Bed Capacity Planning

Department of Industrial and Systems Engineering
IE3100R Systems Design Project AY 08/09

National University Hospital

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Problem Definition

Resource demand is expected to increase annually. With this in mind, this project focuses on streamlining their resource management, through bed capacity planning, such that NUH can still meet the service criteria set by MOH.

Increased Demand → Resource Management → Satisfied service criteria

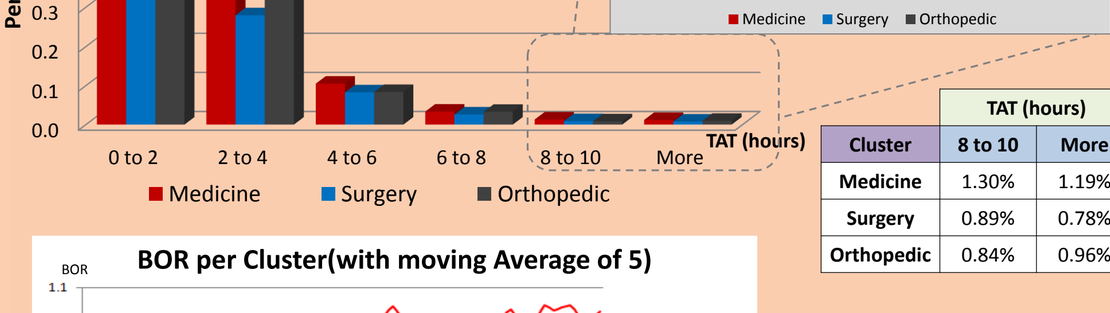
Objectives

- To determine optimum number of beds and specify allocation of beds in various clusters.
- To meet the following criteria:
  1. Patient Turn-Around-Times (TATs) are less than 8 hours 99% of the time
  2. Bed Occupancy Rates (BORs) are maintained below 90%

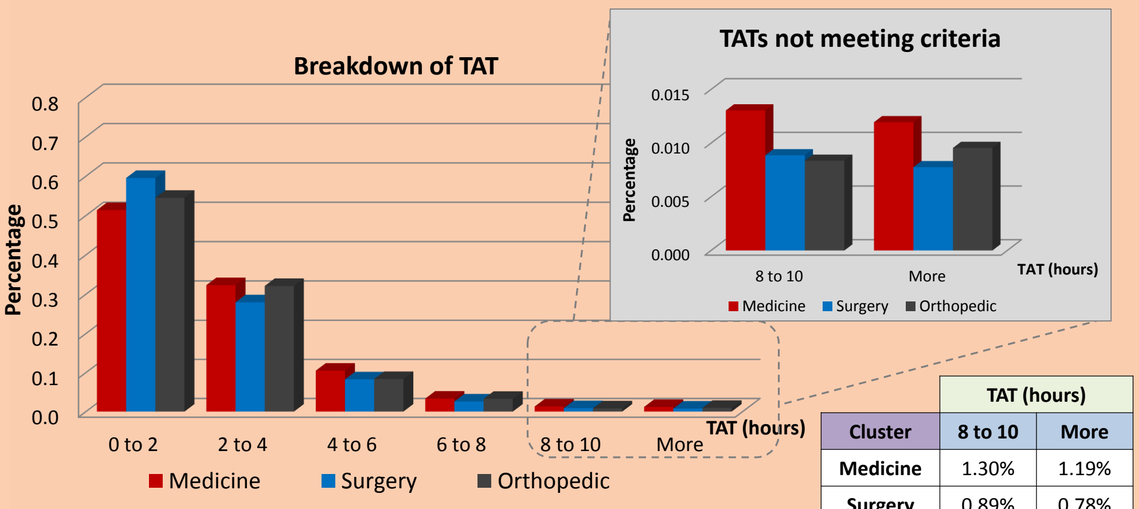
$$Overall\ BOR = \frac{Total\ number\ of\ patients}{Total\ number\ of\ beds}$$

$$TAT = ward\ admission\ time - bed\ request\ time$$

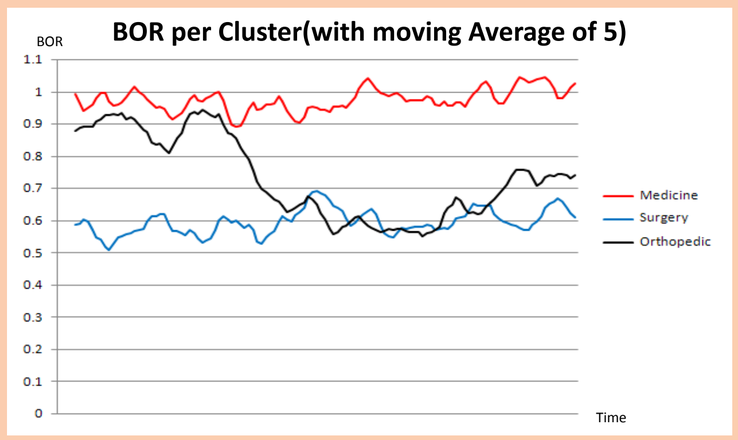
Current Situation Analysis



Current Performance Measures for 2008	
Average TAT (hours)	Average BOR (percentage)
2.43	85.44



