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THE ROLE OF BLOCK ALLOCATION AND SURGERY DURATION PREDICTABILITY ON OPERATING ROOM UTILIZATION

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ABSTRACT

Planning for sufficient surgical capacity at a hospital requires that tactical and operational decisions be made before the day of surgery. Typically, blocks of time in operating rooms (ORs) are assigned and specific surgical cases are placed in rooms. The hospital monitors utilization to determine the schedule's effectiveness in balancing the risk of overtime with idle time. We examine how adjusting schedule risk ratios and penalty values, and providing shared, open posting time affected the hospital's ability to identify an efficient but high quality and low cost block schedule. The proposed schedules were tested by assigning surgical cases to ORs and simulating the schedule's performance using recent data from a local hospital. We also show how scheduling accuracy can impact the performance level of the schedules proposed.

1 INTRODUCTION

Improving operating room (OR) efficiency and utilization has become a priority for hospitals during this time of political change and budget cuts. Hospitals are looking to reduce cost without reducing quality of care (Litvak and Long 2000). The OR schedule affects not only costs and OR utilization, but also affects surgeon, staff, and patient satisfaction. Each hospital has different resource constraints, policy limitations, and variance in case scheduling accuracy, so the complexity of reducing inefficiencies can vary greatly from hospital to hospital. Past surgery data can be used to simulate possible outcomes and costs from different schedule options in order to find a schedule that will best suit the hospital.

In this paper, we describe the models used to create surgical schedules and play out scenarios using recent booked and actual lengths of surgery data. We provide a mechanism that allows for flexibility and a range of options to explore when creating a new schedule. We further show how adjustments to OR and block allocation policies can affect critical hospital performance measures.

2 METHODS, ASSUMPTIONS, AND APPROACH

Data from July 2010 to December 2012 was obtained from a level one trauma, teaching hospital in the Southeastern United States of America. The hospital had 26 different service specialties, 3 locations, and 39 ORs. For each surgical case, the data extracted was: the starting date, the time the patient entered and exited the OR, the scheduled surgical beginning and end times, the location, the OR number in which the surgery was performed, the associated specialty group, and the associated case level.

We used CPLEX to determine optimal schedules, room placement, and surgery set allocations. OR, service-specific, and location constraints were included in the models. Surgeries that had a case level of 1A, 1B, 2, or 3 were considered to be part of the Urgent or Urgent/Emergent block time. Surgeries that had a case level of 4 or 5 were considered to be part of the service-specialty block time. All surgeries were allowed to use open posting block time. No surgeries before 6 AM and after 6 PM were included. The average turnover time was added to all surgical cases except the final surgery of the day in an OR. We used twelve months of historical surgery data when creating optimal block hours for each surgery group, and we reserved the next three most recent months of data for the trace-driven simulation analysis.

3 MANAGERIAL INSIGHTS

The models presented can be useful tools for managers looking to make changes to their current OR schedule. The type of schedule preferred will be up to the hospital, although seeing the results from a few schedule options can allow for new ideas to be pursued. We also showed the impact of scheduling inaccuracy and how slight improvements in booking times can make dramatic changes to efficiency levels.

The models presented are flexible in both their parameters and applications. Whether the schedule is being solved weekly or quarterly, and whether the hospital has high or low capacity, this tool can be used to create a less costly and more satisfactory MSS. The goal was not to instruct hospitals how to schedule their rooms and block times, but rather to provide a variety of options for the management to explore. Factors, conditions, and goals may vary from hospital to hospital, so having a flexible model helps to tailor the solution to the environment. We summarize our findings for various risk ratios and encouragement levels in the tables below.

Table 1: Managerial insights for various levels of adversity to overtime.

Code	Risk Ratio	Results and Comments
Low adversity to OT	1.25	Expect higher utilization levels (~85%) and more overtime. Good for services with low variability. Can reduce number of surgical hours booked but increase overtime.
Low-Medium adversity to OT	1.5	Expect higher utilization levels (~82%) and some overtime.
Medium adversity to OT	1.75	Expect utilization levels around the 80% range.
Medium-High adversity to OT	2.0	Expect lower utilization levels (~78%) and some undertime.
High adversity to OT	2.25	Expect lower utilization levels (~75%) and more undertime. Could protect growing or variable services. Can increase number of surgical hours booked but increase undertime.

Table 2: Managerial insights for various levels of encouragement to provide open posting time.

Code	Penalty Value	Results and Comments
High encouragement	0	Almost every block that is not assigned maximum room time is converted into open posting space.
Medium encouragement	0.1	Open posting time is encouraged more but not always used. Good for reducing total number of ORs scheduled.
Medium-Low encouragement	0.12	Open posting time is taken where excess is found. Good for combining a few hours from different services and saving an OR.
Low encouragement	0.2	Very few hours are changed. Can be used as a place to start if open posting is a new or underused concept.
No encouragement	0.3	Block hours remain as assigned.

4 CONCLUSIONS AND FUTURE WORK

In this paper, we provided models and methods to create a surgical schedule and then assigned surgical cases to ORs based on their book lengths. We showed how changing the overtime-to-undertime risk ratio in the initial model affected number of rooms used and average utilization levels. We also showed how the level of open posting time encouragement can affect the number of ORs used and how time was re-allocated. We took the created schedules and simulated results with recent data to show how well they would work. Results from these tests emphasized the impact of open posting rooms and how important scheduling accuracy is to running an efficient OR. These models will give managers options when deciding on a new OR schedule, and should encourage managers to seek more accurate case posting times.