

White spots

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Abstract

Scheduling operating rooms (ORs) is a critical aspect of managing surgical patients, especially in Level 1 trauma hospitals. The management of surgical patients, both in elective and emergency settings, relies on planning and scheduling procedures to reduce cancellations, delays, and negative outcomes. Some authors have found that reserving capacity in all elective operating rooms improves responsiveness to emergencies, reduces overtime, and optimizes overall operating room utilization. This article aims to find a suitable arrangement for the multi-specialistic operating block of the “M. Bufalini” Hospital in Cesena, Level 1 Trauma Center, Italy. The proposal is to remove the OR dedicated to the urgent surgery (US), keeping the one dedicated to emergency sur-

gery (EM), and redeploy them in slots dedicated to elective activity, redefining them as “white spots”. This proposal requires extreme flexibility and adequate communication between surgical specialties.

Introduction

Operating rooms (ORs) are primary income sources for hospitals, but they also represent significant cost centers. Planning surgeries is a complex task for hospitals; they must balance the importance of carrying out scheduled elective surgeries (ESs) with the requirement to handle emergency cases.¹

This challenge is especially stressed at Level 1 trauma hospitals because of the significant uncertainties in the arrival of patients who require emergent surgery.

The efficient management of surgical patients, whether for elective or emergency procedures, relies heavily on the planning and scheduling of surgeries. This is crucial for minimizing cancellations, treatment delays, and unfavorable results.²

When dealing with non-elective patients, a differentiation can be made between urgent and emergent surgery based on the estimation of the patient's arrival (*i.e.*, the waiting time until the start of the surgery). The surgery of emergent patients (emergencies) must be performed as soon as possible, whereas urgent patients (urgencies) refer to non-elective patients that are sufficiently stable so that their surgery can possibly be postponed for a short period.³

Several new triage systems have been proposed to improve the management of emergency surgical patients. For instance, the TACS (timing in acute care surgery) classification was developed to enhance the accuracy of patient sorting based on condition severity and the reproducibility of the classification.⁴ The updated TACS features six color-coded classes linked to optimal surgery timing, specific scenarios, patient condition, and surgical diseases. Assigning a patient to a color code indicates the severity of the condition and the ideal surgical timing to the anesthesiologist and the operating room team. A clear clinical pathway and timely, suitable surgical interventions can improve outcomes and decrease healthcare system costs.⁵

Handling emergency cases can be particularly challenging, as urgent requests can arise at any time, necessitating immediate allocation of operating room resources.

In hospitals, emergency surgeries (EMs) are accommodated through various OR policies: 1) a dedicated emergency operating room ensures immediate surgery when available; otherwise, the patient may have to wait; 2) EMs can be accommodated in elective operating rooms after ongoing elective surgeries (ESs); 3) if the emergency room (ER) is busy, patients may have to wait for

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availability in emergency or scheduled operating rooms.^{6,7}

Balancing the allocation of operating rooms, staff, and equipment for both elective and non-elective surgeries presents a complex logistical challenge for hospitals.⁸ Researchers have observed that dedicating a specific operating room for acute surgical cases at a children's hospital led to reduced wait times, while the impact on surgical timeliness for certain procedures was not as significant in other studies.^{9,10}

Yazdi *et al.*⁶ presented a mathematical model for scheduling electives and emergencies. They designed surgeries as multi-activity projects, utilizing the break-in-moments (BIMs) technique, and demonstrated that this approach effectively reduces the waiting time for EMs to be scheduled without needing a dedicated operating room solely for emergencies. In this way, there is a balance between efficient OR utilization and responsiveness for EMs.

Indeed, not opening another OR can be more economically preferable as it helps reduce OR suite staffing costs. However, the cost of running a simultaneous second OR may not be greater than running one OR for a longer period, depending on how the staff are paid. For example, some OR suites employ part-time nurses who do not receive overtime pay and do not have a minimum number of work hours per day, along with fee-for-service anesthesiologists. Under this compensation structure, opening an additional OR to complete urgent cases sooner would not result in any additional costs.¹¹

Wullink *et al.*¹² searched the efficacy of reserving a dedicated operating room *versus* reserving capacity in all elective operating rooms to enhance responsiveness to emergencies. Using discrete-event simulation, they found that spreading the reserved capacity across multiple operating rooms led to significant improvements in responsiveness, reduced overtime, and enhanced overall operating room utilization.

State of the art

The objective of this article is to find a useful arrangement for the multi-specialistic outpatient building (OB) of the Surgical Unit "M. Bufalini" Hospital of Cesena, Level 1 Trauma Center, Italy.

This hospital, a 1st-level trauma center, has three more OBs: one completely dedicated to orthopedic surgery (2 OR), one to neurosurgery (2 OR), and one for delivery and cesarean section (2 OR).

We didn't include in our OR management proposal these three OBs since the scientific literature demonstrated it is an appropriate

strategy to keep an OR dedicated to urgent surgery (US) in all three areas, both for budget management and patient safety.¹³

The multi-specialist OB has eight operating rooms, each with a variable number of healthcare workers (ranging from 6 to 10), including surgeons, anesthesiologists, and nurses. The OB works 7 days a week. One OR is dedicated to trauma, while another is designated for EM. Elective surgeries are performed in the remaining six operating rooms 6 days a week for 12 hours each day.

