A Computer Simulation Study on the Impact of Early Inpatient Discharge on Bed Waiting Time

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Introduction

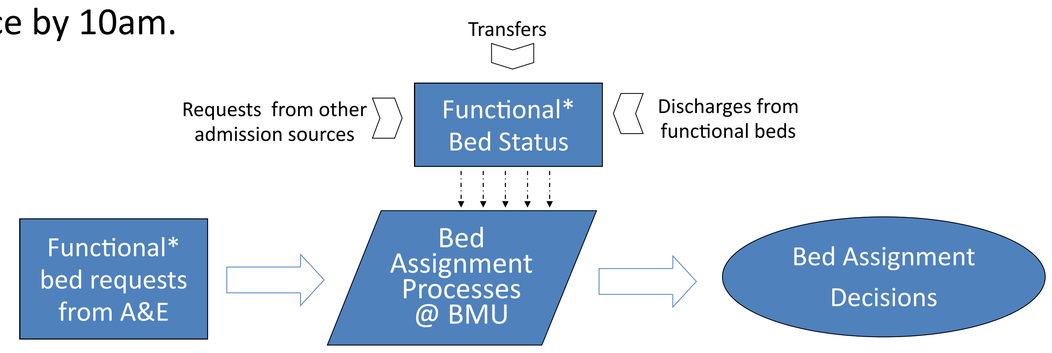
Prolonged bed waiting time among Accident and Emergency (A&E) patients who require inpatient admissions is undesirable as it can contribute to overcrowding at A&E which may in turn compromise patient's care quality, lead to poor patient satisfaction and staff burnout. Several potential bed waiting time reduction strategies had been identified and experimentation of these strategies through pilot scale implementation was impractical since it might incur substantial expenditure and/or be operationally disruptive. Moreover, there was also uncertainty over the effectiveness of each of these bed waiting time reduction strategies.

Aims

This study aimed to develop a discrete-event-simulation (DES) model that could represent the process flows at Bed Management Unit (BMU) and Inpatient Wards of Changi General Hospital (CGH) realistically. It also aimed to employ the model evaluate the impact of a new discharge policy on bed waiting time performance.

Methodology

Based on six-month (8 Apr – 8 Oct 2015) retrospective data of urgent functional bed requests and bed assignments at BMU, and transactional functional bed movements at CGH inpatient wards, key processes representing continuum of activities from urgent functional bed requests were raised for patients till their respective discharges were developed in a DES model (See Figure 1). Bed assignment rules which BMU staff considered in their bed assignment decisions were also incorporated in the DES model. Upon validating the model by comparing its projection with historical data, it was then employed to evaluate a new early discharge policy which entailed about 20% of daily discharges taking place by 10am.



*Functional beds include general ward beds and exclude security ward beds, specialized beds (ICU/HD/ISO), PSY/RMD ward beds

Figure 1: DES Modeling Scope

Results

In validation of the DES model, key indicators like right-siting proportions, waiting time performance, mean functional bed capacity, mean daily bed requests and discharges projected by the model were compared against the historical values. Bed waiting time performance was measured based on MOH tracked indicators which included average waiting time, proportion of A&E patients who required admissions waited more than 4-hours, 12-hours and 24-hours for their respective beds. Overall, model's projection of these indicators were similar to their respective historical values (See Table 1). These results demonstrated the validity of the simulation model in representing the processes of interest.

Indicators	Historical	Model
Right-siting* Proportion	88.9%	92.2%
Proportion of A&E patients# with Bed Waiting Time >= 24 hours	2.0%	2.3%
Proportion of A&E patients# with Bed Waiting Time >= 12 hours	25.7%	22.9%
Proportion of A&E patients# with Bed Waiting Time >= 4 hours	46.7%	45.8%
Mean Daily Number of Bed Requests	122	121
Mean Number of Functional Beds in Service	670	657
Mean Daily Number of Discharges	122	121

*Right-siting occurs when a patient is assigned to a bed of required medical specialty and class
Only A&E patients requiring inpatient functional bed admissions were considered

Table 1: Key Model Validation Results

After the model validation was completed, the DES model was modified so that proportion of daily discharged patients leaving their respective beds by 10am changed from baseline trend of less than 1% to about 20% (See Figure 2). Based on model projection, this change resulted in reduction of median waiting time by 3.6min while proportions of patients waiting more than 4 hours, 12 hours and 24 hours reduced by 7.0%, 1.9% and 0.4% respectively. Details of the CGH baseline and projected bed waiting time performance under the proposed early discharge policy were summarized in Table 2.

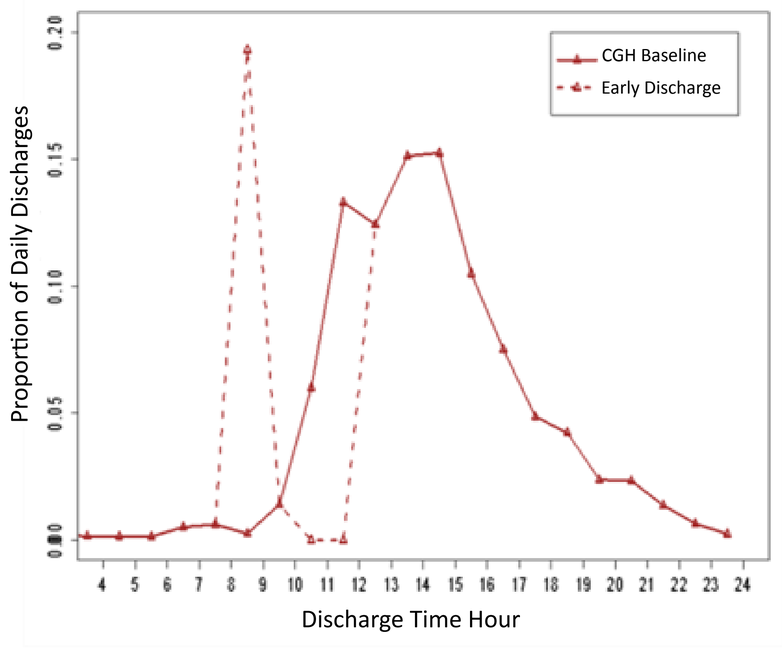


Figure 2: Hourly Inpatient Discharge Distribution

Measures	CGH Baseline	Early Discharge	Change
Proportion of A&E patients# with Bed Waiting Time >= 24 hours (%)	2.2	1.8	-0.4
Proportion of A&E patients# with Bed Waiting Time >= 12 hours (%)	22.9	21.0	-1.9
Proportion of A&E patients# with Bed Waiting Time >= 4 hours (%)	46.1	39.1	-7.0
Median Bed Waiting Time (hours)	3.5	3.4	-0.1
Mean Bed Waiting Time (hours)	6.8	6.5	-0.3

Only A&E patients requiring inpatient functional bed admissions were considered

Table 2: Impact of Early Discharge Policy

Conclusions

The findings from the simulation model suggest that adopting an early discharge policy of 20% of discharges taking place by 10am, would result in a less than 10% improvement in proportions of patients with bed waiting time greater than 4, 12 and 24 hours. The model would enable the testing of other possible strategies that could be operationally challenging to pilot to examine their effectiveness in improving bed waiting times prior to mainstream deployment.

Acknowledgement

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