

Are Your Hospital Operating Rooms “Efficient”?

A Scoring System with Eight Performance Indicators

LAST month, an anesthesiologist at a nearby community hospital phoned me to ask, “We are in discussion with the CEO about bailing us out of our financial woes. How can I figure out if our operating rooms (ORs) are efficient?” This question is increasingly common as hospitals and anesthesia groups negotiate contracts/stipends, hospitals build large expansions and want to open more ORs at 07:00 even though there are gaping holes in the current schedule, and hospitals aim to minimize complaints from the surgeon customer.

The question “Are my ORs efficient?” could be addressed *via* several methods. For example, statistical process control

could be used to prospectively monitor a dashboard of items, such as the fraction of first cases of the day that start on time.¹ In this month’s ANESTHESIOLOGY, Seim *et al.*² studied nonoperative times between cases performed back-to-back by the same surgeon. The OR of the Future used by the investigators offers a nice experimental setting to show that nonoperative times improved with parallel processing of OR tasks (*e.g.*, induction of anesthesia at the same time as the OR is getting cleaned). This required additional OR staff and an induction area.

Alternatively, “Are my ORs efficient?” could be answered with a more qualitative approach by administering a written survey to OR personnel. An example of such a survey is in the appendix. However, surveys of this type have not been validated scientifically.

I recommend that determining a hospital OR suite’s efficiency should involve gathering data already available in OR information systems for analyses, without the need for an on-site consultant to collect data (until later if needed). Fortunately, the published literature to help us pinpoint which analyses can and should be done is growing. In the past decade, more than one hundred OR

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Table 1. A Scoring System for OR Efficiency

Metric	Points		
	0	1	2
Excess staffing costs	Greater than 10%	5–10%	Less than 5%
Start-time tardiness (mean tardiness of start times for elective cases per OR per day)	Greater than 60 min	45–60 min	Less than 45 min
Case cancellation rate	Greater than 10%	5–10%	Less than 5%
PACU admission delays (% of workdays with at least one delay in PACU admission)	Greater than 20%	10–20%	Less than 10%
Contribution margin (mean) per OR hour	Less than \$1,000/h	\$1,000–2,000/h	More than \$2,000/h
Turnover times (mean setup and cleanup turnover times for all cases)	Greater than 40 min	25–40 min	Less than 25 min
Prediction bias (bias in case duration estimates per 8 h of OR time)	Greater than 15 min	5–15 min	Less than 5 min
Prolonged turnovers (% of turnovers that are more than 60 min)	Greater than 25%	10–25%	Less than 10%

OR = operating room; PACU = postanesthesia care unit.

management articles have been published. What have we learned from these packets of information? What endpoints truly are important?

T1

A simple scoring system to assess how well an OR suite is functioning from the hospital's perspective is summarized in table 1. The required data are readily available in any OR information system. The eight objective metrics listed were chosen subjectively based on my synthesis of the relevant literature. Surgeon satisfaction is also critical, but no valid and reliable instrument to measure this has been developed.

This standardized method could be used by OR managers for evaluating baseline performance and identifying areas needing improvement. I would expect poorly managed OR suites to score 0–5 points (on the 0–16 scale), whereas high scores of 13–16 are achievable, especially with state-of-the-art management systems in place. Whether statistical process control as used by Seim *et al.*² can be used to assess changes in each of the metrics deserves further study.

Certainly, safety and patient outcome cannot be compromised when aiming for a more efficient OR suite.

Below I explain each of the metrics in the scoring system. I acknowledge that some metrics are related to one another, and some (e.g., excess staffing costs) are more important than others even though the point system weights the metrics equally.

Excess Staffing Costs due to OR Allocation Not Being Based on Maximizing OR Efficiency

Nothing is more important in OR management than to first allocate the right amount of OR time to each service on each day of the week. To illustrate this, imagine that two cases each lasting 2 h are scheduled into OR No. 1 with OR nurses and an anesthesiologist scheduled to work an 8 h day. The matching of workload to staffing has been so poor that little can be done

the day of surgery to increase the efficiency of use of the nurses and anesthesiologists. Neither awakening patients more quickly nor reducing the turnover time, for example, will compensate for management's poor initial choice of staffing for OR No. 1 and/or how the cases were scheduled into OR No. 1.