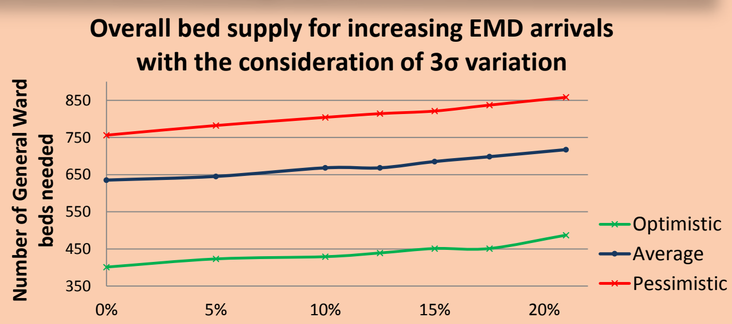
Cluster	TAT (hours) 8 to 10	TAT (hours) More
Medicine	1.30%	1.19%
Surgery	0.89%	0.78%
Orthopedic	0.84%	0.96%

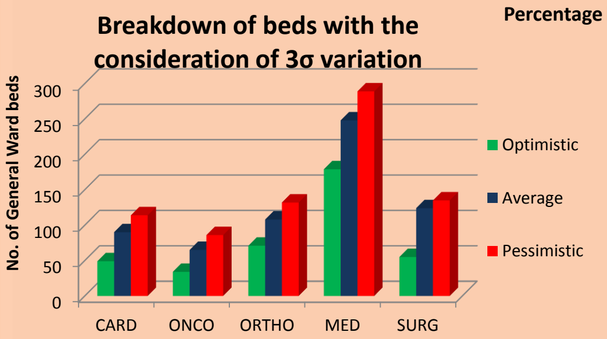


Cluster	Average BOR
Medicine	97.67%
Surgery	59.56%
Orthopedic	73.32%
OVERALL	85.44%

3 Sigma Variation in Arrivals Analysis

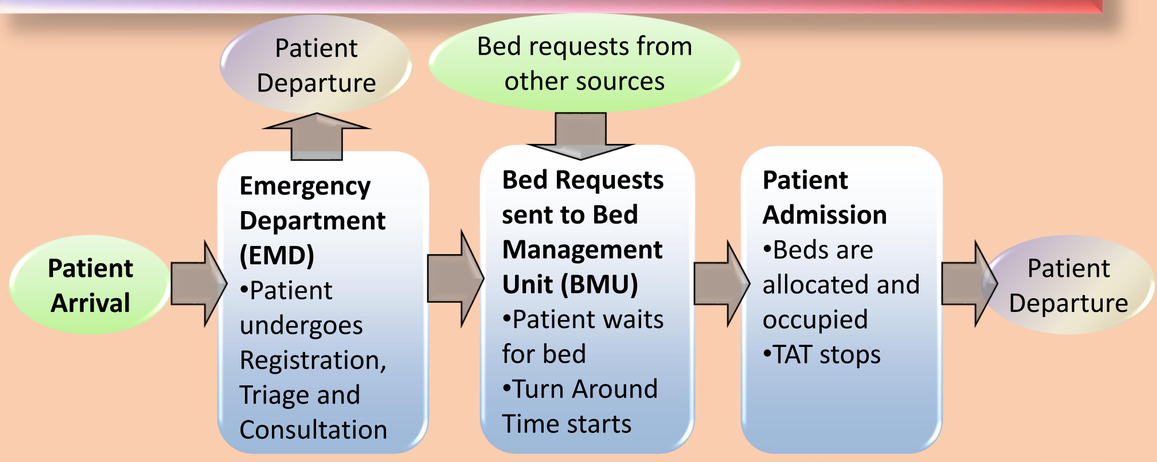
- 3 Sigma increase in patient arrivals required lesser changes in total number of beds compared to a 3 Sigma decrease in patient arrivals





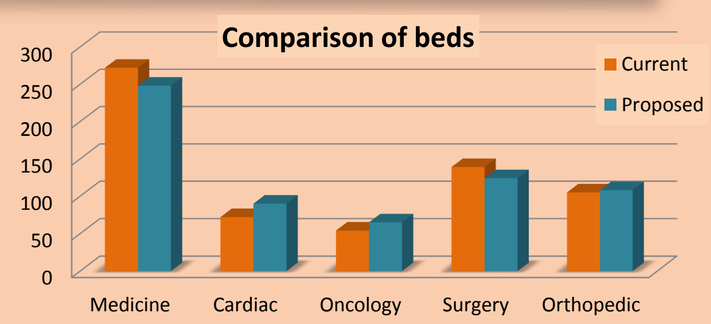
BREAKDOWN OF BEDS PER CLUSTER			
Cluster	Optimistic	Average	Pessimistic
Medicine	179	248	289
Cardiac	49	90	114
Oncology	34	65	86
Surgery	55	124	135
Orthopedic	71	108	132
OVERALL	388	635	756

