Explore the strategies of hospitals facing global budget and evaluate its effects in Taiwan[1]

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Abstract

The Bureau of National Health Insurance (BNHI) fully implemented a global budget (GB) payment system in 2002. Under GB, the benefit payments were under control as planned. Since the benefit payments from BNHI are the largest part of the revenues of hospitals, some hospitals have financial imbalance.

This study uses system dynamics to explore the strategies of hospitals facing GB and evaluate its effects on hospitals and patients. In order to improve the financial imbalance of hospitals, four strategies and two scenarios are proposed. Each strategy is evaluated for each scenario. According to the simulation results, the strategy of increasing out of pocket plus making a contract with BNHI so each hospital will have its own budget is the best strategy for improving hospital financial imbalance and does not cause the most severe wait problem.

This research reaches two achievements. First, submitting the stock-flow diagrams can provide the managers of hospitals with a further understanding on their strategies. Second, building the model can simulate and evaluate the effects of multiple strategies on hospitals and patients.

Keywords: System Dynamics, Simulation, Global budget, Hospital, Strategy

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Introduction

The National Health Insurance (NHI) program has been implemented in Taiwan since March 1995. The initial balance of revenues and expenditures was stable, but there has been a deficit since 1998 (Bureau of National Health Insurance, 2004, pp.94-99).

According to the literature review, the deficit problem is mostly caused by the payment system of fee-for-service (FFS). FFS was a major method of the payment scheme from the time the NHI program was launched. Under FFS, hospitals increased the volume of care to make the maximum profits. This is because 1 RVU (relative value unit) is equal to NT$ 1. The more medical services hospitals provide, the more medical benefits the Bureau of NHI (BNHI) pays, and the more revenues hospitals will receive.

As the deficit problem is mostly caused by the payment system of FFS, the BNHI has implemented the global budget (GB) payment system to limit the payments under FFS. Under the GB payment system, the BNHI negotiates with hospitals to set a rate of change of benefit payments per beneficiary before a fiscal year. The payment per RVU is floating and equal to the quotient of the annual medical benefit budget divided by the total RVU of medical services. As total RVU of medical services are over the medical benefit budget, the payment per RVU will be less than one NT$. On the contrary, when total RVU of medical services are under the medical benefit budget, the payment per RVU will be more than one NT$.

After the GB payment system has been implemented for dental care, Chinese medicine, basic Western medicine and Western medical center on July 1998, July 2000, July 2001 and July 2002 respectively, the benefit payments were under control as planned. Since the benefit payments from BNHI are the largest part of revenues of hospitals, some hospitals have financial imbalance. What strategies will hospitals adopt to cope with the GB payment system?

Up to now, those researches about strategies for the financial status of hospitals focused mostly on those influences of the individual strategy. Research rarely studied the long-term whole influences of multiple strategies. Moreover, those methods of the researches were mostly questionnaires, data analysis and regression. Researchers rarely used simulation methods. Hence, this study applies system dynamics to explore the long-term influences of multiple strategies on the financial status of hospitals.

The system dynamics model

The system dynamics model was developed on the basis of the research of Hwang

(2002, 2004), Wolstenholme et al. (2005) and Rauner and Schaffhauser-Linzatti (2002). The model is constructed using the Vensim software (Ventana Systems Inc, 2004). Figure 1 shows the stock-flow diagram of the system dynamics model. The Appendix shows the model's complete equations.

