

Reallocation of Bed Capacity in a Hospital Combining Discrete Event Simulation and Integer Linear Programming

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Abstract : The number of inpatient admissions in the UK has been significantly increasing over the past decade. These increases cause bed occupancy rates to exceed the target level (85%) set by the Department of Health in England. Therefore, hospital service managers are struggling to better manage key resource such as beds. On the other hand, this severe demand pressure might lead to confusion in wards. For example, patients can be admitted to the ward of another inpatient specialty due to lack of resources (i.e., bed). This study aims to develop a simulation-optimization model to reallocate the available number of beds in a mid-sized hospital in the UK. A hospital simulation model was developed to capture the stochastic behaviours of the hospital by taking into account the accident and emergency department, all outpatient and inpatient services, and the interactions between each other. A couple of outputs of the simulation model (e.g., average length of stay and revenue) were generated as inputs to be used in the optimization model. An integer linear programming was developed under a number of constraints (financial, demand, target level of bed occupancy rate and staffing level) with the aims of maximizing number of admitted patients. In addition, a sensitivity analysis was carried out by taking into account unexpected increases on inpatient demand over the next 12 months. As a result, the major findings of the approach proposed in this study optimally reallocate the available number of beds for each inpatient specialty and reveal that 74 beds are idle. In addition, the findings of the study indicate that the hospital wards will be able to cope with 14% demand increase at most in the projected year. In conclusion, this paper sheds a new light on how best to reallocate beds in order to cope with current and future demand for healthcare services.

Keywords : bed occupancy rate, bed reallocation, discrete event simulation, inpatient admissions, integer linear programming, projected usage

Conference Title : ICHEHSO 2018 : International Conference on Healthcare Engineering and Healthcare Systems Optimization

Conference Location : Amsterdam, Netherlands

Conference Dates : December 03-04, 2018