In our OB, the order of priority of the patients who need to undergo EM follows the "color code" rules.⁸ Normally, trauma and EM exceed 20% of the elective activities.

According to the length of the surgeries in ES and US, we can classify them into three categories: 1) "Short": duration ≤ 90 mins; "Intermediate": 90 mins < duration ≤ 180 mins; "Long": duration > 180 mins.

A retrospective analysis on USs in our OB has shown that 80% of these are short or intermediate.

Proposal plan

This article proposes removing the OR dedicated to the US and keeping the one dedicated to trauma to prevent the assistance activity for major trauma from being affected.

The OR dedicated to EM runs simultaneously with the trauma activity for only 12 hours a day so that it can be ideally split into eight short slots arranged in vertical projection (Figure 1). The suggested plan is to redeploy those eight slots in different ORs dedicated to the elective activity in a horizontal projection, calling them "white spots" (Figure 2). The distinct white spots shall be placed to always guarantee a free slot for EM within the whole OB.

According to this arrangement, each surgical specialty loses one or more slots in its daily elective OR. The entire OB gains an OR consisting of eight slots, distributed in advance among the various specialty surgeries.

In the event of USs waiting in line, the first available slot will be assigned according to the rules of the color code system.

There are some steps before a patient is ready for US: the patient, receiving a diagnosis in the ER or in other wards, is first admitted to the surgical ward, then undergoes the first necessary work-up before the surgery, and finally, the patient is sent to the OB. The whole process never takes more than 60 min. If the free slot (the white spot) does not overlap with an US request, the unit can continue its elective activities. This organization presupposes the establishment of an extremely flexible system.

US	EM	ES	ES	ES	ES	ES	ES
1h 30min	Dedicated	4h	2h	6h	6h	10h	3h
1h 30min		2h	2h	1h	6h	2h	3h
1h 30min		6h	2h	1h			3h
1h 30min			3h	1h			3h
1h 30min			2h	1h			
1h 30min			1h	2h			
1h 30min							
1h 30min							
TOT = 12h		TOT = 12h	TOT = 12h	TOT = 12h	TOT = 12h	TOT = 12h	TOT = 12h

Figure 1. State of the art.

US	EM	ES	ES	ES	ES	ES	ES	ES
1h 30min	Dedicated	1h 30min						
1h 30min			1h 30min					
1h 30min				1h 30min		REARRANGED		
1h 30min		REARRANGED			1h 30min			
1h 30min						1h 30min		
1h 30min				REARRANGED			1h 30min	
1h 30min								1h 30min
1h 30min		1h 30min						
TOT = 12h		TOT=12h	TOT=12h	TOT=12h	TOT=12h	TOT=12h	TOT=12h	TOT=12h

Figure 2. Proposal plan.

Conclusions

Some authors have proposed the use of specialized operating rooms for USs. Nevertheless, this may not always be practical or effective in high-capacity facilities and has demonstrated varied outcomes in terms of wait times.¹⁴

It is easier to have a dedicated operating room for US rather than evenly reserving capacity for EM in all elective operating rooms regarding raw utilization, overtime, and the number of operating rooms running late. However, it's important to note that these benefits specifically apply only to ES activity.¹⁵

Although the US dedicated room allows prompt access to specific technology devices, it is common practice that the human resources dedicated to it in periods of inactivity are reallocated to other tasks to compensate for the staff shortage. Doctors could be employed in different activities like consulting and training, and nurses could be employed in organizational activities relevant to the OB. Hence, when the EM room is needed for an urgent case, it is possible that the team is not immediately ready and available. Implementing "white spots" would alleviate this problem, as the EM team is the same as the ES team during the same time slot. Level 1 trauma centers provide extensive care for a wide range of injuries, ensuring continuous coverage by general surgeons around the clock. They also offer quick access to orthopedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology, internal medicine, plastic surgery, oral and maxillofacial surgery, pediatric care, and critical care. Despite the wide range of trauma cases, current literature often focuses on a single surgical specialty.¹⁴

There is an issue related to having a dedicated OR for EM, the surgical specialty with the highest priority overall. Obviously, specialties dealing with less acute conditions are consistently postponed (e.g., non-evolving green and blue codes). On the other hand, distributing USs across all elective operating rooms in a horizontal projection could allow them to be performed simultaneously, albeit at the expense of delaying lower-priority cases.

The "white spots" operational proposal requires extreme flexibility on the part of all the personnel involved and adequate communication between the various surgical specialties.

Cardoen *et al.*⁶ emphasized that most of the research has been primarily focused on planning and scheduling for elective patients. While elective patient cases can present complex problems, the arrival of non-elective patients tends to cause major organizational operational deficiencies. There is a lack of extensive research regarding scheduling non-elective patient appointments.

To advance this article proposal, an experimental phase will ultimately be required through the implementation of a discrete-event simulation model.

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