Chapter 12

Planning and Scheduling in Health Care

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12.1 Introduction

In most countries the health care industry represents a significant percentage of the Gross National Product. With the aging of the population, health care costs have been going up considerably over the last couple of decades. For these reasons, many governments have begun to look into the productivity of their health care industries.

Health care productivity is to a great extent based on the proper planning and scheduling of all the activities involved. The variety in planning and scheduling processes in health care turns out to be immense. This chapter focuses on just a few of these processes.

The most expensive resources in a hospital are typically the operating room(s), the surgeons, and the anesthesiologists. An hour of operating room time is very expensive and so is an hour of a surgeon’s time. The operating
rooms in a hospital can actually be regarded as the hospital’s engine. The
surgeries drive the demand for many of the hospital’s divisions, such as the
Intensive Care Units (ICUs) and other postoperative care units (including
beds, nurses, and so on).

Common objectives in an operating theatre are the minimization of the
idle times of the operating rooms and the minimization of the times surgeons
have to wait for an operating room to become available. Since the durations of
surgeries are typically random, the planning and scheduling of the surgeries is
usually not a simple task. The scheduling of an operating theatre (consisting of
a number of operating rooms) is very similar to the parallel machine scheduling
problem described in Chapter 5 since an operating room may be regarded as
a machine and a surgery may be regarded as a job. The scheduling of an
operating room may also be regarded as a timetabling problem (see Chapter
9). The first three sections of this chapter describe several approaches for
dealing with the scheduling of operating rooms.

This chapter also considers other planning and scheduling problems that
are of importance in health care. For example, the planning and scheduling of
radiotherapy treatments (which is a special case of an appointment scheduling
problem). Another example of a planning and scheduling problem in a health
care setting that is considered in this chapter is the assignment of physicians to
emergency room shifts. This problem is a special case of a workforce scheduling
problem. (Workforce scheduling and staffing will be considered in more detail
in the next chapter.)

The last section of this chapter describes an actual system for surgery
scheduling and bed occupancy levelling in a hospital in Belgium.

12.2 Scheduling a Single Operating Room

The basic problem concerning surgery scheduling is the underlying random-
ness. The duration of an operation is inherently random. The distribution is
often known since most hospitals keep detailed statistics with regard to the
surgeries.

The scheduler of the surgeries in a hospital faces actually two problems.
First, he has to determine in which sequence the operations should be per-
formed. Second, given the sequence, he has to tell the surgeon who will perform
the $k$th operation in the sequence the time at which the operating room will
be made available to him.

In the analysis that follows, the subscript $k$ refers to operation $k$, whereas
the subscript $(k)$ refers to the $k$th operation in a given sequence. So the oper-
ation referred to by subscript $(k)$ does not refer to operation $k$ since operation
$k$ may be assigned to a different position in the sequence.

Assume that, given a sequence of operations, the surgeon who has to per-
form the $(k + 1)$st operation in the sequence is told that the operating room
will be available at time $d_{(k)}$ (i.e., $d_{(k)}$ may be regarded as a form of due date