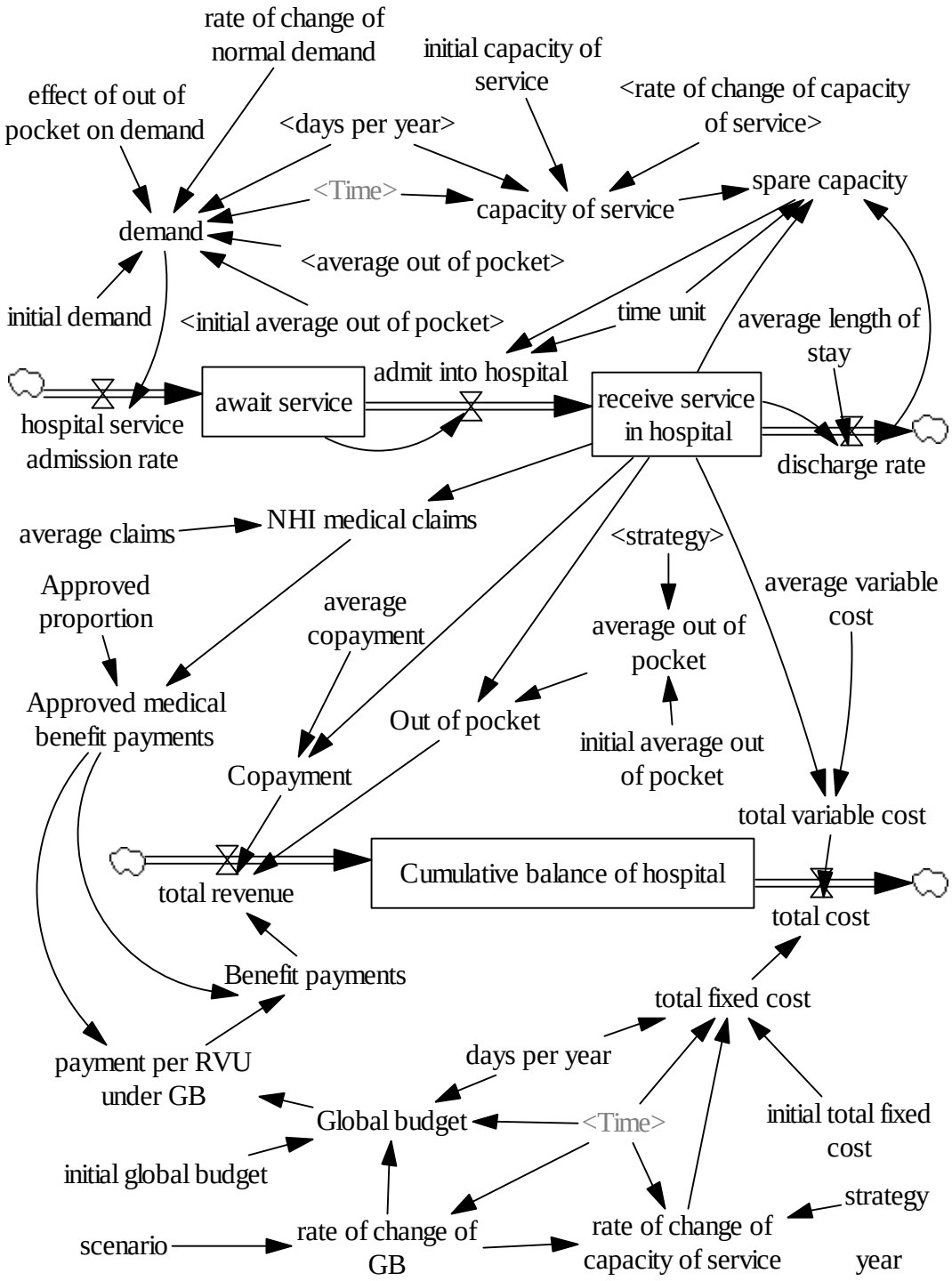

Figure 1. The stock-flow diagram of the system dynamics model

At the top of Figure 1, the stocks of await service and receive service in hospital

represent accumulations of patients. The flow of hospital service admission rate is driven by demand. The flow of admissions into hospital is controlled by the spare capacity and await service. The flow of discharge rate is determined as those patients receiving service in hospital divided by a given average length of stay. The patient process is similar to the research of Wolstenholme et al. (2005).

At the bottom of Figure 1, the stock of cumulative balance of hospital represents the financial status of the hospital. The flow of total revenue is the sum of benefit payments, out of pocket and copayment. The flow of total cost equals total fixed cost plus total variable cost.

The parameters in Figure 1 need to be estimated. The values of approved proportion, average claims, average copayment and average length of stay were obtained from the National Health Insurance Annual Statistical Report (Bureau of National Health Insurance, 2004). For the patient process to be in equilibrium, the stocks of await service and receive service in hospital were initialized to 280 and 200 respectively. Since the GB payment system was implemented at the beginning of the simulation, the stock of cumulative balance of hospital was initialized to zero.