Optimal allocation of OR time needs to be based on historical use by a particular service (*i.e.*, unit of OR allocation such as surgeon, group, department, or specialty) and then using computer software to minimize the amount of underutilized time and the more expensive overutilized time.³ The excess staffing cost⁴ in the above example would be 50%. On the other hand, if 9 h of cases are performed in an OR with staff scheduled to work 8 h, the excess staffing cost is 25% (1 h/8 h = 12.5% multiplied by the additional cost of staying late, which we often assume to be approximately 2; part of that is overtime cost and part is recruitment and retention costs related to unhappy staff because they have to stay late).

Operating room suites can reasonably aim to achieve a staffing cost that is within 10% of optimal (*i.e.*, workload is perfectly matched to staffing). Importantly, for elective cases, increasing the duration of time patients have to wait to have surgery has an important effect on improving OR use because cases can be placed better. From computer simulation studies, this seems to be true in particular if average waiting time is greater than 2 weeks.

Start-time Tardiness (Mean Tardiness of Start Times for Elective Cases per OR per Day)

Reducing the time patients have to wait for their surgery after they arrive at the hospital (especially if the preceding case runs late) is another important goal for the OR manager. If a case is supposed to start at 10:00 AM (patient enters OR) but the case starts at 10:30 AM instead, then there is 30 min of

tardiness. In computing this metric, no credit is given if the 10:00 AM case starts early (e.g., at 9:45 AM).

The tardiness of start of scheduled cases should total less than 45 min per 8-h OR day in well-functioning OR suites. To achieve this, the OR manager can (1) properly determine when patients should be told to arrive, so as not to be too early or late; (2) schedule appropriate delays between successive cases; (3) move cases among ORs when a preceding surgeon's case in the same OR is running late; and (4) sequence each surgeon's list of cases in the same OR on the same day, with the most predictable case first and the least predictable (often the longest) case last.⁵ Facilities with long work days will have greater tardiness because the longer the day is, the more uncertainty there is about case start times.

Case Cancellation Rate on Day of Surgery

Cancellation rates vary among facilities, depending partly on the types of patients receiving care, ranging from 4.6% for outpatients⁶ to 13%.⁷ Many cancellations are due to nonmedical problems such as a full intensive care unit, surgeon unavailability, or bad weather (less common in Palo Alto, California). OR cancellation rates can be monitored statistically,⁸ and well-functioning OR suites should have cancellation rates of less than 5%.

Postanesthesia Care Unit Admission Delays (% of Workdays with at Least One Delay of 10 min or Greater in Postanesthesia Care Unit Admission because Postanesthesia Care Unit Is Full)

It is important to adjust postanesthesia care unit nurse staffing around the times of OR admissions. Algorithms exist that use the number of available nursing hours to find the staffing solution with the fewest number of understaffed days.^{9,10}

Contribution Margin (Mean) per OR Hour

An OR suite that puts up with excessive surgical times can schedule itself efficiently but still lose its financial shirt if many surgeons are slow, use too many instruments or expensive implants, and so forth. These are all measured by the contribution margin per OR hr. The contribution margin per hour of OR time is the hospital revenue generated by a surgical case, less all the hospitalization variable labor and supply costs. Variable costs, such as implants, vary directly with the volume of cases performed.

Theoretically, any case with a contribution margin greater than 0 that can be done safely is financially worth doing to a facility. This is because fee-for-service hospitals have a positive contribution margin for almost all elective cases mostly due to a large percentage of OR costs being fixed. For US hospitals not on a

fixed annual budget, contribution margin per OR hour averages \$1,000–2,000 per OR hour.^{11–13} Contribution margin is, of course, insurance mix dependent. Therefore, hospitals with poor contracts may score poorly here despite the OR being highly efficient in other ways. For hospitals with a fixed budget, maximizing contribution margin per OR hour is equal to minimizing variable costs.

Turnover Times

Turnover time is the time from when one patient exits an OR until the next patient enters the same OR.¹⁴ Turnover times include cleanup times and setup times, but not delays between cases. Based on data collected at 31 US hospitals, turnover times at the best-performing OR suites average less than 25 min.¹⁵ Cost reduction from reducing turnover times (because OR workload is less) can only be achieved if OR allocations and staffing are reduced.¹⁶ Despite this, turnover time receives lots of attention from OR managers because it is a key satisfier for surgeons.

