Proceedings of the 2018 Winter Simulation Conference
M. Rabe, A.A. Juan, N. Mustafee, A. Skoogh, S. Jain, and B. Johansson, eds.

ASSESSING THE POTENTIAL OF CASE MANAGERS IN EMERGENCY DEPARTMENTS BY USE OF DISCRETE-EVENT SIMULATION

Lien Vanbrabant

UHasselt/Research Foundation Flanders
Research Group Logistics
Agoralaan, building D
Diepenbeek, 3590, BELGIUM

Kris Braekers
Katrien Ramaekers

UHasselt
Research Group Logistics
Agoralaan, building D
Diepenbeek, 3590, BELGIUM

ABSTRACT

Emergency departments (EDs) are continuously exploring opportunities to improve their efficiency. A relatively new opportunity, which has proven to be effective in other service systems, lies is the application of a case manager approach to ED physicians. By using dedicated physicians, putting a limit on the number of patients simultaneously assigned to a physician, and determining appropriate priority rules for assigning patients to physicians, throughput may be increased. The potential of applying a case manager approach in an ED is tested by use of a realistic simulation model based on the ED of a Belgian university hospital.

1 BACKGROUND

The efficient operations of an emergency department (ED) are impeded as a result of crowding. In order to alleviate the negative consequences related to crowding (e.g. long waiting times, reduced quality of care, high personnel utilization), hospital managers are constantly looking for opportunities to improve ED performance. The versatile, stochastic and complex nature of an ED makes simulation a highly appropriate and frequently used technique to gain insight into the effect of possible improvements. Patient flow through an ED consists of three phases: input, throughput and output. Operational improvements in all three phases have proven to be effective to overcome the negative effects of crowding. As input and output processes are partly dependent on external factors, the main focus in current literature is on interventions in the throughput phase, since these processes are under the direct control of the ED (Vanbrabant et al. 2017).

2 PROPOSED WORK

A relatively new opportunity to improve efficiency lies is the application of a case manager approach to ED physicians. Physicians are the most costly resource in an ED and have multiple consultations with a patient during his stay, which are interspersed by radiological and laboratory examinations, and waiting for the results of these examinations. Because of these external delays, a physician is simultaneously responsible for a set of patients, which necessitates a physician to multitask. Multitasking results in productivity gains as the idle time of a physician caused by external delays is reduced. However, the cognitive limitations of physicians and the setup costs involved when switching between patients cause productivity losses as the number of patients assigned to a physician increases. In addition, a too high workload may negatively impact the quality of care (Kc 2014). In order to maximize productivity, an upper limit should be placed on the number of patients assigned to a single physician at one time (Campello et al. 2017).

The case manager concept with limited caseloads entails the formation of two separate physician queues in the ED. In the pre-assignment queue, patients are awaiting physician assignment. As most EDs are crowded, the patient census in the ED may exceed the maximum capacity of all physicians, resulting in a

significant pre-assignment queue. Once patients are assigned to a physician, they join the internal queue of the specific physician to await their consultation. After a physician consultation, each patient has a certain disposition probability. Most patients are repeatedly placed in the internal queue as they need multiple interactions with the physician before disposition from the ED (Campello et al. 2017).

The case manager system is characterized by three parameters that should be customized and optimized. Apart from a decision on the caseload limit (i.e., maximum capacity), priority rules for both queues should be defined. In the pre-assignment queue, a decision should be made which patient gets priority once capacity becomes available (e.g., urgency, FIFO). As the workload related to a patient depends on individual patient characteristics, assignment rules may be based on balancing workload between the different physicians. In the internal queue, a physician should decide to prioritize newly arriving patients needing a first consultation or patients closer to the end of their ED stay (Dobson et al. 2013). A customized and optimized case manager system may result in increased physician throughput, better physician utilization, lower service times and higher quality of care (Campello et al. 2017; Dobson et al. 2013; Kc 2014). Introducing case managers in the context of ED simulation implies the optimization of a fourth factor, namely the alignment of the case manager concept with the complex ED setting. As shift work is the primary employment model of ED physicians, patient handovers are necessary at shift changes. Furthermore, physician capacity may differ between shifts. Consequently, a handover policy should be determined (e.g., a systematic decrease in caseload when approaching shift changes, a temporary increase of caseloads after shift changes). Also, as a high urgency patient may enter the ED at all times, a policy to deal with these patients should be foreseen. This may imply the introduction of spare (or reserved) capacity or a temporary increase in caseload.

In this study, a realistic simulation model is built in the Arena simulation software. The model is based on the ED of a Belgian university hospital which is confronted with crowding. The total number of ED visits reached 57,650 in 2016, 60,727 in 2017, and is expected to increase even further in 2018. Data extracted from the electronic health records of the hospital under study is used as basis for simulation model construction. The dataset consists of anonymized patient records containing medical and patient flow information of all patients that visited the ED in 2016. This enables to model the complete patient flow in a detailed and realistic way, for example by including time- and day dependent patient arrival rates, individualized patient pathways and stochastic service times. The model is validated in several ways, such as meetings with the operational management and ED staff, and a comparison of model output against actual performance by use of the available data (e.g., length of stay). The model closely reflects real ED operations. Based on our simulation model, the optimal case manager setting is determined, and the effect on physician productivity will be investigated in a more realistic environment. Additionally, the effect on the ED as a whole can be investigated as interactions and trade-offs between processes may be revealed that are otherwise neglected. An increased physician throughput may, for example, lead to an increase in the number of boarding patients, which can result in an increased length of stay for admitted patients. Based on these findings, improvement options in other ED processes that reinforce the case manager concept may be identified.

REFERENCES

Campello, F., A. Ingolfsson, and R.A. Shumsky. 2017. "Queueing Models of Case Managers". *Management Science* 63(3):882–900.

Dobson, G., T. Tezcan, and V. Tilson. 2013. "Optimal Workflow Decisions for Investigators in Systems with Interruptions". *Management Science* 59(5):1125–1141.

Kc, D. S. 2014. "Does Multitasking Improve Performance? Evidence from the Emergency Department". *Manufacturing & Service Operations Management* 16(2):168–183.

Vanbrabant, L., K. Braekers, and K. Ramaekers. 2017. "Analysis and Simulation of Emergency Departments: State of the Art and Prospects". *31st Annual Conference of the Belgian Operational Research Society,* February 2-3, Brussels, Belgium, 127-128.