



Operating room efficiency



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ABSTRACT

The operating room is the financial hub of any hospital, and maximizing operating room efficiency has important implications for cost savings, patient satisfaction, and medical team morale. Over the past decade, manufacturing principles and processes such as Lean and Six Sigma have been applied to various aspects of healthcare including the operating room. Although time consuming, process mapping and deep examinations of each step of the patient journey from pre-operative visit to post-operative discharge can have multiplicative benefits that extend from cost savings to maintaining the focus on improving quality and patient safety.

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Introduction

The operating room (OR) is the financial nexus of the modern hospital, accounting for up to 40% of a hospital's costs and 60–70% of revenue.¹ It also represents an important interface between surgeon, patient, consultants and the community. With significant revenue at stake and operating costs conservatively estimated at \$15–\$50/minute,^{2,3} we all have a strong vested interest in maximizing OR efficiency. Beyond simple financial savings, improving OR efficiency can have myriad salutatory secondary benefits including improved patient safety, increased OR throughput, and improved patient, surgeon and staff satisfaction (Fig. 1). These benefits may translate into a competitive advantage in the healthcare market.

What drives OR efficiency? Or, perhaps better asked, what factors lead to OR inefficiency? This list is long, but includes human resource and material issues, limited availability and application of information technology, schedule variation, and impaired process flow. Variety in patient types, operation types, and multiplicity of surgeons and other proceduralists can make the task of maximizing efficiency daunting. In pediatric surgery, one must add the variability introduced by patients of a wide range of sizes and ages, congenital comorbid conditions, specialized surgical procedures, and the addition of parents as a special form of “co-patient.”

And how can we affect OR efficiency in a positive manner? The past decade has seen the wide adoption of manufacturing industry

principles aimed at reducing waste, standardizing production steps, and lowering personnel costs. Probably the most commonly applied principles are those of the Lean and Six Sigma methodologies, but other processes have been applied to the healthcare industry, including lessons learned from aviation safety (Team STEPPS), computerized scheduling, and eliminating constraints (avoiding “bottlenecks”).

This review will examine the major industry lessons that have been applied to healthcare, look at some successful approaches to increasing efficiency, discuss some of the challenges particular to pediatric surgery, and make some recommendations for consideration by individuals interested in improving any aspect of OR efficiency.

Operating room complexity

The OR is a complex environment comprising multi-layered social interactions, unpredictability, low tolerance for mistakes, and high expectations.¹ It is at once inconceivable that the OR environment allow for an efficient, streamlined perioperative experience and paradoxically completely unacceptable that it not approach perfection.

A major part of an OR's complexity stems from unpredictability. Patient factors unexpected violations of preoperative instructions about timeliness of presentation, fasting periods, or medical clearance may prompt last-minute cancellation. As in any type of pediatric care, viral respiratory illnesses can raise concerns regarding pulmonary health of a child and increase risks of anesthesia. In addition, a case itself will often produce surprise delays due to complexity, intraoperative complications, or even such mundane

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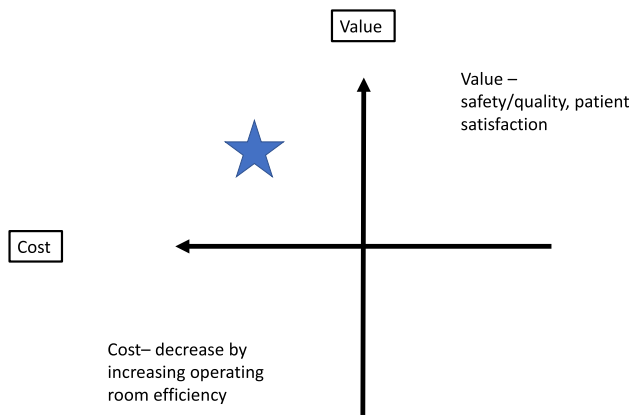


Fig. 1. Value cost proposition.

things such as difficulty in obtaining intravenous access that is common in young or recidivist patients. Surgeon factors include case start delays due to conflicting tasks and poor communication with staff about equipment needs. These same factors are applicable to anesthesiologist, with the added possibility of the individual's being responsible for supervising multiple ORs at once and being unavailable for an on-time case induction. System factors include myriad challenges from delayed transport, missing paperwork, inability to locate preoperative laboratory tests, missing equipment, and case flow interruption due to staff turnover for meal or other breaks (see Wakeman and Langham's comments on this topic in the Team Dynamics chapter of this *Seminars in Pediatric Surgery* issue).