Times between cases that are longer than a defined interval (e.g., 1 h) should be considered delays, not turnovers. For example, a case scheduled for 3 h finishes after 30 min because the patient has widespread metastases. The surgeon for the to-follow case is not available for 2 h. The delay is 2 h. That delay should not contribute to calculations of turnover times.¹⁷ Prolonged turnover times peak in the middle of the workday because most turnovers occur then.

Prediction Bias (Bias in Case Duration Estimates per 8 h of OR Time)

Prediction error equals the actual duration of the new case minus the estimated duration of the new case. Bias indicates whether the estimate is consistently too high or consistently too low, and precision reflects the magnitudes of the errors of the estimates. Efficient OR suites should aim to have bias in case duration estimates per 8 h of OR time that is less than 15 min.¹⁸ A reason for bias can be surgeons' consistently shortening their case duration estimates because they have too little OR time allocated and need to "fit" their list of cases into the OR time they do have.

Remember that lack of historic case duration data for scheduled procedures is an important cause of inaccuracy in predicting case durations. In general, half of the cases scheduled in your OR suite tomorrow will have less than 5 previous cases of the same procedure type and same surgeon during the preceding year.¹⁹ In fact, 37% of cases at a tertiary surgical suite did not have any cases at all in the previous year of the same procedure type and surgeon. This may be counterintuitive to many OR staff. However, the existence of thousands of combinations of scheduled surgeon and procedure is consistent with reports that many hospitals have 5,000–6,000 pref-

erence cards.²⁰ Each preference card defines a surgeon and a procedure (or combination of procedures).

One way to increase the amount of historical data available to make case duration predictions is to lump together similar current procedural terminology codes into buckets. Unfortunately, this is impractical because, for example, procedures with current procedural terminology codes that differ only in the final (fifth) digit have different case times. For example, a vitrectomy (67108) may take more than an hour longer than a scleral buckle (67107).

Conclusion

Most US hospitals perform all cases scheduled by their surgeons, provided a case can be done safely. This reflects the desire to retain and grow surgeons' practices, to enhance market share and reputation, and to fulfill community-service missions. Getting the right case in the right room at the right time is the goal for every OR director. For anesthesiologists, efforts to increase anesthesia group productivity are the same as increasing the efficiency of use of OR time.

Often, though, defining how well the OR suite runs depends on who you ask. The hospital administrator may want the most "throughput" with the least cost, whereas the surgeon wants first case of the day block time, rapid turnover, low cancellation rate, and on-time starts. Nurse managers may focus more on flexibility to move cases around, disposable supply costs/case, the percentage of cases in compliance with flash sterilization policy, and having adequate reserve capacity for add-on cases or emergency cases. Risk management, on the other hand, will want to know the percentage of patients without injury (e.g., wrong-sided surgery).

With proper management weeks to months ahead of time, the groundwork for an efficient (well-functioning) OR suite should be in place. This means that superhuman effort, for example, to rush around on the day of surgery trying to reduce turnover times, may be dangerous and stressful with little financial justification. On the day of surgery, the best way to proceed is by simply taking care of each patient in a relaxed, cheerful, and supportive way, having done most of the thoughtful planning ahead of time.

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Appendix: OR Personnel Survey to Assess How Well an OR Suite Is Functioning*

T2

Please rate your level of agreement with the following statements regarding the OR suite (1 = strongly agree, 3 = neutral, 5 = strongly disagree).

1. Patients wait a minimum period of time before start of surgery	1	2	3	4	5
2. Surgeries start on time	1	2	3	4	5
3. We provide timely communications to the patient's family in the waiting area	1	2	3	4	5
4. We provide a comfortable and pleasant waiting area	1	2	3	4	5
5. We cancel few cases on the day of surgery	1	2	3	4	5
6. We practice "truth in scheduling"	1	2	3	4	5
7. We have adequate nursing support	1	2	3	4	5
8. We have adequate technician support	1	2	3	4	5
9. We have the ability to add nonelective procedures	1	2	3	4	5
10. We have short turnaround time between cases	1	2	3	4	5
11. We have reliable, high-quality equipment	1	2	3	4	5
12. Surgeons are on time	1	2	3	4	5
13. Anesthesiologists are on time	1	2	3	4	5
14. We get the required instruments properly cleaned and on time	1	2	3	4	5
15. We have reliable communication mechanisms across the OR	1	2	3	4	5
16. Other _____	1	2	3	4	5

OR = operating room.

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