The model has been examined by the author. Structure verification test, parameter verification test, dimensional-consistency test, extreme-conditions test, behavior reproduction test, changed behavior prediction test, and behavior-sensitivity test were used to validate the model (Forrester and Senge 1980; Sterman 2000, pp.843-891; Ventana Systems Inc, 2004).

The base case

FFS was a major method of the payment scheme since the NHI program was launched in 1995. In order to improve the financial status of NHI, the BNHI gradually implemented the GB payment system from 1998 and had fully implemented it in 2002. Since the payment system of FFS is completely different from the GB payment system, the simulation of the base case starts from 2002 to 2005.

Figure 2 displays the output of the base case simulation. The volume of await service is increasing because hospital service admission rate is greater than admission rate into hospital. Although the volume of receive service in hospital has been increasing, the cumulative balance of hospital has been decreasing since 2004. This is because the payment per RVU under GB is less than one NT$. The model reproduces the behavior of interest in the hospital.

Strategies of hospitals facing GB

What are the strategies of hospitals facing GB? Chuang et al. (2004) investigated

127 hospitals in Taiwan by sending them structured questionnaires. The response rate was 59.1% with 75 hospitals returning the questionnaires. The results of their study indicated that most hospitals adopted strategies such as further educating their staff about the major changes in the GB payment system, enhancing their financial management and constructing a better cost accounting system, establishing a referral system, developing the services which were not included in the NHI program.

Why did hospitals adopt the strategy of developing the services which were not included in the NHI program? The main reason is that patients must pay the services themselves and the payments (out of pocket) are another hospital revenue which is different from benefit payments from the BNHI (see Figure 1).

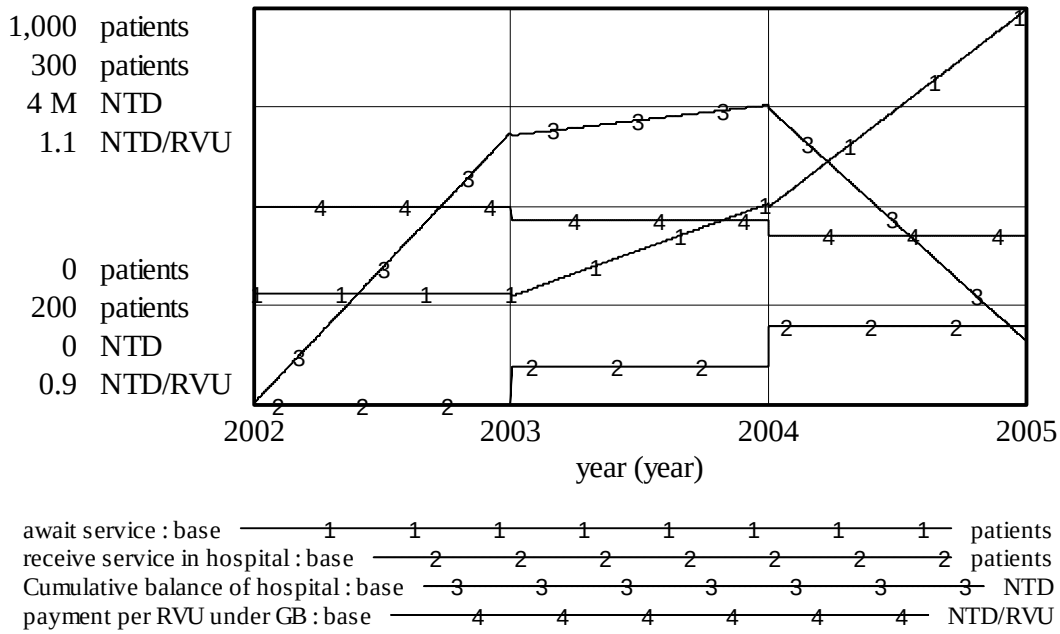

Figure 2. The output of the base case simulation

Chang and Liao (2002) employed Outpatient Medical Expenditure Data file to compare the changes in medical claims among primary Western physician clinics in the same half year before (i.e., 2000/07) and after (i.e., 2001/ 07) the GB payment system was inaugurated. The results of their study indicated that six months after launching the GB payment system, the number of cases claimed from primary Western physician clinics dropped sharply with a significant increase in unit price. However, the results of the study of Chuang et al. (2004) showed that change in service volume following the implementation of the GB payment system is diversified. In ambulatory care, the percentage of increasing service volume, maintaining service volume and decreasing service volume is 56%, 25.3% and 18.7% respectively. The

corresponding percentage for emergency is 48%, 41.3% and 10.7% respectively. The corresponding percentage for inpatient is 50.7%, 33.3% and 16% respectively.

