Chapter 27
Operating Room Management in Health Care:
Operations Research and Artificial Intelligence Approaches

Irem Ozkarahan
Troy University – Montgomery, USA

Emrah B. Edis
Celal Bayar University, Turkey

Pinar Mizrak Ozfirat
Celal Bayar University, Turkey

ABSTRACT

Surgical units are generally the most costly and least utilized units of hospitals. In order to provide higher utilization rates of surgical units, scheduling of operating rooms should be done effectively. Inefficient or inaccurate scheduling of operating room time often results in delays of surgery or cancellations of procedures, which are costly to the patient and the hospital. Therefore, operating room scheduling and management problems have been an important area of research both for operations researchers and artificial intelligence researchers since the 1960s. In this chapter, the operations research and artificial intelligence solutions developed for operating room scheduling problems in the operational level are examined and discussed. The studies are classified according to the approaches employed. The chapter is aimed to be helpful for researchers who are willing to make contributions in this area as well as the practitioners who are looking for efficient and effective ways to handle the operating room management problem of their own.

1. INTRODUCTION

As the world population increases, reduction of health care costs is of paramount importance. During the past decades, a lot of research is carried out to develop less costly hospital systems that can maintain or even improve the quality of health care.

Surgical unit is a potentially major area of hospital cost containment for three reasons. First reason is that surgical units are generally the most costly and least utilized units of hospitals. Second reason is surgical patients make up a significant part of the demand of other hospital departments. Therefore, high utilization of a surgical unit is extremely important in meeting the increasing demand for health care services and decreasing the costs to improve quality of services. Thirdly, surgical unit directly affects other operations of the hospital such as resource management, financial management, purchasing, and many other areas along with the patients' waiting times. Therefore, it has great potential of reducing costs also in these areas.

In order to provide higher utilization rates of surgical units, scheduling of operating rooms should be done effectively. Inefficient or inaccurate scheduling of operating room time often results in delays of surgery or cancellations of procedures, which are costly to the patient and the hospital. Patient whose surgery is delayed may end up being lost to the system that may occur in the form of having the surgery done in another hospital or country, giving up, becoming emergency case if his/her health deteriorates, and death.

Now more than ever, the healthcare industry needs to respond to challenges in its environment. The constant increase in number of patients and surgeries require new unconventional methods that aim increasing the efficiency of operating rooms.

Looking at all these reasons, operating room scheduling and management problem has been an important area of research both for operations researchers and Artificial Intelligence (AI)

researchers since 1960s. Early studies in this area are mostly about the characterization and setting of the problem whereas with the evolving computer technology recent studies employ some very successful Operations Research (OR) and/or AI solutions.

OR may be defined as a scientific approach to decision making. It aims to support solving real world problems in a wide variety of application areas, using mathematical and computer modeling. The future of OR is clearly tied to its ability to use the computer technology effectively while devising methods and techniques that will enable organizations to improve productivity and quality.

AI on the other hand is the application of methods of heuristic search to the solution of complex problems that defy the mathematics of optimization, contain non-quantifiable components, involve large knowledge basis, incorporate the design of alternative choice, and admit ill-specified goals and constraints. The characterization of AI does not set very definite boundaries. It emphasizes the aspiration of AI to deal with all the aspects of decision making that stretch beyond the limits of classical OR.

A careful integration of OR and AI to problem solving shows significant promise for improving the capability and notably the acceptability of problem solving systems. In other words, this integration provides representations that are expressive enough to describe real-world problems and at the same time guarantees efficient and fast solutions.

In this chapter, the OR and AI solutions proposed since the very early studies in 1960s for operating room scheduling and management in the operational level are classified and summarized. The reader may refer to Cardoen et al. (2010) and Guerriero and Guido (2011) for a more detailed review on operating room planning and management. However, Cardoen et al. (2010) restrict their survey with the studies that are published between the years 2000 and 2010 and furthermore does not give much emphasis to OR and AI solution

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