Proceedings of the 2013 Winter Simulation Conference
R. Pasupathy, S.-H. Kim, A. Tolk, R. Hill, and M. E. Kuhl, eds

BED BLOCKAGE IN IRISH HOSPITALS: SYSTEM DYNAMICS METHODOLOGY

Wael Rashwan
Mohamed AF Ragab
Waleed Abo-Hamad
Amr Arisha

3S Group, College of Business,
Dublin Institute of Technology (DIT)
Dublin 2, IRELAND

ABSTRACT

Population aging is creating an immense pressure on hospitals to meet the growing demand for elderly healthcare services. Current demand-supply gaps results in prolonged waiting times for patients and substantial costs for hospitals due to delay in discharges. This study uses System Dynamics (SD) methodology to address the bed blockage in the Irish healthcare hospitals that results from elderly patients delay in discharge. The developed system dynamic model helped decision makers to envisage the problem complexity. Stock and flow intervention policies are proposed and evaluated subject to the projected future demographic changes. The model enables policy makers to identify potential strategic policies that will contribute significantly to overcome the delayed discharge for elderly patients.

1 INTRODUCTION

In Ireland, the elderly population is expected to grow from 0.5 to 1.3 million over the next 30 years. Shortage of community care beds leads to delayed discharges from acute hospitals which restrict new admissions and hospitals have to carry unjustified costs. The high number of delayed discharges means that beds cannot be vacated to treat new patients (bed blockage), thereby more buildup in the queues for hospital ED trolley and treatment lists. An analysis by the Health Service Executive (HSE) shows that there are 700 patients on average monthly, are awaiting 'step-down' facilities to be discharged from hospitals. The cost of running an acute bed is about €850 a night and the cost of caring 700 delayed patients costs about €595,000 daily. This limits the hospitals' ability to cut their waiting lists and deliver their services efficiently and effectively (Majeed et al. 2012).

2 METHODOLOGY

System dynamics (SD) provides a wide system thinking methodology that is very effective for modeling large and complex systems and well-received approach for modeling strategic aspects on the macro level (Brailsford 2008). The first phase of this study began in 2012 where a DES model was developed to model the flow of elderly patients (Ragab et al. 2013). Although using DES approach was found to be effective for understanding the system constraints, several problems aroused such as data requirements, detailed modeling, static demand, and running time. The primary aim of this study is to deliver a holistic and strategic SD model at the national level to address the delayed discharge problem subject to the projected future demand.

A causal loop diagram can illustrate the main feedback loops of the key variables influencing the elderly care discharge pathways (Figure 1). There are two types of feedback loops: balancing loops (B1-B7) and reinforcement loops (R1-R4). All balancing loops are controlled with the bed capacity of either acute hospitals or post-acute care. The admission loop (B1) is responsible for the emergency admission, where bed occupancy level continues increasing until its maximum level is reached (B2) and no more admission

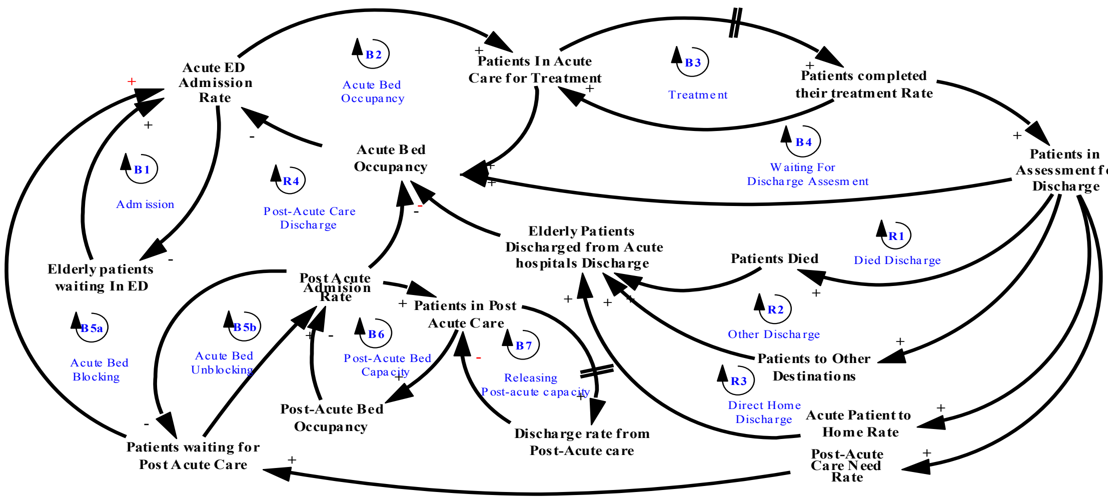

Figure 1: Simplified Causal Loop Diagram for Elderly Patients' Bed Blocking

is allowed. Treatment loop (B3) represents the treatment process for patients in the acute hospitals. Patients who are medically fit and waiting for discharge assessment are still occupying acute beds, hence bed occupancy level remains unchanged (B4). Patients who are waiting for post-acute care (e.g. rehabilitation) usually occupy acute beds which cause a bed blocking problem in the whole healthcare system (B5a). The loop that controls post-acute admission for elderly patients is the acute bed unblocking loop (B5b). This loop is an essential loop because it works as releaser for the blocked acute beds. Increasing the discharge rate from post-acute care decreases the post-acute bed occupancy and hence increases the admission to post-acute care that reduces the acute bed occupancy level. Reinforcement loops (R1 - R4) are responsible for the discharge pathways from the acute hospitals. Historical admission and discharge data was obtained from the central healthcare information system, national reports while bed capacities and length of stay (LOS) data were collected through surveys. The causal loop diagram is followed by developing a stock and flow model to simulate the system. A set of policy interventions is proposed and evaluated subject to the projected future demographic changes.

3 CONCLUSION

The developed system dynamics model helped to develop new insights in the understanding of the complexity of the bed blockage issue in Irish hospitals. The impact of stock interventions independently, such as increasing post-acute capacity, is time-limited. A combination of the stock and flow interventions seems to be more effective. Policy 5 (increasing the long term care capacity by 20%, 15% reduction of elderly acute emergency admissions, and 10% increase in the long term care discharge) can reduce the acute bed occupancy significantly (about 76% occupancy level) and also put down delayed discharge percentage (less than 1.7 % of total acute bed capacity). This enables HSE executive to cope with the financial pressures by closing some of acute beds resulting savings in cost of delayed discharges.

REFERENCES

Brailsford, S.C. 2008. "System Dynamics: What's in it for Healthcare Simulation Modelers." In *Proceedings of 2008 Winter Simulation Conf*, Ed. S. J. Mason, R. R. Hill, L. Mönch, O. Rose, T. Jefferson, J. W. Fowler, 1478-1483, Piscataway, New Jersey: Institute of Electrical and Electronics Engineers, Inc

Majeed, M., D. Williams, R. Pollock, F. Amir, M. Liam, K. Foong, and C. Whitaker. 2012."Delay in discharge and its impact on unnecessary hospital bed occupancy" *BMC Health Services Research* 12:410

Ragab, M., W. Rashwan, W. Abo-Hamad, and A. Arisha. 2013."Using Modelling and Simulation to Improve Elderly Care in Ireland: A Case Study."*Int. Journal On Advances in Life Sciences* 5:89-102.