Young and Hwang (2000) used causal loop diagrams and the prisoners' dilemma to explore two providers (A and B) and three strategies (increasing service volume, maintaining service volume and decreasing service volume). The results of their study indicated that increasing service volume is dominant for both A and B. However, adopting the strategy of increasing service volume is related to an increase in costs because more services are provided. Therefore, hospitals might collapse when the benefit payments are unable to cover the costs.

To avoid the "tragedy of the commons" as in the above description, a hospital could make a contract with BNHI to have its own annual budget. In this condition, no matter what strategies are adopted by other hospitals, the hospital will receive the fixed benefit payments, if it meets the criteria proposed by BNHI. And, for reducing the service costs, the hospital will not adopt the strategy of increasing service volume.

Simulation and evaluation

According to the analysis described above, four strategies and two scenarios are proposed. These strategies are currently adopted by hospitals. Each strategy is evaluated for each scenario. These are:

Strategy 1: nothing will be changed. As in the base case, the rate of change of capacity of service is supposed to be 120% of the rate of change of GB. It means increasing service volume as in the payment system of fee-for-service.

Strategy 2: a 5% increase in out of pocket will begin in 2005.

Strategy 3: making a contract with BNHI to have the hospital's own budget will begin in 2006. It means the rate of change of capacity of service is the same as the rate of change of GB.

Strategy 4: Strategy 2 plus Strategy 3.

Scenario 1: nothing will change. As in the base case, the rate of change of GB is 4% each year.

Scenario 2: the rate of change of GB is 5% each year will begin in 2006.

Figure 3 and Figure 4 display the cumulative balance of hospital under each strategy against Scenario 1 and Scenario 2 respectively. Figure 5 and Figure 6 show the volume of await service under each strategy against Scenario 1 and Scenario 2 respectively. According to the simulation results, Strategy 4 is the best strategy for improving hospital's financial imbalance (Figure 3 and Figure 4). Besides, Strategy 4 does not cause the most severe wait problem (Figure 5 and Figure 6). This is because

Strategy 4 is Strategy 2 plus Strategy 3. By increasing out of pocket, Strategy 2 can increase hospital's revenue and decrease the service demand (Figure 5 and Figure 6). Adopting Strategy 3, a hospital can receive the fixed benefit payments and plan the service volume provided to control service costs and improve financial imbalance (Figure 3 and Figure 4).

