, while higher Gini coefficient indicates more inequality.

Evaluation of the absolute number in the future

$$\text{sufficiency level} = \frac{\text{the forecasted number of physician}}{\text{the required number of physician}}$$

"The required number of physician", reported by Health, Labour and Welfare Ministry, was used to define *"sufficiency level",* in order to evaluate the absolute number of physicians. If the sufficiency level is ≧1.0, we judge as "sufficient", if the sufficiency level is < 1.0, we judge as "shortage".