アフリカの多くの地域で、医師の不足が深刻な問題になっています。特に、感染症の拡散と患者の治療に影響を及ぼしています。これに対して、システムダイナミクスに基づいた予測モデルが、医療の将来を見据えての資源の最適配置に寄与できる可能性が示唆されています。この方法は、医師の配置に応じた地域の特性を考慮し、医師の不足を予防するための戦略を提案します。
Analysis the future shortage and maldistribution of physician by forecasting based on System Dynamics modeling approach

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Purpose
To evaluate the absolute number and distribution of future physicians

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”

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, maldistribution 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.

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

Next step for our vision...
- More micro analysis: Using geographical information system
- Redefinition of sufficiency: Considering the needs by community resident

Background
There is a lack of the absolute number...
Regional maldistribution arise at once...

Policy change to address these matter...
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.

Analysis target: all clinical physicians
Spatial units: Japan, Hokkaido, and Secondary Medical Services Area(SMSA)

Evaluation of distribution in the future
Gini coefficient = \(1 \frac{1}{n(n-1)} \sum_{i=1}^{n-1} x_i - \frac{x_i}{n} \)

Evaluation of the absolute number in the future
sufficiency level = the forecasted number of physician / 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 is 2.0, we judge as “sufficient”, if the sufficiency level is < 2.0, we judge as “shortage”.