

# PATIENT EVALUATION OF REGIONAL-LEVEL HEALTHCARE QUALITY AFFECTS OUTMIGRATION: AN AGENT-BASED SIMULATION

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## INTRODUCTION

- Patients' decision-making and hospital choice reflect perception of the quality of their region's health system, well beyond objective measures of quality and structural capacity.
- Outmigration**, a characteristic phenomenon of the South Korean health system, occurs when **patients in provincial areas bypass local hospitals and travel to Seoul in the hopes of receiving better treatment**.
- Outmigration not only puts a heavy strain on the health system in the capital area but also deprives other regions of further opportunities to develop a high-quality regional healthcare system.
- To better understand the mechanism of outmigration, there is a need to **analyze the perceived quality of the regional healthcare system from each patient's perspective and at a population level**.

## AIM

- Adopting a complex systems approach, we constructed an **agent-based model (ABM)** of outmigration and performed **policy simulations**.
- We aimed to examine **how outmigration is affected by changes in different aspects of quality**.

## RESULTS

- Dynamic agent-based interactions resulted in **an increase in overall outmigration**, and we observed polarization of reassurance between the outmigrating and non-outmigrating group. (Fig. 1, upper right)
- The overall outmigration rate was dependent on distance- and quality-related initial parameters.

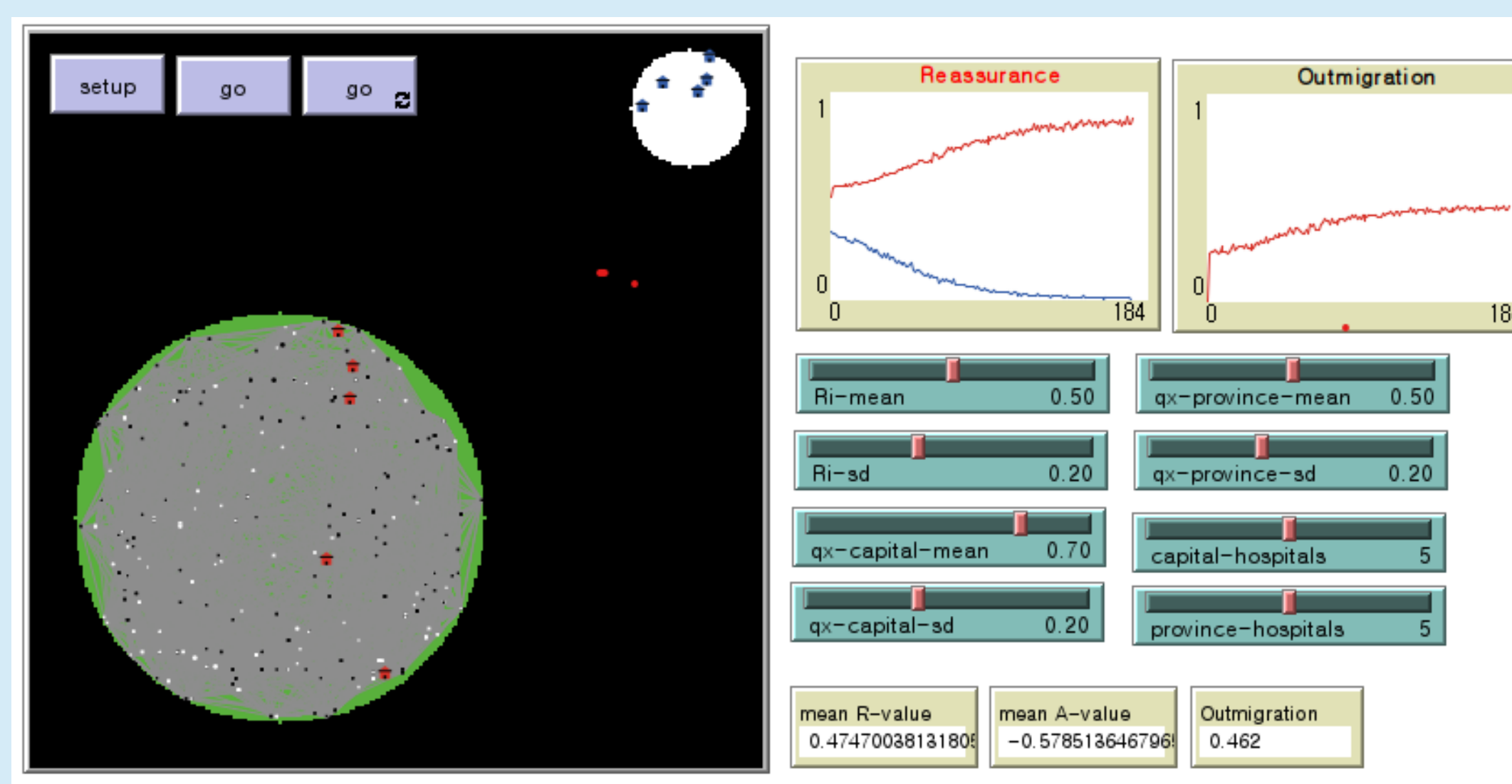


Fig. 1. Model environment in NetLogo 6.0.4, along with basic simulation results. Model parameters are set empirically. The two graphs on the upper right show (i) change in reassurance over time, and (ii) change of outmigration rate over time.

