Managing Operating Room Cost in Cardiac Surgery with Three Process Interventions

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INTRODUCTION

Health care providers in both public and private sectors are facing increasing pressure to improve their cost efficiency and productivity. The increasing cost of new technological solutions has enforced the application of operations management techniques developed for industrial and service processes. Meyer's (2004) review of existing research shows that, on average, operating rooms (ORs) operate only at 68% capacity. Using OR time efficiently is especially challenging when long operations are scheduled to fixed OR block time. This situation is typical in open heart surgeries where a high variability in the length of required OR time combined with four and a half hour average OR time duration makes scheduling two operations during a normal eight-hour workday difficult.

The objective of this chapter is to analyze the effect that three process interventions have on the OR cost in ORs performing open heart surgeries. The investigated process interventions are four days OR week (4D), the better accuracy of operating room time forecast (F), and doing anesthesia induction outside the OR (I). These interventions emerged from practical organization context.

This chapter is organized as follows. First we provide a review of the existing literature on measures of OR utilization and the investigated three interventions. Based on existing literature, we construct a simulation model to test the interventions' effects on OR utilization. Conclusions of results are presented, and practical implications and new contributions to existing theory of OR management are discussed.

BACKGROUND

Operating room efficiency is typically defined as raw utilization, which means a percentage of time that patients are in the operating room during resource hours (Donham, Mazzei & Jones, 1996). This definition for OR efficiency, however, does not take into account the cost of overused time, which emerges when operations are stretched. Thus, a more valid measure for OR efficiency is a weighted sum of underused and overused OR time (Dexter, 2003). Estimates for relative cost of overused to underused OR time varies in literature from 1.75 (Dexter, Traub & Macario, 2003) to 4 (Dexter, Yue & Dow, 2006). Besides this relative cost, the total OR cost depends on substitutive tasks for underused OR time. Therefore, when evaluating the effect of various process improvements to OR cost, results have to be calculated with case-specific, relative cost for operating time, underused time, and overused time. In the next section, we consider the estimated interventions from existing literature's point of view.

4 Days OR Week (4D)

Especially in long operations, the lengthening of the OR shift has been mentioned as a relevant method to improve OR utilization. In open heart surgeries, the hypothetical advance will be achieved by reallocating the working hours of Friday to the other four working days. Nearly 10 hours OR block time improves the possibility to schedule two operations per day. Despite statistical advances to lengthen the OR block, it has

been shown that moving to a four-day week might lead to an increase in sick leaves (Dzoljic et al., 2003). In this case, it was assumed, however, that allocating resources for four 10-hour OR sessions per week is more effective than continuing with 8-hour blocks in open heart surgeries.

The Better Accuracy of Operating Room Time Forecast (F)

An accurate modeling of time distribution as well as an estimation of operating room times has been recognized as an important factor in effective OR planning and scheduling systems (May, Strum & Vargas, 2000; Spangler, Strum, Vargas & May, 2004). The more accurately the required OR time for planned operation can be estimated, the more exactly can the OR resource hours be scheduled while still avoiding overtime. Many researches show that forecasting a required OR time for planned operation is difficult (Macario & Dexter, 1999), but the best estimates can be derived from historical surgeon and surgery type-specific durations (Strum, Sampson, May & Vargas, 2000). Determination of individualized operating room times associated with definition of a daily limit in scheduled OR resource hours resulted in reduction of time overruns and delays before surgery (Broka, Jamart & Louagie, 2003). In open heart surgeries, a hypothetical advance of better OR time forecasting was to get more OR sessions with two operations being performed.

Doing Anesthesia Induction Outside the OR (I)

By moving the anesthesia induction outside the OR and doing it simultaneously with a previous operation, an additional operation can be scheduled for fixed OR block time (Friedman, Sokal, Chang & Berger, 2006). The effect of doing anesthesia induction in parallel with a previous case is best when it makes it possible to increase the amount of performed operations from one to two per day. This is a recurring situation in open heart surgeries. On the other hand, parallel processing requires more nursing staff per OR, and that has to be taken account when assessing a total effect of the intervention (Torkki, Alho, Peltokorpi, Torkki & Kallio, 2006).

RESEARCH QUESTIONS AND METHODOLOGY

The research questions of this chapter are:

1. What is the effect of a four-day OR week, the better accuracy of operating room time forecast, and doing anesthesia induction outside the OR, as well as their combinations, on OR cost per patient?
2. How does the relative cost for operating time, slack time, and overtime impact the effects of the interventions?

The effects of three process interventions and their combinations are tested with a discrete-event simulation model on the open heart surgery patient process. Discrete-event simulation enables the evaluation of alternative productivity improvement proposals while maintaining the dynamic nature of the open heart patient queue. The simulation model was constructed based on Kuopio University Hospital (KUH) open heart surgery process.

CASE UNIVERSITY HOSPITAL

Kuopio University Hospital (KUH) has the special responsibility of treating severe illnesses that call for special expertise and technology in the Hospital District of Northern Savo, Finland. The average yearly number of open heart surgeries is about 1,000. One of the focus areas in KUH is to increase productivity in the operation theater, which was identified as one of the resources that limited the throughput of open heart surgeries. KUH offers coronary bypass surgeries for external hospital districts, and it is losing patients to its competitors. Thus, improving productivity of coronary bypass surgeries would directly increase hospital turnover and profitability.

The input data for developing both the operation time forecasting model and the simulation model was the actual data of all the 2,603 open heart surgeries performed at KUH hospital during the years 2001–2003.

Open Heart Operation Time Model

The average operating theater time usage for open heart surgery is more than four hours, with the actual operation

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