Introduction

The Emergency Department (ED) in Sengkang General Hospital (SKH) provides emergency care to walk-in and ambulance patients. A key challenge is to manage high volumes of patients with limited manpower. This may result in long wait times and delays in providing timely care. The project aims to use 3D computer simulation software to model the current state in the ED and simulate possible scenarios to recommend manpower resources required for improvements in patient experience.

Methodology

1. Understanding the current state of the ED

The initial phase of the project was to understand the current state of the ED. We mapped out the entire patient journey in the ED, detailing every movement, process and decision point. This was done for both walk-in and ambulance patients requiring different acuity of care.

The arrival volume for walk-in and ambulance patients was also analyzed from the period of October 2018 to March 2019. Actual hourly patient arrivals in this period showed a daily bimodal distribution for walk-in patients at 10AM and 8PM.

2. Modelling ED patients’ journey

FlexSim Healthcare is a 3D simulation modelling software used to visualize and analyse patient based processes in healthcare. It allows the risk-free testing of various “what if” scenarios. A floor plan of the ED was used to build a model of the ED which includes key areas that patients will pass through from registration to discharge.

In the ED, P3 walk-in patients with minor emergencies are seen in P3 Consult while P2 walk-in patients requiring expedited care are seen in P2 Northpod.

Actual patient arrival data from October 2018 to March 2019 was fed into the model. Estimated distributions of key process durations such as consultation and registration were provided by ED doctors and input into the model. Physical space capacity, staffing numbers and shift schedules were also accounted for.

3. Scenario simulation of possible resource reconfigurations

After the model development process, the model was used to simulate the following different scenarios to quantify improvements in wait time to consult for the patient journey. We focused our improvements at the P3 patient track and the P2 walk-in patient track as they had the longest wait time to consult, which is a key factor of overall patient experience.

The model was run for a week from Monday 0000 hours to Sunday 2359 hours and the wait time to consult was compared with the current state in the ED. The wait time to consult is defined in the model as the duration from end triage or end registration to start of consult by a doctor.

P3 patient track: Increasing by one doctor

Workload sharing with P3 refers to having doctors from P2 Northpod assist doctors in P3 Consult when available. However, attending to P2 walk-in patients still takes higher priority. Scenarios like increasing staffing by one doctor per shift and adding a straddle shift timing to cover the evening patient arrival peak are also simulated.

Results

1. P3 patient track

Increasing by one more doctor for a shift

Triage / Registration

Consult

Pharmacy / Payment

Reduced from average of 125 minutes to 17 minutes (-86%)  
Increased from average of 21 minutes to 40 minutes (+47.5%)

Average wait time to consult is reduced by 86%. However, with higher throughput, there is an increase of 47.5% in the average end consult to departure duration. Thus, the impact on downstream processes needs to be considered when increasing manpower upstream.

2. P2 walk-in patient track

Adding a straddle shift 1700 to 0100

50th percentile wait time to consult for P2 walk-in at night

Reduced from average of 149 minutes to 57 minutes (-64%)

Enabling workload sharing with P3 in the evening

50th percentile wait time to consult for P3 in evening

Increased from average of 41 minutes to 23 minutes (+70%)

One more evening P3 doctor

50th percentile wait time to consult for P2 walk-in in evening

Increased from average of 31 minutes to 11 minutes (+45%)

Enabling workload sharing + adding a straddle shift

Firstly, having a straddle shift improves the wait time to consult for P2 walk-in patients at night by 64%. Secondly, enabling workload sharing in the evening with P3 consult helps to improve the wait time to consult for P3 by 70%. However, workload sharing with P3 causes wait times for P2 walk-in to increase, as P2 Northpod doctors may be attending to P3 patients.

Summary

1. Implementation of findings

The model has shown that having a straddle shift provides the additional bandwidth needed for workload sharing with P3 in the evening. This improves wait time to consult for P3 and P2 walk-in patients in the evening. While the project was ongoing, the ED concurrently implemented the straddle shift timing on the ground. The real-world improvements in wait time was anecdotally consistent with the simulation results.

2. Future applications

The model could be refreshed with new data and be extended to other institutions’ EDs. The model can be used to simulate how changes to numbers and layouts of physical resources (beds, X-ray machines) can impact process timings. Cost benefit analysis can be done to make informed decisions on resource allocations.