

Modelling the Critical Care Pathway for Cardiothoracic Surgery

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The west of Scotland heart and lung centre based at the Golden Jubilee National Hospital houses three national services (heart transplantation, pulmonary hypertension and adult congenital) and all adult cardiothoracic surgery for the region. Recent fluctuations in emergency referrals resulted in increasing waiting times and patient cancellations leading to a desire by senior staff at the centre to review this valued service. The main issue was limited resources, which was aggravated by the stochastic nature of the length of stay (LOS) and arrival of patients.

Discrete event simulation (Simul8) was used to assess if an optimized schedule was sufficient, or more radical changes, such as capacity or other resource reallocations should be considered in order to solve the problem. Patients were divided into six different types depending on their condition and LOS at the different stages of the process. The simulation model portrayed each patient type's pathway with sufficient detail. Patient LOS figures were analyzed and distributions were formed from data stored in Excel files, which were then fitted to the simulation. The model proved successful as it showed figures that were close to what is observed in real life, including average patient LOS in different stages, the maximum and minimum LOS in the system, and most importantly, near-exact cancellation numbers. Acquiring results and knowing exactly when and what caused a cancellation was another strong point of the model.

The results showed that the bottleneck was High Dependency Unit (HDU) beds, which were recovery beds used by most patients. Optimizing the schedule relied on leveling out the daily arrival of patients to HDUs, which caused cancellations to be reduced by 20%. However, coupling this technique with minor capacity reallocations caused cancellations to be reduced by up to 60%, and cancellations were completely eliminated for some patient types.