A DECISION SUPPORT SYSTEM FOR CAPACITY PLANNING IN EMERGENCY DEPARTMENTS

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Abstract
In this article, we present a decision support system (DSS) for improving patient flow in emergency departments (EDs). The core of the system is a discrete-event simulation (DES) model that aims to support capacity planning in the ED, in view of controlling patients’ length of stay (LOS). Conceptually, it regards the patient LOS as the result of different queueing systems, the behaviour of which is influenced by different types of capacities. Taking inputs from ED patient record data, the DSS allows to analyse the impact of different capacity changes on patient flow, and to detect efficient capacity combinations using data envelopment analysis (DEA). We report on the insights obtained from a case study in a large regional hospital in Belgium.

Key Words: Healthcare Management, Emergency Department, Patient Flow, Capacity Planning, Decision Support System

1. INTRODUCTION

Emergency departments (EDs) all over the world are struggling with a phenomenon called (over)crowding. While there is no single agreed-upon definition of crowding in the literature, it can be understood in general as “the situation when the demand for emergency services exceeds the ability of an ED to provide quality care within appropriate time frames” [1]. Following [2], we chose to use the term ‘crowding’ in this article. Crowding has received attention since the early ’90s in the medical literature (see, e.g., [1-5]) and in the field of Operations Research and Operations Management [6, 7]. Simultaneously, there is increasing pressure on EDs to improve their operational performance, and decrease the length of stay (LOS) of patients in the ED [6].

In practice however, hospital management often lacks the tools to effectively analyse the problem and detect efficient solutions. The issue is that EDs are highly complex environments: patient arrival rates vary over time, patient care paths depend on urgency and pathology, resources (staff and beds) may or may not be suited for treating all patient types, urgent patients typically get priority over (and may even preempt resources from) non-urgent patients, patients who need to be admitted often board in ED beds (i.e., they remain blocked in ED beds due to the unavailability of beds in the inpatient units (IUs)), etc. While in reality, the patient flow through the ED results from the interplay of all these factors, the majority of academic models tend to analyse only one factor [6]. This article presents a practical DSS for improving patient flow in real-life EDs. It contributes to the literature by:

(1) simultaneously taking into account the main drivers impacting patient flow: (a) limited bed availability in the ED, (b) limited availability of staff (doctors and nurses), and (c) boarding, also referred to as ‘access block’ or ‘bed block’ [2, 3, 8]. This allows hospital management to analyse the impact of capacity changes (changes in number of beds, staff schedules, boarding times) on patient flow.

(2) taking into account the time-varying nature of the demand and the patient mix (i.e., the patients’ pathologies and urgencies).


