

SIMULATION MODEL FOR BED OPTIMISATION AND MANAGEMENT

OBJECTIVE

SGH has several Key Performance Indicators (KPI) in rating its own service: Waiting Time, Right-Siting and Uplodging proportions of patients. This project will look at how beds are currently assigned to patients and attempt to find measure to improve its KPIs.



Did you know that SGH cannot reject patients? This limits their ability to control demand; adding constraints to managing their already **high Bed Occupancy Rate**

DIAGNOSIS

EXISTING SYSTEMS ALGORITHM BY BED MANAGEMENT UNIT

Priority Assignment Algorithm

To maximize resource utilization at every time period



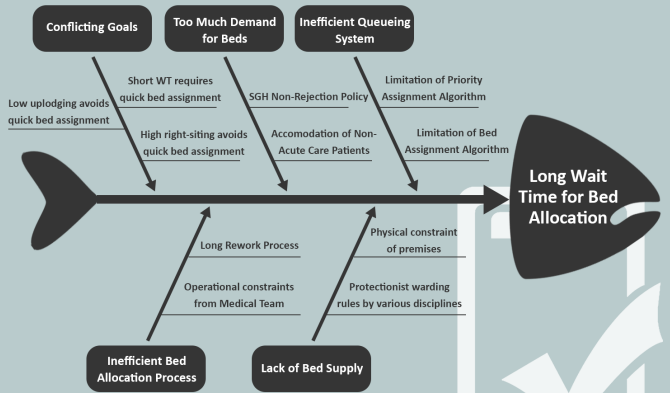
- To assign priorities to patients
- Priorities differ at different timings
- Priorities are allocated based on Type of Admission:
 - Same Day Admission (SDA), Elective, Step-Down Transfer (TRF), Specialist Outpatient Clinic (SOC), Department of Emergency Medicine (DEM)

Bed Assignment Algorithm

To manage Uplodging proportion and Right-Siting goals



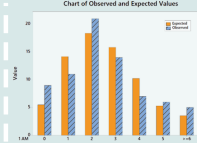
- Search algorithm for bed allocation
- Bed search is done based on Patient Class, Bed Class, Gender and Discipline
- Right-Siting occurs when patient is assigned to their Parent or Preferred Overflow wards



Learning Outcomes:
Project Management, Programming (Python, VBA), Systems Thinking, Data Analysis (Minitab, Excel), Simulation (Arena Software)

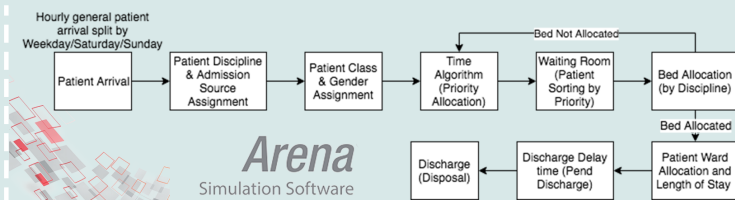
SIMULATION

INPUT ANALYSIS



- Perform Data Cleaning by running Excel VBA
- Perform Goodness of fitness tests to identify underlying distributions (Minitab, Excel)
- Perimeters for simulation model: Hourly Arrival Rate, Patient Attributes, Service Time

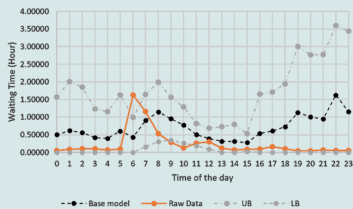
OVERVIEW OF SIMULATION MODEL



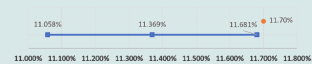
OUTPUT ANALYSIS OF KPIs

- Model validation and verification

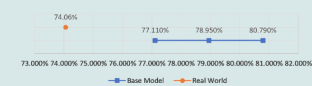
Median Waiting Time Summary



95% CI for Uplodging Proportion



95% CI for Right-Siting Proportion



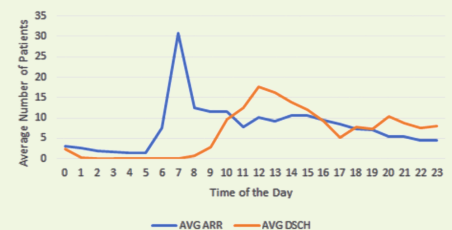
INSIGHTS



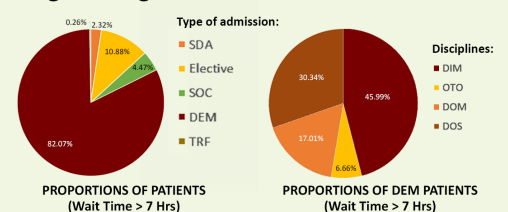
Mismatch between Arrival and Discharge Trends

- Most of the arrivals occur in the early morning
- Most of the discharge only occurs in the late afternoon
- Patients who come in the morning are generally unable to find beds promptly due to a lack of bed supply

Arrival and Discharge Trends



Long Waiting Time for DEM Patients



- Based on Arrival Type, DEM has most patients with long wait time
- Among the DEM patients, those from Internal Medicine discipline (DIM) has the highest proportion of wait time

RECOMMENDED PRESCRIPTION

IMPROVE DEM BED ALLOCATION PROCESSES

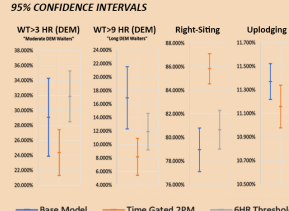
A. 6 HRS THRESHOLD

- 8AM - 6PM**
For DIM: Search for available beds in Parent wards for 6 hours before overflowing
For non-DIM: Free Flow
- After 6PM**
Search for any available bed

B. TIME GATED 2PM

- 8AM - 2PM**
Only search for beds in parent wards for DEM patients
- 2PM - 6PM**
Include searching in Preferred Overflow wards
- After 6PM**
Search for any available bed

KPI COMPARISON



ELIMINATING PATIENT'S DISCHARGE INERTIA

- To address the mismatch between Arrival and Discharge trends
- Perform Hypothesis Testing at 95% confidence level:
 - H_0 : No significant difference in Median Waiting Time
 - H_1 : Median Waiting Time of after removing Discharge Delay Case is less than Base Case

Time period	Remove Mismatch		Base Case		combined s.d.	t-value	p-value	
	Mean	s.d.	Mean	s.d.				
7	0.11807	0.00507	0.76012	0.47020	0.21030	-3.05299	0.046	Reject H0
8	0.12742	0.00624	0.90333	0.44134	0.19761	-3.93053	0.030	Reject H0
9	0.12072	0.00380	0.82933	0.40068	0.17920	-3.95425	0.029	Reject H0
10	0.08958	0.00153	0.62572	0.29486	0.13187	-4.06578	0.028	Reject H0
11	0.09694	0.00206	0.42925	0.18293	0.08182	-4.06166	0.028	Reject H0

*Implementing policies, such as providing transport home, to minimize mismatch between Arrival and Discharge will therefore reduce Median Waiting Time at peak periods (7AM - 12PM)