Chapter 10
Using Simulation to Design and Improve an Outpatient Procedure Center

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ABSTRACT

Discrete-event simulation (DES) is an effective tool to for analyzing and improving healthcare processes. In this chapter we discuss the use of simulation to improve patient flow at an outpatient procedure center (OPC) at Mayo Clinic. The OPC addressed is the Pain Clinic, which was faced with high patient volumes in a new, untested facility. Simulation was particularly useful due to the uncertain patient procedure and recovery times. We discuss the simulation process and show how it helped reduce patient waiting time while ensuring the clinic could meet its target patient volumes.

INTRODUCTION

Effective patient flow through treatment processes is an increasingly important issue for healthcare organizations. Economic pressures are putting a growing importance on treating more and more patients without corresponding increases in staff and other healthcare resources. Expensive resources such as operating rooms and sophisticated diagnostic imaging equipment drive organizations to maximize their utilization. Further, with an increasing array of procedures, equipment, and specialized staff, the complexity of managing patient flow is growing. Add to this, the desire to improve patient satisfaction (i.e., limit patient waiting time) and it is clear that health care organizations have a very challenging problem in managing patient flow.

To design and manage patient flow processes, healthcare organizations can use a variety of

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techniques. Often, the treatment processes evolve over time with trial and error. Sometimes, more structured methods like Lean and Plan-Do-Study-Act (PDSA) techniques are applied that help the processes evolve more quickly (Fischman, 2010). However, given the previously discussed complex interaction of people and equipment along with the highly variable nature of treatment times for diverse patients and it appears sensible that sophisticated quantitative methods like discrete-event simulation (DES) may be more appropriate analysis and improvement tools. DES can directly incorporate the uncertainties in the process and provide a more process-wide versus localized analysis approach.

In this chapter we discuss the use of computer simulation modeling applied to the design and operational improvement of an outpatient procedure center (OPC) at the Mayo Clinic. The specific application is for interventional procedures in Pain Medicine – the Pain Clinic. This Clinic was faced with growing demand for its services and desired to optimize patient flow as it moved to new facilities.

Our primary objectives in this chapter are to discuss the modeling process and how it answered the specific questions regarding the design of the new Pain Clinic practice (Huschka et al., 2008). These questions included:

- How many recovery rooms would be sufficient to accommodate the anticipated demand and adequately serve the procedure rooms?
- How could patient waiting time for recovery rooms be minimized?
- When should patients be released at various treatment stages to minimize waiting times?
- Could the desired daily patient volume be achieved and if not, what process improvements were required to achieve this volume?

In addition to addressing these design questions, the DES model was also used to address process flow issues related to nurse staffing. These issues arose subsequent to the initial study as the Pain Clinic approached the desired volume levels. Thus, the simulation model continues to be a useful analysis and improvement tool as the Mayo Clinic strives to maximize value for its patients.

A REVIEW OF PATIENT FLOW SIMULATION LITERATURE

In this section we provide an overview of some of the literature regarding the use of DES to address patient flow problems, in general, and flow issues in outpatient (and similar) clinics, specifically.

Discrete-Event Simulation Applied to Patient Flow

As discussed in Chapter 8 of Hall (2006) the application of discrete-event simulation to study the design and operation of health care delivery systems is steadily increasing. One of the reasons for this, as pointed out by Jun et al. (1999) in their DES literature review article, is that increasing health care costs is driving many health care organizations to consider more sophisticated improvement tools like DES. As the authors state, discrete-event simulation "…allows managers to select management alternatives that can be used to reconfigure existing systems, to improve system performance or design, and to plan new systems, without altering the present system." This what-if analysis capability is a key given the high cost of designing and making changes to health care operations.

Difficulties in managing patient flow are exasperated by the high degree of innate uncertainty in healthcare. In their overview article, Noon et al. (2003) note the sources of variability and the corresponding queuing effects that restrict easy patient flow. This variability due to the way patients