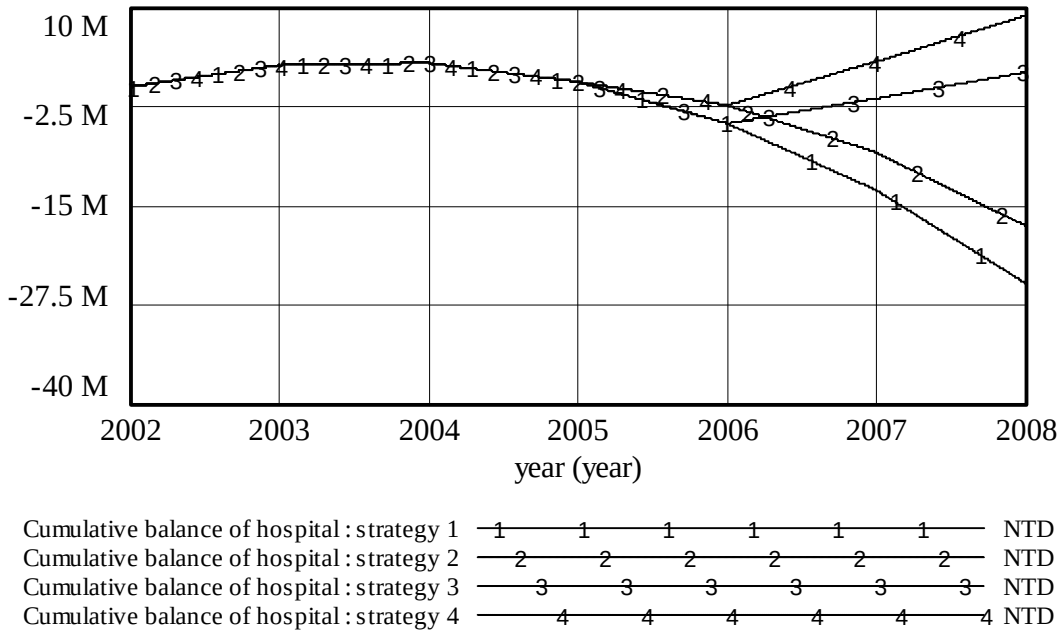

Figure 3. The cumulative balance of hospital under each strategy against scenario 1

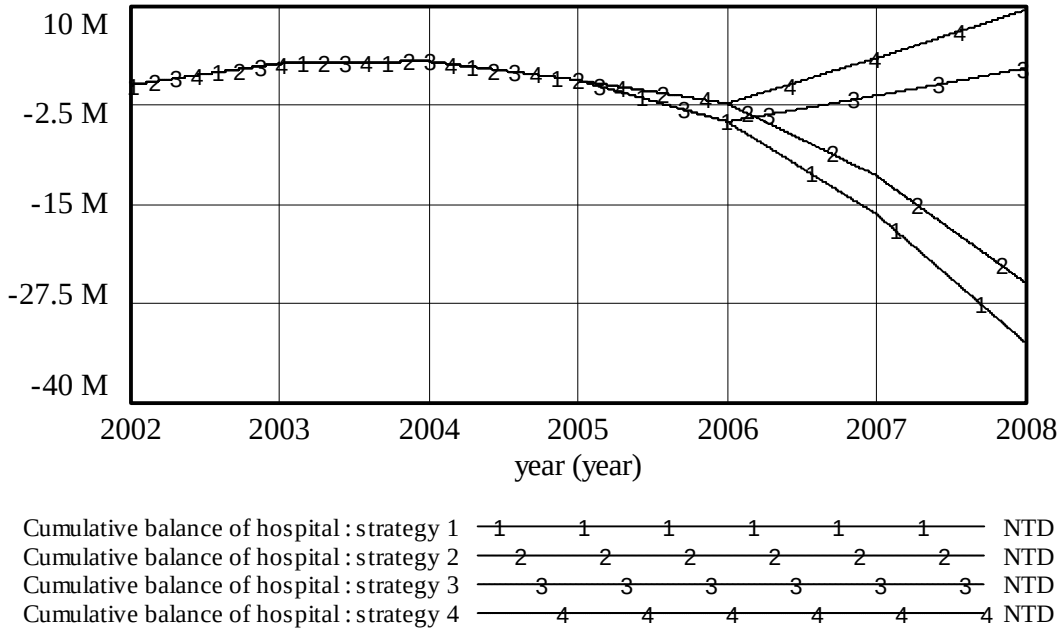

Figure 4. The cumulative balance of hospital under each strategy against scenario 2

