INTEGRATED BED MODELLING

Mayan Salama / Michael O'Sullivan / Cameron Walker

BACKGROUND

Placing patients in beds in appropriate wards gives them the best possible care. If this cannot happen then patients overflow to other wards. Modelling bed occupancy allows a hospital to make short and long term plans for overflow events.

The aim of this project was to:

- Build a simulation model of the Auckland Adult Hospital.
- Model patient arrivals and length of stay.
- Predict required capacity to avoid overflow events.

CHOOSING A BED

Auckland Hospital allocated beds by gender and diagnosis:

Choosing a Ward

A patient's diagnosis will fit into a general specialty, e.g. cardiac arrest fits into cardiology. Each ward has one or two patient specialties that it prefers to accept.

Choosing a Room

Patient Gender

Ideally rooms with multiple patients contain the same gender.

Overflow

Outlier Patients

When a patient cannot be put into a ward with the right specialty they are an outlier. Patients are placed into wards on the same floor as their ideal ward.

SHUFFLING

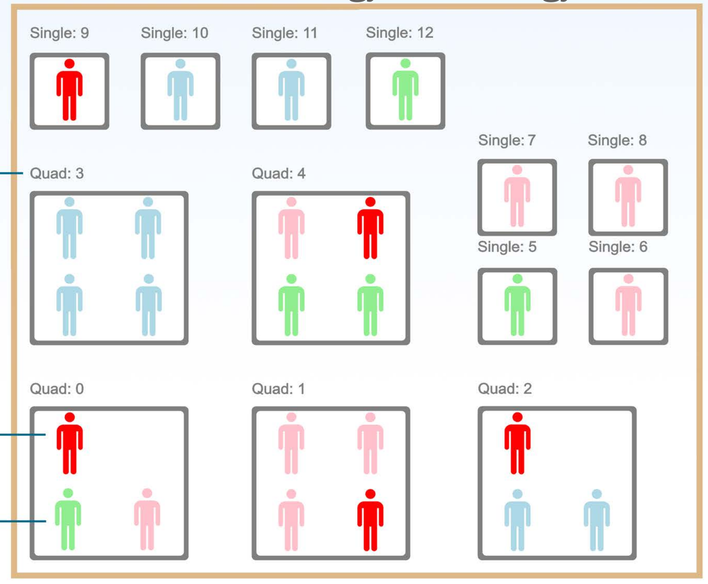
Reshuffled Patients

An alternative bed placement process was investigated:

- If a patient is an outlier they will request to be placed into a ward that is more suitable for their diagnosis.
- Patients are reallocated using a greedy process, prioritised by their remaining length of stay.
  - In reality this would need to be done based on estimated remaining time.

SIMULATION MODEL

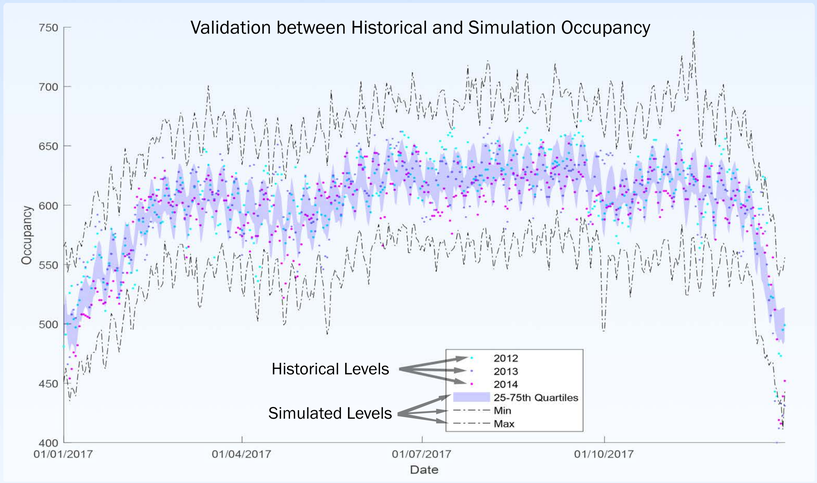
The simulation model shows occupancy for all wards in the hospital. It also displays genders, overflows, and shuffling.



- Patient arrivals vary depending on time of day, the day pf week, and month.
- ADHB expects an annual growth of 5% in emergency patients.
- Length of stay cannot be accurately captured by regression on categorical factors.

Arrivals modelled as non-stationary Poisson process. Length of stay is sampled from the historical distribution.

RESULTS

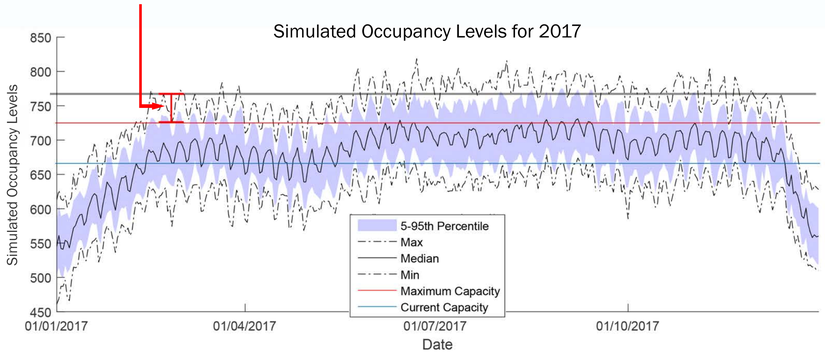


Once the arrival process was calibrated simulated occupancy levels and historical occupancy levels matched each other closely.

The model allows us to test capacity restrictions. We know which wards overflow most frequently and how many outliers are in the system.

65% reduction in outliers with shuffling routine

43 beds required to limit overflow events



SUMMARY

1. The simulation model presents strong evidence that the hospital requires an increase in the number of beds.
2. We can identify which wards need additional beds most urgently.
3. We have identified a more effective bed placement policy that significantly reduces the number of outliers.
4. This tool also provides a framework to test the effects of different scenarios, for example adding or removing a ward