

Physician Scheduling in Emergency Rooms

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Abstract. We discuss the problem of constructing physician schedules in emergency rooms. Starting from practical instances encountered in five different hospitals of the Montreal (Canada) area, we first propose generic forms for the constraints encountered in this context. We then review several possible solution techniques that can be applied to physician scheduling problems, namely tabu search, column generation, mathematical programming and constraint programming, and examine their suitability for application depending on the specifics of the situation at hand. We conclude by discussing the problems encountered when trying to perform computational comparisons of solution techniques on the basis of implementations in different practical settings.

1 Introduction

Constructing schedules (rosters) is not an easy task to accomplish in settings where work must be performed 24 hours per day and 7 days a week, such as in police and fire departments, or in emergency rooms of hospitals. The problem that one is faced with is to generate ‘good schedules’ that satisfy many complicated rules, including ergonomic rules as defined by Knaunth [20,21]. As mentioned by Carter and Lapierre [12], ergonomic constraints are very important in order to manage the circadian rhythm of the staff and it is critical to take them into account when building schedules.

In this paper, we focus on the problem of the scheduling of physicians in emergency rooms (ER) in health care institutions where work is continuous. It

is known that ER are a very stressful place for physicians, but it is also a great challenge for them to work in such a place. According to Lloyd et al. [24], 24.5% of physicians in Canadian ER are not satisfied with their jobs. Consequently, making a ‘good’ schedule for physicians in ER is very important. A good schedule for a physician is a schedule that satisfies a large number of the requests he or she may have regarding different issues: total amount of work to be performed, specific timing of shifts, sequencing of shifts, etc.

As already mentioned, building such schedules is quite difficult and it may take up to several weeks for a human expert to generate an acceptable solution [3]. In order to reduce time and effort, an automated approach is therefore imperative.

Besides the biological and psychological effects involved in the scheduling of physicians, one must also pay careful attention to the fairness of the schedules among physicians. This important aspect is unfortunately very difficult to address because it involves balancing the distribution of different types of shifts among physicians with respect to several criteria that often conflict.

In this paper, we give an overview of the typical constraints that may be encountered in physician scheduling by building on the lessons learned from five practical cases encountered in hospitals of the Montreal (Canada) area: Jewish General Hospital (JGH), Charles-Lemoyne Hospital (CLH), Santa-Cabrini Hospital (SCH), Sacré-Coeur Hospital (SaCH), and Côte-Des-Neiges Hospital (CNH). An important purpose of the paper is to formalize the specific constraints of these five settings into ‘generic constraints’ that could be used to describe problems in other practical contexts. We also review major approaches for solving the problem: mathematical programming, tabu search, constraint programming and column generation.

The remainder of this paper is organized as follows. In Section 2, we define more precisely the problem of scheduling physicians in ER and review the relevant literature. In Section 3, we propose the generic constraints that capture the essence of the various constraints encountered in the five physician scheduling case studies. Section 4 is devoted to solution approaches. We briefly discuss the similarities and differences between physician scheduling and nurse rostering problems in Section 5. Finally, we conclude in Section 6.

2 Problem Definition and Literature Review

In the health care area, there are two important types of scheduling problems that involve medical staff: nurse scheduling problems and physician scheduling problems. In the first category of problems, nurses work under collective agreements, while in the second category, there are no such rules for physicians. Moreover, in the nurse staff problem, one has to maximize their individual satisfaction and minimize the cost of salaries, whereas in the physician staff problem, one only cares about the maximization of their individual satisfaction. Despite these differences between nurse and physician problems, their formulations are not very different. Indeed, according to Rousseau et al. [27], a pure mathematical