

Chapter 5

The Applications of Simulation Modeling in Emergency Departments: A Review

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ABSTRACT

A recent study carried out an empirical investigation of the quality of healthcare delivered to adults and found out that only $54.9 \pm 0.6\%$ adult received recommended care. Huge variation in the quality of care depends on patient's condition. In fact, the literature on healthcare is laden with articles like these that emphasize on the importance of the systems view of healthcare problems. Healthcare is a very vast and complex system where different departments interact with each other in order to deliver a certain service to arriving patients. Emergency departments (EDs) are the busiest units of healthcare. Existing problems and their cascading effect will be highlighted by a literature review of a bunch of researches. The purpose of this work is to study, in specific, the emergency department of a hospital with the existing problems and how simulation modeling can interfere in order to solve these problems, increase patient satisfaction and reduce cost. Simulation has emerged as a popular decision support in the domains of manufacturing and services industries.

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INTRODUCTION

The medical sector has been growing largely over the last decade and healthcare services became more complex and costly, amplified by a poor healthcare delivery system. Healthcare is a highly interconnected dynamic environment where individuals and teams contribute in order to serve patients' demand. The main focus of this study is to discuss this revolution and take care of the whole medical community not only illness, but also improving patient safety, quality, and effectiveness of the healthcare system. This can be achieved by developing new methodologies to improve the health care systems available nowadays.

Many methodologies were presented over the literature in order to study healthcare problems. Some of them are listed as follows (Ceglowski, 2006):

- Patients are grouped by clinicians under several cases; where similar cases should be treated alike and should share the same type of resources every time the same case arises (see Palmer, 1996). This approach can be valuable only in case of few available cases such as in clinics not in large complex systems like ED.
- Time and motion studies were used by industrial engineering analysts in order to introduce enhancement to healthcare (see Hoffenberg et al., 2001).
- Prevention of high patient waiting times and ambulance diversions were discussed over the years and simulation was introduced in order to alleviate this risk (see Jun et al., 1999; Preater, 2002).
- The flow of data in the ED was studied by information science analysts in order to design a computer system that supports the doctors and nurses in their roles (see Nelson et al., 2004).
- ED data inspection for better knowledge of information retrieved.

As a result of the above, the first area to focus on in order to develop an efficient and effective healthcare system is developing systems perspective, where simulation modeling can be generated and a review can be achieved. Simulation modeling can be a solution to tackle this complexity and valuable in providing predictions to forecast the outcome of a change in strategies or policies. The computer simulation is a decision making technique that allows management to conduct experiments with models representing the real system of interest. Busy and complex healthcare systems provide big challenges to managers and decision makers who should be able to serve the high demands constrained by limited budget and high costs of healthcare services. The highest number of patients should be cared of within a limited period of time in order to insure patient satisfaction (reduce waiting time) and increase hospital's revenue (reduce cost).

The delivery of healthcare quality can vary depending on patient's conditions, affecting the recommended care and leading sometimes to urgent and critical health conditions. This huge variation opens the eye on the importance of reviewing the healthcare systems' problems and improving them.

Emergency department (ED) is the most complex, critical and busy unit of a hospital, where medical facility treatment is provided to patients without prior appointment. Other reasons for ED to be a complex system and chosen, specifically, for this study are the high increase in patients' number, the 24/7 operation of the ED, and the open facility to all type of illness and all level of patients. EDs interact with the majority of other departments of the healthcare system. Table 1 shows this interaction. A patient arriving to the ED may be transferred to any other unit of the hospital depending on the diagnosis (such as requiring extra facilities: laboratory, imaging, etc., admission to hospital, referring to surgery unit if a surgery is scheduled, referring to pediatric unit in case the patient arriving is a kid/baby, etc.).

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