- Quality-based policy simulation results (Fig. 2)
  - Increasing mean reassurance** by 1 standard deviation resulted in a 27%p **decrease in outmigration**.
  - Alleviating objective quality gap** to zero resulted in an 11%p **decrease in outmigration**.
  - Constructing each new provincial hospital** resulted in a 2%p **decrease in outmigration**.

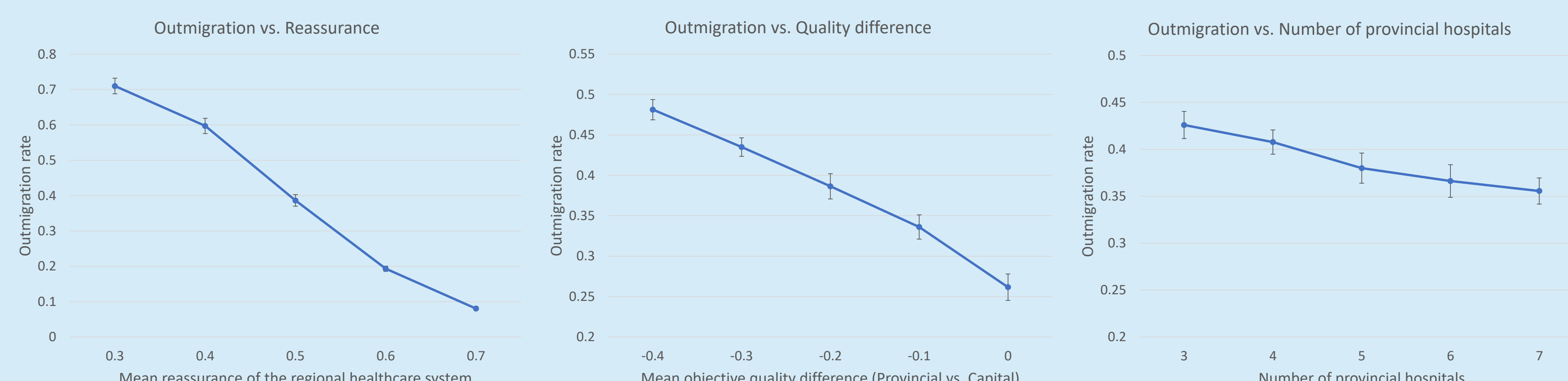


Fig. 2. Policy simulation results for three hypothetical scenarios are presented. 95% confidence intervals are presented as bars. (Left) Outmigration and mean reassurance, where 1 standard deviation = 0.2. (Middle) Outmigration and objective quality gap. The negative values on the horizontal axis imply that provincial hospitals are generally worse in objective quality. (Right) Outmigration and number of provincial hospitals.

Note: We did not reflect the nested structure between the parameters. Thus, those three aspects of quality were assumed to be independent with one another.

## METHOD

- We designed a virtual health system in which 1,000 **individuals choose hospitals based on utility**, which is **updated based on interactions**:
  - Direct interaction**: between individuals within a network, through direct transmission of words
  - Indirect interaction**: arising from common values within a certain society (i.e. neighborhood)
  - Experience-based interaction**: reflecting each individual's past experience
- Simulation software: *NetLogo 6.0.4*.
- Initial parameters were set empirically.

## CONCLUSIONS

- An agent-based simulation model developed in this study helps **understand the dynamic process of patient outmigration** according to care quality and provides useful insights by performing **simulations on hypothetical policy experiments**.
- Population-level evaluation of the quality of regional health system** shapes the complex adaptive procedure of patient choice of hospitals.

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## REFERENCES

- Fan, J., Friedman, D., Gair, J., Iyer, S., Redlicki, B., & Velu, C. (2021). A simulation study of how religious fundamentalism takes root. *Journal of Economic Behavior & Organization*, 192, 465-481.
- Lee, M. H., Lee, J.-s., & Do, Y. K. (unpublished). Feeling of reassurance with the regional healthcare system: A novel approach towards explaining patient outmigration in South Korea
- Lipsitz, L. A. (2012). Understanding health care as a complex system: the foundation for unintended consequences. *JAMA*, 308(3), 243-244.
- Tracy, M., Cerda, M., & Keyes, K. M. (2018). Agent-Based Modeling in Public Health: Current Applications and Future Directions. *Annu Rev Public Health*, 39, 77-94.

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