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# Improved Operating Room Efficiency via Constraint Management: Experience of a Tertiary-Care Academic Medical Center



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**BACKGROUND:** Suboptimal operating room (OR) efficiency is a universal complaint among surgeons. Nonetheless, maximizing efficiency is critical to institutional success. Here, we report improvement achieved from low-cost, low-technology measures instituted within a tertiary-care academic medical center/Level I trauma center.

**STUDY DESIGN:** Improvements in preadmission testing and OR scheduling, including appointing a senior nurse anesthetist to help direct OR use, were instituted in March 2012. A retrospective review of prospectively maintained OR case data was performed to evaluate time periods before and after program implementation, as well as to assess trends over time. Operating room performance metrics were compared using Mann-Whitney and chi-squared tests. Changes over time were analyzed using linear regression.

**RESULTS:** Data including all surgical cases were available for a 36-month period; 10 months (6,581 cases) before program implementation and 26 months afterward (17,574 cases). Dramatic improvement was seen in first-case on-time starts, which increased from 39.3% to 83.8% ( $p < 0.0001$ ). Additionally, the percent utilization of available OR time demonstrated a steady increase ( $p < 0.001$ ). After an initial lag, case volume also improved, evident by an increase observed in the 12-month rolling average of cases per month ( $p < 0.001$ ). The increase in case volume occurred during peak OR time (7 AM to 5 PM), and did not result from adding cases after hours (5 PM to 11 PM).

**CONCLUSIONS:** After many years of what seemed an insoluble problem, simple changes fostering collaboration among services, including active management of the OR schedule and transparent data, have resulted in substantial improvement in OR efficiency and case volume. (*J Am Coll Surg* 2015;221:154–162. © 2015 by the American College of Surgeons)

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Decreasing reimbursements and an increasing have forced health care organizations to become more efficient providers of care. Operating room (OR) performance has come under particular scrutiny. As one of the largest

contributors to a hospital's financial success, a productive OR is critical to institutional viability. Beyond financial considerations, suboptimal OR efficiency also decreases physician satisfaction and can result in low workforce morale.

Improving OR efficiency can be a challenging task. The OR is a very complex environment, and multiple factors have been identified that contribute to inefficient care delivery. These factors encompass a broad spectrum, including patient scheduling, preoperative care pathways, OR management, and postoperative recovery.<sup>1,2</sup> Additionally, the human element comes into play, with physician availability, nurse staffing, and other ancillary personnel contributing to the complexity of the OR environment. To improve efficiency, multiple strategies have been described in the literature.<sup>3-7</sup> Many authors have evaluated interventions

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### Abbreviations and Acronyms

CRNA	= Certified Registered Nurse Anesthetist
FCOT	= first-case on-time
OR	= operating room
QI	= quality improvement
TOC	= Theory of Constraints

aimed at isolated problems: turnover time, percent on-time starts, case volume, and OR utilization have all been popular metrics for study.<sup>4,8-10</sup> Although many of these studies show positive results, there has been no consensus as to the best strategy to improve efficiency. In addition, several require investment in expensive new technologies, with the assumption that any cost incurred will be balanced by gains in productivity.<sup>11,12</sup>

In recent years, there has been a rising emphasis on management strategies that target inefficiencies by focusing on the overall process of care delivery.<sup>13</sup> Many of these quality improvement (QI) strategies are adapted from the business and manufacturing sectors. For example, Lean and Six Sigma methodologies frequently are applied to health care and surgery.<sup>14</sup> In general, these strategies aim to standardize care in an effort to eliminate any wasteful steps that decrease overall quality and efficiency. These complex methods generally require investment in staff training or data collection, and can involve hiring additional project managers or consultants.<sup>15</sup> Although many studies have reported success across a variety of metrics with these strategies, they can be difficult to implement and detailed cost-effectiveness data are lacking.<sup>16</sup> The cost and complexity intrinsic to implementing these advanced QI measures can be unrealistic for some institutions.

Given the heterogeneity of the literature, no predominant QI strategy has emerged and clear recommendations have yet to be defined.<sup>17</sup> This has led some authors to apply the Theory of Constraints (TOC) to health care. According to this philosophy, systems can be held up at bottlenecks (ie, constraints) and process improvements occur by concentrating efforts on these areas.<sup>18</sup> The theory outlines a simple, logical approach to these problems. After identifying the constraint, there is a stepwise progression from improvements through the use of existing resources, to realigning the overall system to alleviate the constraint, to considering entirely new actions that might be necessary to address the constraint. Importantly, the process should be repeatable to avoid inertia, and inherent to TOC methodology is the ability to address constraints as they arise.<sup>19</sup> This aspect is particularly appealing, given the complexity of the OR system.

In this study, we hypothesized that application of TOC techniques could result in improved performance in our

OR. Here we report the results of straightforward initiatives undertaken by an academic medical center aimed at improving OR performance and efficiency. These measures were driven by low-cost, low-technology solutions, and were derived from simple, common-sense approaches that addressed system constraints in real time.

## METHODS

### Setting

The University of Louisville Hospital is a tertiary-care academic medical center located in Louisville, KY. The hospital includes close to 400 beds and a Level I trauma center. As the principal provider of indigent care in the region, the hospital serves a relatively large uninsured population in addition to insured patients. There are 14 main ORs, with an annual volume of approximately 8,000 cases. One OR is reserved principally for acute trauma, and the remaining 13 are mixed use and accommodate elective, urgent, and emergency cases. Rooms are not strictly service based, although block time is proportioned by service and use is regularly reviewed. No major changes in block time allocation occurred during the study period. Typically, one room is reserved to accommodate overflow and add-on cases. The end result is that most rooms are available for use by all services, allowing a degree of flexibility in scheduling cases.

### Quality improvement initiatives

The principal campaign to improve OR efficiency was launched in March 2012. Initially, the primary focus of the campaign was to improve first-case on-time (FCOT) starts and OR throughput. However, preliminary groundwork with additional improvements was performed before March 2012.<sup>20</sup> These initiatives included improved data collection and dissemination, changes in OR governance, and new procedures in preoperative scheduling and testing.

### Operating room governance

Initially, the OR manager began working with leaders from different sections of the OR and perioperative care units to identify areas where change was necessary. Several areas were subsequently addressed to help improve workflows (see Perioperative initiatives section, below). In addition, a new perioperative management team consisting of multiple stakeholders from different parts of the hospital was created. The team consisted of department chairs from anesthesia and the surgical services; administrators, including OR managers and perioperative nursing managers; a representative from quality and patient safety; and a few interested senior-level surgeons and anesthesiologists.

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