Improving patient flow at a Tunisian outpatient department using simulation modelling approach

Hana BEN MBAREK[1], Amel JAOUA[2], Najla AISSAOUI OMRANE[3], Safa BHAR LAYEB[4], Atidel HADJ ALOUANE[5]

[1]UR-OASIS, National Engineering School of Tunis, University of Tunis El Manar, Tunisia, hana.benmbarek@enit.utm.tn

[2]UR-OASIS, National Engineering School of Tunis, University of Tunis El Manar, Tunisia, ameljaoua@outlook.com

[3]UR-OASIS, National Engineering School of Tunis, University of Tunis El Manar,
National Engineering School of Carthage, University of Carthage, Tunisia, najla.aissaoui.omrane@gmail.com

[4]UR-OASIS, National Engineering School of Tunis, University of Tunis El Manar, Tunisia, safa.layeb@enit.utm.tn

[5]UR-OASIS, National Engineering School of Tunis, University of Tunis El Manar, Tunisia, atidel.hadj@enit.utm.tn

Keywords
Health Care, Simulation, Performance Analysis.

Abstract

This study aims to improve the performance of the outpatient department of Abderrahmène Mami Hospital, Tunis, by addressing overcrowding and decreasing patient waiting times. Discrete Event Simulation (DES) is adopted to model the current ambulatory care process in order to support managers' decision about new organizational practices. Several well-elaborated scenarios are proposed about (i) re-dimensioning admission and waiting areas, and (ii) considering well designed appointment systems rather than scheduling by only providing a specific date for patient consultations. Simulation runs are conducted to evaluate each scenario's performance. Computational results show that we can reach a substantial decrease of the waiting time by implementing new resources configuration.

Problem Presentation

Overcrowding is one of the most challenging problems in healthcare, and it is stated as a universal issue that hospitals are suffering from (Bal et al., 2017). It leads to long waiting times, patients' dissatisfaction, and medical errors. In addition, healthcare managers are challenged by the dramatic increase in patient expectations for service quality, the intrinsic uncertainty of demands, and the high level of human involvement at both resource and patient levels (Swallmeh et al., 2014). In this context, the scope of our work is to support healthcare administrators, within the Abderrahmène Mami Hospital, in analyzing outpatient department overcrowding and its associated important waiting time due to admitting more than 50.000 patients per year. More precisely, a new ambulatory care unit grouping three specialties (pulmonology, cardiology, and allergology) is under implementation. Thus, we investigate the existing care processes' efficiency in order to highlight opportunities to organize resources deployment more effectively.

Solving Approach

Traditionally, healthcare managers take critical decisions basing on data contained in clinical and administrative records. However, this approach has limited use in solving waiting lines problem in healthcare systems since it is unable to represent the dynamic interaction between its complex interconnected components. Thus, analytical and informatics tools are needed to support healthcare professionals' decisions. In our study, we have opted for the use of the Discrete Event Simulation (DES) that is an operational research technique based on the concept of queuing systems, where entities compete for resources (Brailsford, 2014). This tool provides the ability to evaluate the efficiency of an existing health care system, to ask 'what if?' questions, and to design new ones (Jun et al. 1999). Moreover, it allows managers to predict the outcomes of changes or proposed actions by evaluating their impact on the system key performance indicators. In our case study, we developed a comprehensive DES model for the patient pathway that reflects the interaction between entities in the real world outpatient department. Thus, we derived appropriate scenarios and we evaluated the corresponding impact on the patients' waiting time and length of stay within the department.

Simulation Experiments

To achieve the announced objectives, the following steps were taken. First, we state the process mapping and we collect data that was fitted into distributions. Then, we model the current situation. The simulation model is built using the popular Arena Software, and we validate it using the real system. The primary results of the simulation allow identifying queuing times, bottlenecks and resource allocation. In the light of these results, several opportunities for improvement are outlined to address the significant waiting times within the department. It is mainly about enhancement of resources deployment. More precisely, we propose reorganizing admission and waiting areas, and improving the outpatient appointment and doctors scheduling. Evaluating the outcome of the proposed scenarios provides good insights about reducing considerably congestion and patients' length of stay, by more efficient use of available resources.

References

Bal, A., Ceylan, C. and Taçoğlu, C., 2017. Using value stream mapping and discrete event simulation to improve efficiency of emergency departments. *International Journal of Healthcare Management*, *10*(3), pp.196-206.

Brailsford, S., 2014. Discrete-event simulation is alive and kicking!. *Journal of Simulation*, *8*(1), pp.1-8.

Jun, J.B., Jacobson, S.H. and Swisher, J.R., 1999. Application of discrete-event simulation in health care clinics: A survey. *Journal of the operational research society*, *50*(2), pp.109-123.

Swallmeh, E., Tobail, A., Abo-Hamad, W., Gray, J. and Arisha, A., 2014.Integrating simulation modelling and value stream mapping for leaner capacity planning of an emergency department.Sixth International Conference on Advances in System Simulation, SIMUL 2014, Nice – France.