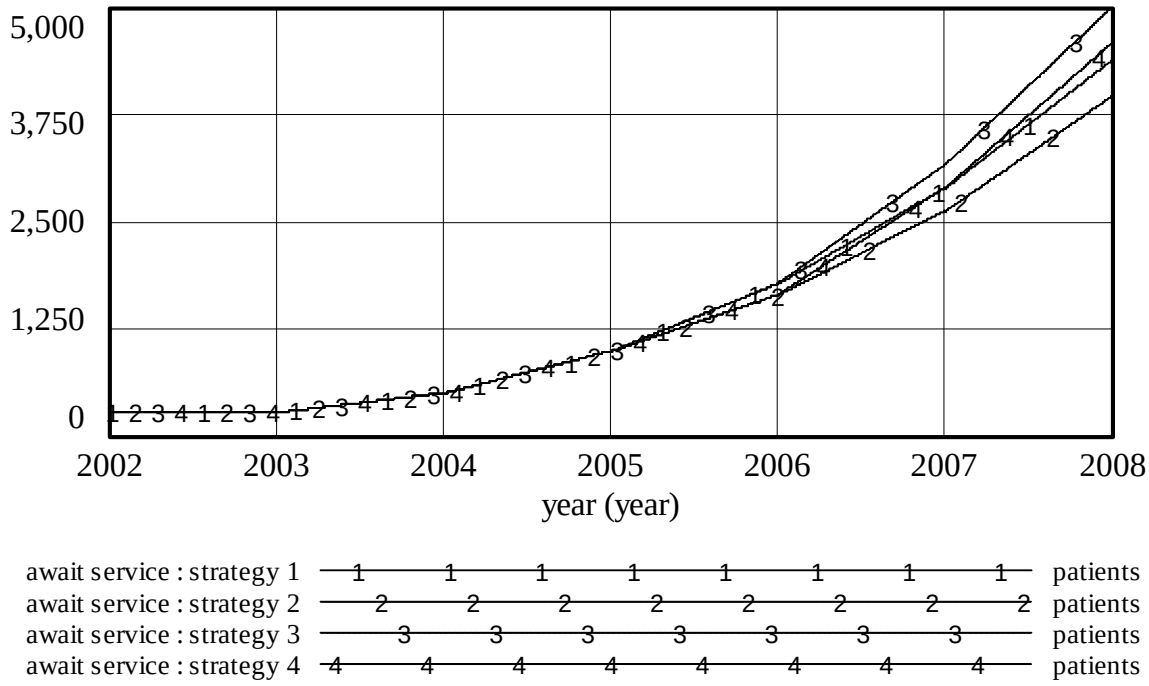

Figure 5. The volume of await service under each strategy against scenario 1

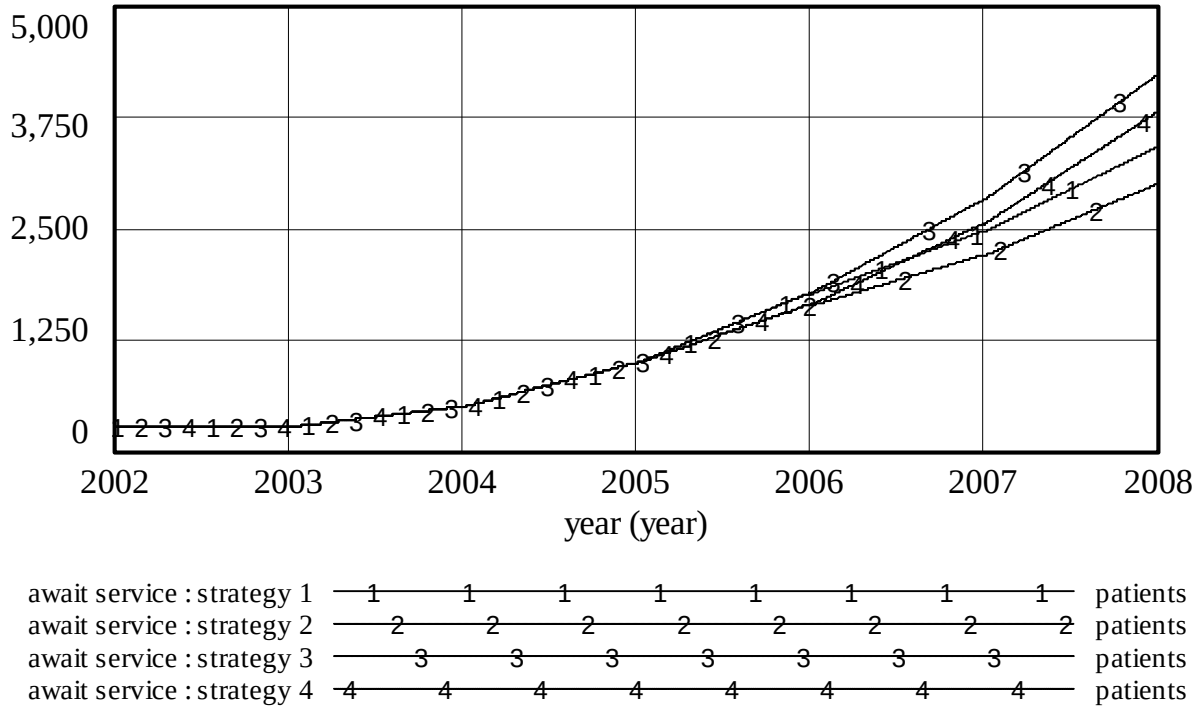

Figure 6. The volume of await service under each strategy against scenario 2

Summary and future prospects

This study used system dynamics to explore the strategies of hospitals facing GB and to evaluate its effects on hospitals and patients. In order to improve the financial imbalance of the hospital, four strategies and two scenarios were proposed. Each strategy was evaluated for each scenario. According to the simulation results, the strategy of increasing out of pocket plus making a contract with BNHI to have hospital's own budget is the best strategy for improving hospital's financial imbalance and does not cause the most severe wait problem.

This research reaches two achievements. First, submitting the stock-flow diagrams can provide the managers of hospitals with a further understanding on their strategies. Second, building the model can simulate and evaluate the effects of multiple strategies on hospitals and patients.

This research had two reservations. First, it only explored the financial problem and those strategies of hospitals. Second, the cumulative balance of the hospital and the volume of await service were the only two variables to evaluate the effects of strategies. However, different criteria could be used for judging the priority of strategies and could have different results.

Hence, future research could consider extending the model boundary and could consider selecting the criteria used for judging the priority of strategies under multiple objectives.

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References

1. Bureau of National Health Insurance. 2004. *National Health Insurance Annual Statistical Report*. Taiwan: Bureau of National Health Insurance.
2. Chang, Yi-Cheng, Hung-En Liao. 2002. The Effect of the Global Budget on the Western Medicine Clinics Price and Utilization - Case of Western Medicine Clinics in the Northern Taiwan. *Taiwan J Public Health* 21(5): 363-372.
