ST. JOHN'S COLLOQUIUM

JUNE 27-29, 2016





Application of Agent-based Modeling (ABM) to Health Care Reform

Presented by

Kosuke Iwasaki

Fellow of Institute of Actuaries of Japan

kosuke.iwasaki@milliman.com





- 1. National Health Insurance System in Japan
- 2. Result of the past healthcare system reform
- 3. Agent Based Model
- 4. Simulation results of the ABM
- 5. Conclusion



1. National Health Insurance System in Japan 1.1 Insurers

• Universal health insurance coverage system as of June 2015

System Name	Number of Insurers	Insureds (000s)	Cost sharing	Funding
Health Insurance Association	1 association	36M employees and their families in SME	20% for people age <6 or 70-75 30% for the others	Premium (10% $ imes$ remuneration) + Tax
Health Insurance Societies	1,419 societies	29M employees and their families in large companies		Premium (3-12% \times remuneration) + Tax
National Health Insurance	1,717 local governments	37M self-employed/ retirees and their families		Premium + Tax
Healthcare System for People Aged 75+	1 national government	15M people aged 75+	10%	Premium + Tax

1. National Health Insurance System in Japan 1.2 Benefit for High Medical Cost (Copay-max)



Canadiar

1. National Health Insurance System in Japan 1.3 Benefit/Coverage

- Uniform throughout the nation
 - Dental care is covered (excluding implant and cosmetic dentistry)
 - Long-term Care is not included (It is covered by National Long-term Care Insurance System)
 - Ophthalmologist for eye glasses is not covered
 - No system for Compassionate Use of drugs
- Prohibition of combinational use of medical treatment at patient's own cost and at national health insurance cost
 - Medical treatment (not approved for used under national health insurance) upon patient's request is available

1. National Health Insurance System in Japan 1.4 Providers

- Hospitals (number of beds > 19), clinics (number of beds ≤ 19), and pharmacies designated by the Ministry of Health, Labor, and Welfare
- Number of beds are regulated by the governor of each prefecture.

1. National Health Insurance System in Japan 1.5 Reimbursement

• Reimbursement from insures to providers is determined by the National Reimbursement Table for each procedure on the FFS basis.



Result of the past medical system reform Nagase effects

- Nagase Formula
 - y: Utilization
 - x: %Cost sharing

 $y = 0.475(1-x)^2 + 0.525$

• When %Cost sharing is changed, the utilization level does not change immediately but it changes gradually during a period of one year.



Annualized Increase Rate of Utilization



Canadian

Institute of

PBSS

3. ABM3.1 What is ABM?

 An agent-based model (ABM) is one of a class of computational models for simulating the actions and interactions of autonomous agents (both individual or collective entities such as organizations or groups) with a view to assessing their effects on the system as a whole. (wikipedia)



3. ABM3.2 ABM of a Health System

- The government can control % Cost Sharing
- Within the limitation of financial sustainability, in order to maximize sum PV of future QOL of population, what are they?



Canadian



3. ABM3.3 Drug price and ICER

- In the model, the drug price was determined to meet its ICER is the average of annual income.
- ICER, Incremental Cost Effectiveness Ratio, is defined as Δ Cost divided by Δ QALY, Quality Adjusted Life Years.
 - In this model, ICER is Drug price divided by the QALY saved by the drug.
 - Generally, in Health Technology Assessment, the insurer approve the drug if the ICER < GDP per capita.
 - In this model, drug price is set to 5 million yen divided by the QALY saved by the drug.



3. ABM3.4 Other assumptions

- monthly disease incident rate = 5%
- disease continuation rate = 80%
- monthly income = $\Lambda(12.2, 1.2)$ if not disease, or 0 if disease
- monthly living cost = 150,000 yen
- monthly expenses other than living cost = 37% x (income living cost)
- income tax = 50% x (income living cost)
- People can be treated if he/she can afford to cost sharing.



ABM 3.4 Other assumptions (cont.)

- QOL = 1 if not disease, 0.9 if disease under treatment, or 0.5 if disease under not treatment
- Expenses of the pharma is 80% of the revenue.
- Corporate tax rate = 50%



4. Simulation Results of the ABM4.1 Validation

- National Income per capita = 2.5 million yen (c.f. 2.8 million in 2013)
- Income tax per capita = 0.23 million yen (c.f. 0.26 million in 2015)
- National Health Expenditure per capita = 0.18 million yen (c.f. 0.31 million yen)
 - The difference can be justified by the health expenditure other than drug.



4. Simulation Results of the ABM4.2 Validation of Nagase Effect



Canadian

IAAHS

4. Simulation Results of the ABM4.3 Financial Sustainability vs. QALY



Canadiar

IAAHS

5. Conclusion

- Nagase effect can be reproduced by an ABM with very simple assumptions and algorithm.
- 30% cost sharing can be justified as the % cost sharing which maximize the QALY of population within the limitation of financial sustainability.
 - If the % cost share is 30%, the QALY is 99.2% of the QALY with 0% cost sharing.