Simulation Model



Proposed Solution

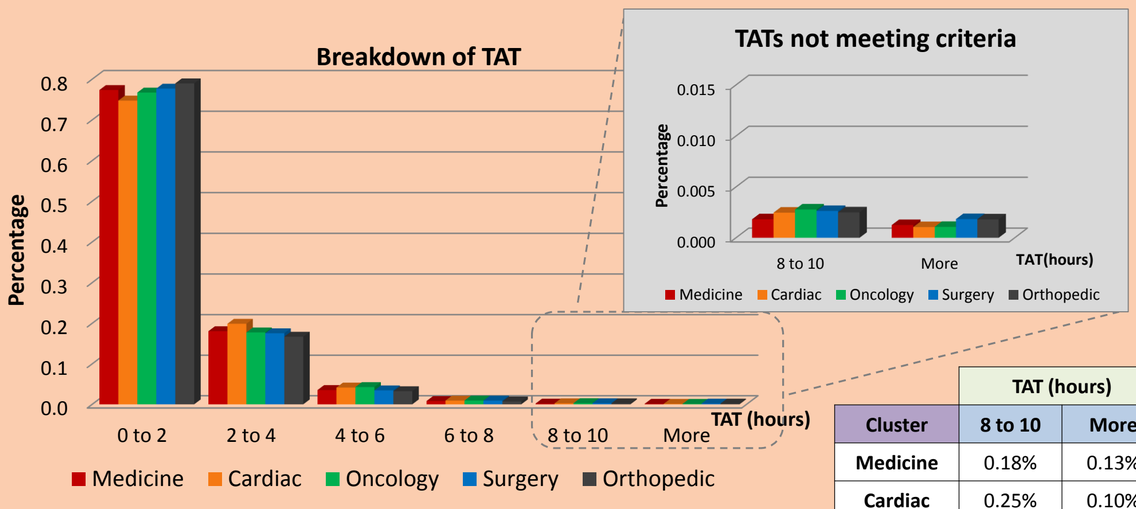
PROPOSED ALLOCATION OF BEDS FOR 2008		
Cluster	Current	Proposed
Medicine	272	248
Cardiac	72	90
Oncology	54	65
Surgery	139	124
Orthopedic	105	108
OVERALL	642	635



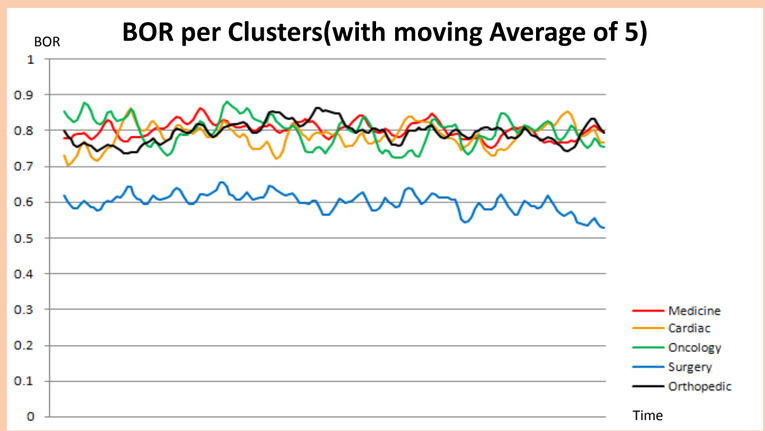
Proposed Solution Analysis

- Re-allocation of beds led to an improvement in overall average BOR and TAT across all 6 clusters
- Overall TAT of NUH improved by **28.64%** (approximately 0.70 hours)
- Overall BOR of NUH improved by **12.01%**

Simulated Performance Measures for 2008	
Average TAT (hours)	Average BOR (percentage)
1.74	75.18



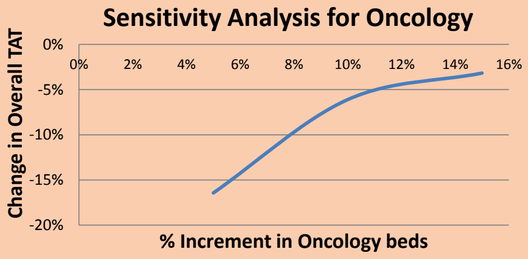
Cluster	TAT (hours) 8 to 10	TAT (hours) More
Medicine	0.18%	0.13%
Cardiac	0.25%	0.10%
Oncology	0.28%	0.11%
Surgery	0.26%	0.18%
Orthopedic	0.25%	0.18%



Cluster	Average BOR
Medicine	80.00%
Cardiac	76.42%
Oncology	77.85%
Surgery	59.50%
Orthopedics	79.48%
OVERALL	75.18%

Sensitivity Analysis

- Oncology cluster is highly sensitive to changes in number of beds
- There is a decreasing improvement of Oncology TAT with every increment in Oncology beds



Recommendations

Further analysis and studies on the following are greatly recommended:

- Reduction of system variability through process improvement
- Effect of having buffer beds to accommodate days of high EMD admission
- Efficiency of overflow protocol and actual allocation
- Correlation and trade-off between TAT and BOR
- Trends and effects in changes in patient demographics