

# Chapter 5

## Surgery Operations Modeling and Scheduling in Healthcare Systems

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### ABSTRACT

*Surgery operations scheduling is a complex task due to operation duration uncertainties and resource sharing and availabilities in healthcare processes. In current health care systems it is important to minimize staff idle time and maintain a high utilization rate for surgery facilities. In the present study a nonlinear mathematical model for surgery scheduling is described, and an approximated linear model is deduced based on a set of assumptions. The linear model is solved using heuristic approach. The objective is to maximize the utilization of operating rooms and the surgery staff. Computational results show that our model improved the surgery schedule and the resources utilization. Our model also showed the potential of adding cases to the schedule due to minimizing the completion time of the schedule.*

### 1. INTRODUCTION

Providing efficient healthcare services to patients are gaining an increasing attention over the past few years. Recent budgetary restrictions, prescribed by politics, due to economic changes, led public hospitals to seek and implement methodolo-

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gies and techniques at their managerial and operational levels, to achieve efficient resource usage, without compromising the quality of their service, risking patient endangerment, or causing additional costs (patient waiting and resources usage costs). Emergency department and surgery department got to be the most critical subsystems in any hospital, due to their role in fulfilling emergent needs. Surgery departments service both urgent and elective surgery procedures, and are linked to referrals from physicians outside the hospital, and/or from other department within, such as the emergency department. The Surgery department is the hospital most expensive center (Health Care Financial Management Association.2005), and due to his linkage to other hospital services (intensive care, preoperative care, post anesthesia care, surgery admission, and recovery units), its impacts the performance of the hospital as whole. To provide an idea of surgery department cost distributions, based on data from statistics Canada collected for the period 2007-2008, the New Brunswick regional health authority expenditures averaged: staff wages (70%), medical and surgical supplies (13%), drugs and medicines (7%), equipment and miscellaneous (10%). When putting these expenditure figures in contrast with the increasing demand in surgery procedures inflicted on the same New Brunswick regional health authority (16% increase over the period from 2005 to 2008), seeking continuous improvement of the operating theatre management becomes critical to ensure quality healthcare delivery for all patients, by keeping a cost-effective, and a flexible scheduling of all surgery demands.

In the same line of thought, this study is aimed, in a first stage, toward the development of a general mathematical programming model (nonlinear) for elective surgery planning and scheduling. During modeling, surgeries are assumed to be of uncertain durations, also operating room, and surgeon preferences are taking into consideration. The two goal of increasing operating room utilization, and reducing surgeon idle times are combined in a single objective formulation. In the second stage of this study, a linear program is extracted from the general model and solved using a simple heuristic approach. Several feasible schedules (no optimal) can be obtained easily using the linear model, providing a flexibility in the decision making process.

The reminder of this chapter starts with a brief background on recent studies on modelling and scheduling of surgery procedures, followed by a mathematical description of the constraints involved in the surgery planning and scheduling problem. The nonlinear model is then simplified to a linear mathematical program, and a heuristic procedure is presented to solve the simplified model. Based on a case study, some results are discussed, with conclusion and future possible extensions.

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