Applying Multi-phase DES Approach for Modelling the Patient Journey Through Accident and Emergency Departments

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Abstract

Accident and Emergency departments (A&ED) are in charge of providing access to patients requiring urgent acute care. A&ED are difficult to model due to the presence of interactions, different pathways and the multiple outcomes that patients may undertake depending on their health status. In addition, public concern has focused on the presence of overcrowding, long waiting times, patient dissatisfaction and cost overruns associated with A&ED. There is then a need for tackling these problems through developing integrated and explicit models supporting healthcare planning. However, the studies directly concentrating on modelling the A&EDs are largely limited. Therefore, this paper presents the use of a multi-phase DES framework for modelling the A&ED and facilitating the assessment of potential improvement strategies. Initially, the main components, critical variables and different states of the A&ED are identified to correctly model the entire patient journey. In this step, it is also necessary to characterize the demand in order to categorize the patients into pipelines. After this, a discrete-event simulation (DES) model is developed. Then, validation is conducted through the 2-sample t test to demonstrate whether the model is statistically comparable with the real-world A&ED department. This is followed by the use of Markov phase-type models for calculating the total costs of the whole system. Finally, various scenarios are explored to assess their potential impact on multiple outcomes of interest. A case study of a mixed-patient environment in a private A&E department is provided to validate the effectiveness of the multi-phase DES approach.