3. Chuang, Nien-Tzu, Kuo-Cherh Huang, Yi-Hsin Elsa Hsu, Nai-Wen Kuo, Zhong-Ren Wei. 2004. Factors associated with strategic choices of hospitals in response to the global budget payment system. *Taiwan J Public Health* 23(2):150-158.

4. Forrester, Jay W. and Peter M. Senge. 1980. Tests for building confidence in system dynamics models. In A. A. Legasto Jr., J. W. Forrester, & J. M. Lyneis (ed.), *System Dynamics*, Vol. 14 Series: TIMS Studies in the Management Sciences. pp. 209-228. New York: North-Holland.
5. Hwang, Lih-Lian. 2002. *A system dynamics approach to the decisions taken by the Bureau of National Health Insurance, the insured, and contracted medical care institutions on the financial status and medical quality of National Health Insurance*. Doctoral Thesis, Department of Business Management, National Sun Yat-sen University, Taiwan, R.O.C.
6. Hwang, Lih-Lian. 2004. Explore the financial status and policies of medical care institutions. A project that is funded by a grant from the National Science Council (NSC 93-2416-H-130-013).
7. Rauner, Marion Sabinea, Michaela-Mariab Schaffhauser-Linzatti. 2002. Impact of the new Austrian inpatient payment strategy on hospital behavior: a system-dynamics model. *Socio-Economic Planning Sciences* 36(3): 161-182.
8. Sterman, John D. 2000. *Business Dyamics: Systems Thinking and Modeling for a Complex World*. Boston: Irwin McGraw-Hill.
9. Ventana Systems, Inc.. 2004. *Vensim Version 5 User's Guide*. 60 Jacob Gates Road. Harvard, MA 01451, USA.
10. Wolstenholme, Eric, David Monk, Gill Smith, Douglas McKelvie, 2005, Coping but not Coping in Health and Social Care – Masking the Reality of Running Organizations well beyond safe Design Capacity, the 23rd International Conference of the System Dynamics Society.
11. Young, Showing H. and Lih-Lian Hwang, 2000, A system dynamics approach to the growth of medical expenses in Taiwan, Full Paper on CD-ROM Proceeding of the 18th international conference of the System Dynamics Society, Bergen, Norway.

