World Academy of Science, Engineering and Technology
International Journal of Health and Medical Engineering
Vol:16, No:10, 2022

Decision Support System for Hospital Selection in Emergency Medical Services: A Discrete Event Simulation Approach

Authors : D. Tedesco, G. Feletti, P. Trucco

Abstract : The present study aims to develop a Decision Support System (DSS) to support the operational decision of the Emergency Medical Service (EMS) regarding the assignment of medical emergency requests to Emergency Departments (ED). In the literature, this problem is also known as “hospital selection” and concerns the definition of policies for the selection of the ED to which patients who require further treatment are transported by ambulance. The employed research methodology consists of the first phase of revision of the technical-scientific literature concerning DSSs to support the EMS management and, in particular, the hospital selection decision. From the literature analysis, it emerged that current studies are mainly focused on the EMS phases related to the ambulance service and consider a process that ends when the ambulance is available after completing a request. Therefore, all the ED-related issues are excluded and considered as part of a separate process. Indeed, the most studied hospital selection policy turned out to be proximity, thus allowing to minimize the transport time and release the ambulance in the shortest possible time. The purpose of the present study consists in developing an optimization model for assigning medical emergency requests to the EDs, considering information relating to the subsequent phases of the process, such as the case-mix, the expected service throughput times, and the operational capacity of different EDs in hospitals. To this end, a Discrete Event Simulation (DES) model was created to evaluate different hospital selection policies. Therefore, the next steps of the research consisted of the development of a general simulation architecture, its implementation in the AnyLogic software and its validation on a realistic dataset. The hospital selection policy that produced the best results was the minimization of the Time To Provider (TTP), considered as the time from the beginning of the ambulance journey to the ED at the beginning of the clinical evaluation by the doctor. Finally, two approaches were further compared: a static approach, which is based on a retrospective estimate of the TTP, and a dynamic approach, which is based on a predictive estimate of the TTP determined with a constantly updated Winters model. Findings reveal that considering the minimization of TTP as a hospital selection policy raises several benefits. It allows to significantly reduce service throughput times in the ED with a minimum increase in travel time. Furthermore, an immediate view of the saturation state of the ED is produced and the case-mix present in the ED structures (i.e., the different triage codes) is considered, as different severity codes correspond to different service throughput times. Besides, the use of a predictive approach is certainly more reliable in terms of TTP estimation than a retrospective approach but entails a more difficult application. These considerations can support decision-makers in introducing different hospital selection policies to enhance EMSs performance.

Keywords : discrete event simulation, emergency medical services, forecast model, hospital selection
Conference Title : ICHSOPFO 2022 : International Conference on Healthcare Systems Optimization and Patient Flow Optimization
Conference Location : Lisbon, Portugal
Conference Dates : October 27-28, 2022