OR efficiency also requires that cases be booked appropriately, with case length and complexity appropriately predicted, and available block time used to capacity to avoid leaving OR staff unused and OR rooms lying idle. A large literature on OR room utilization points to the need for adequate communication between surgeon and office staff in the time period before an operation, as well as minute-to-minute communication between the control desk and surgeons, staff and patients on the day of surgery. In addition, several studies in OR utilization have suggested that using surgeon-specific metrics to predict OR case time may not be as effective in pediatric surgery as in adult surgery.⁴

Last is the challenge of appropriate staffing. The OR must be overstaffed to allow provide flexibility for unanticipated crises or the addition of an emergent case. Yet financial restraints may dictate understaffing to avoid paying staff who are not actively engaged in patient care or OR preparation. In this aspect, there is a clear parallel to trauma triage to maximize specificity and sensitivity of anticipated staffing requirements.

Metrics of OR efficiency

Multiple measures of OR efficiency have been proposed, although no single one appears to represent every aspect of efficiency from the perspectives of the multiplicity of stakeholders including nurses, surgeons, anesthesiologists, patients/families, hospital administrators, regulatory bodies and payors. Most institutions will select different combinations of metrics based on local custom and requirements. The Canadian Paediatric Wait Times Project, launched at 15 pediatric centers in 2007, identified the following metrics,⁵ many of which are familiar:

- Off-hours surgery – may result from urgent add-on cases or case over-runs, each requiring different solutions
- Same-day cancellation rate – it can be helpful to classify cancellations by cause as well as time of day in seeking to reduce this rate

- First case start-time accuracy – most hospitals allow a 5-minute grace period for this metric; a more accurate reflection of start time accuracy is probably incision time, a measure of true patient readiness,⁵ although this can be influenced both by patient complexity and lack of OR team preparedness (e.g., when one or more of the members are not physically present when the patient is ready for incision)
- OR use – one can distinguish between overall utilization (time something is occurring in the OR, whether actual operation or turnover activities) and operating-specific utilization (time spent between first incision and final closure as a percentage of the room's overall "open" period)
- Percentage of unplanned closures – these may occur due to unanticipated staff or equipment deficits, cleaning requirement for infection control, or equipment malfunction (such as oxygen supply deficit, or overhead light malfunction)
- Case duration accuracy – it is useful to distinguish between true case time (the interval between patient entry and exit) and turnover times in order to find intervention targets
- Turnover time – the interval between patient exit and next patient entry, although this assumes that a patient is always available for immediate entry once a room is cleaned and ready
- Excess staffing costs – unanticipated staffing costs can result from both over-utilization (a case goes beyond a planned OR day, requiring that either additional nurses be called in or the existing nurses be paid overtime salary) and underutilization (paying nurses to fill a scheduled shift when too few cases are booked or the case times are inappropriately long)

Approaches to evaluating the OR process

Various methods to evaluate OR processes exist, all centering on data collection, analysis, evaluation with iterative correction, and dissemination to staff and institution. Process mapping is the method by which each large process is broken down into component parts, which are in turn dissected for areas for improvement. Multiple groups have described this process, including Russ and colleagues, who created the Metric for Evaluating Task Execution in the Operating Room (METEOR) tool to measure task completion in the perioperative process for basic procedures.⁶ METEOR is comprised of 80 tasks that were felt to represent well-established processes of care, broken down into three tasks – patient, equipment/provision, and communication – for each of the familiar OR phases of care –preoperative, intraoperative, and postoperative. Although not yet validated in prospective larger studies to measure its impact on the OR efficiency, the described breakdown offers a comprehensive taxonomy typical of most operations and provides opportunities for improvement.

Another approach to assessing processes in healthcare is time-driven activity-based costing (TBABC).⁷ Traditionally, activity-based costing was challenging in healthcare as each activity must have a cost assigned. One can imagine that in an OR, there are dozens of activities being performed simultaneously and many of these activities do not have a discrete price tag. TBABC simplifies the process of cost accounting in healthcare by using more streamlined estimates of costs and incorporating time spent caring for a patient. Thus, TBABC is as much a metric of efficiency as it is for costs. TBABC has been used to help improve efficiency in clinics and with overall operating room utilization.^{8–10}

The preoperative phase

Preoperative medical clearance is among the most important modifiable factors that can help avoid unnecessary cancellations

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