Appendix: Equations of the model

(01) admit into hospital = MIN (await service , spare capacity) / time unit
Units: patients/day

(02) Approved medical benefit payments = NHI medical claims * Approved proportion
Units: RVU/day

(03) Approved proportion = 0.975
Units: Dmnl

(04) average claims = 4500
Units: RVU/(patients*day)

(05) average copayment = 250
Units: NTD/(patients*day)
(06) average length of stay = 10
Units: day
(07) average out of pocket = IF THEN ELSE (strategy = 2 :OR: strategy = 4, STEP (initial average out of pocket * 0.05, 1095) , 0) + initial average out of pocket
Units: NTD/(patients*day)
registriation fee, bed fee gap
(08) average variable cost = 1500
Units: NTD/(patients*day)
(09) await service = INTEG(hospital service admission rate - admit into hospital , 280)
Units: patients
(10) Benefit payments = Approved medical benefit payments * payment per RVU under GB
Units: NTD/day
(11) capacity of service = initial capacity of service * (1 + rate of change of capacity of service) ^ INTEGER (Time / days per year)
Units: patients
(12) Copayment = average copayment * receive service in hospital
Units: NTD/day
(13) Cumulative balance of hospital = INTEG(total revenue - total cost , 0)
Units: NTD
(14) days per year = 365
Units: day
(15) demand = initial demand * (1 + rate of change of normal demand) ^ INTEGER (Time / days per year) * effect of out of pocket on demand (average out of pocket / initial average out of pocket)
Units: patients/day
(16) discharge rate = receive service in hospital / average length of stay
Units: patients/day
(17) effect of out of pocket on demand
([(0,0)-(4,2)],(0,1.25),(0.25,1.25),(0.5,1.2),(0.75,1.1),(1,1),(1.25,0.93),(1.5,0.88),(1.75,0.85),(2,0.82),(3,0.8),(4,0.78))
Units: Dmnl
(18) FINAL TIME = 2190
Units: day
The final time for the simulation.
(19) Global budget = initial global budget * (1 + rate of change of GB) ^ INTEGER

((Time - 1) / days per year)
Units: NTD/day

(20) hospital service admission rate = demand
Units: patients/day

(21) initial average out of pocket = 550
Units: NTD/(patients*day)

(22) initial capacity of service = 200
Units: patients

(23) initial demand = 20
Units: patients/day

(24) initial global budget = 877500
Units: NTD/day

(25) INITIAL TIME = 0
Units: day
The initial time for the simulation.

(26) initial total fixed cost = 730000
Units: NTD/day

(27) NHI medical claims = receive service in hospital * average claims
Units: RVU/day

(28) Out of pocket = average out of pocket * receive service in hospital
Units: NTD/day

(29) payment per RVU under GB = Global budget / Approved medical benefit payments
Units: NTD/RVU

(30) rate of change of capacity of service = IF THEN ELSE (Time < 1460, 1.2, IF THEN ELSE (strategy = 3 :OR: strategy = 4, 1, 1.2)) * rate of change of GB
Units: Dmnl

(31) rate of change of GB = IF THEN ELSE (Time < 1460, 0.04, IF THEN ELSE (scenario = 1, 0.04, IF THEN ELSE (scenario = 2, 0.05, 0.06)))
Units: Dmnl

(32) rate of change of normal demand = 0.08
Units: Dmnl

(33) receive service in hospital = INTEG(admit into hospital - discharge rate , 200)
Units: patients

(34) SAVEPER = TIME STEP
Units: day
The frequency with which output is stored.

(35) scenario = 1
Units: Dmnl

(36) spare capacity = (capacity of service - receive service in hospital) + discharge rate * time unit
Units: patients
(37) strategy = 4
Units: Dmnl
(38) TIME STEP = 1
Units: day
The time step for the simulation.
(39) time unit = 1
Units: day
(40) total cost = total fixed cost + total variable cost
Units: NTD/day
(41) total fixed cost = initial total fixed cost * (1 + rate of change of capacity of service) ^ INTEGER (Time / days per year)
Units: NTD/day
(42) total revenue = Benefit payments + Copayment + Out of pocket
Units: NTD/day
(43) total variable cost = average variable cost * receive service in hospital
Units: NTD/day
(44) year = TIME BASE (2002, 0.00273973)
Units: year [2002,0.00273973]