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Review Article

Operating room management: why, how and by whom?

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Operating room (OR) is a cost-intensive environment, and it should be managed efficiently. When improving efficiency, shortening case duration by parallel processing, training of the resident surgeons, the choice of anesthetic methods, effective scheduling, and monitoring of the overall OR performance are important. When redesigning the OR processes, changes should be given a clear target and the achieved results monitored and reported to everyone involved. Advanced, reliable, and easy to use information technology solutions for OR management are under development. Pre-operative clinic and functionally designed facilities support efficiency. OR personnel must be kept motivated by clear management and leadership, supported by superiors.

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Key words: Operating room; management; parallel processing; resources; personnel.

Why?

OPERATING rooms (ORs) incur high costs and considerable amount of hospitals revenues. Demand for OR and procedural facilities appears to be increasing due to aging population and developments in surgery. The conventional solution has been to build new facilities. Building them and, of course, staffing them adequately is increasingly expensive. By contrast, committing to increase the productivity of existing facilities seems to be a wiser strategy. One of the key methods here is proper OR management and optimizing the whole process or chain of processes involved in the treatment of a patient.

Goals for OR management

Clear goals for OR management are essential: improving productivity and efficiency while maintaining high quality of care at all times. Improving efficiency means shorter case durations, rational scheduling of various types of surgery, and minimizing nonoperative time (NOT) (Table 1) by reorganizing OR tasks. This requires motivated personnel and teamwork in every step of the patient care process. If all professionals working in the OR remain interested in developing their own work, we reach our goal: working smarter, not faster (Tables 2 and 3).

How?

Shortening case times

Novel surgical techniques, although enhancing recovery, may prolong operations (2). Case durations (time spent in the OR) are highly variable even between similar procedures (3, 4). Differences

Table 1

Operating room (OR) management glossary [partly adopted from Abouleish et al. (1)].

Raw utilization	The percentage of time a patient is in the OR of the total allocated time for a given service (case durations only)
Adjusted utilization	The percentage of time a patient is in the OR of the total allocated time for a given service plus the time for set up and clean up (= case duration plus turnover time)
Case duration	The time the patient is in the OR
Turnover time	The time from the previous patient out-room time to the succeeding patient in-room time to the same OR
Nonoperative time (NOT)	The time between the end of surgery of the previous patient to the beginning of surgery of the succeeding patient
Tardiness	The delay from the scheduled start time (patient enters OR) to the actual start time of the patient

Table 2

Key factors for operating room efficiency.

Streamlining processes with other units
Patient flow and its coordination
Timely patient preparation
Efficient patient reception
Parallel processing by use of induction area/PACU
Recovery room/ICU/ward capacity
Personnel: number/professional skills/motivation
Flexible facilities
Patient focused processes
Continuous process improvement

PACU, post anesthesia care unit; ICU, intensive care unit.

Table 3

Common problems with operating room management.

Poorly designed processes
Change reluctance/friction
Lack of motivation (no financial incentives?)
Dodging responsibility/placing blame
Lack of discipline (physicians!)

arise mainly from the surgeon's work rate (4, 5). The presence or participation of a resident physician prolongs the duration of the surgery up to 70% increasing costs accordingly (6–8). Adequate resident training, possibly with the aid of a simulator (9) and experienced assistance should be provided to the residents starting to operate more independently (10). Even small reductions in operative time can increase OR throughput (11).

Individual differences between anesthesiologists have very little effect on the case length (4), although specializing in certain types of surgery may speed up the anesthesiologists work (12). Teaching a resident seems to delay the anesthesiologist only by 2–3 min (13). Covering more than one room statistically causes a delay of 6 min (14).

Selecting the right type of anesthesia is crucial as it is the second important factor affecting the time spent in OR – right after the surgeon's speed. Anesthesia induction, taking roughly 10% of the time spent in the OR, is most affected by the type of anesthesia, the type of the airway, the need for invasive monitoring, and the American Society of Anesthesiologists (ASA) physical status. ASA class IV doubles (in children) or triples (in adults) the anesthesia preparation time compared with ASA physical status class I (15, 16).

Administering neuraxial blocks may take longer than inducing general anesthesia, yet this appears not to cause inefficiency, because no time is needed for emergence from anesthesia (17). However, performing a brachial plexus block tends to take too much OR time and should therefore be performed in a separate area well in advance of the anticipated start of the surgery (18). Moreover, local anesthesia should be considered whenever possible. Local anesthesia is cost efficient for example for hernia repair (19, 20), especially if administered beforehand in the induction room (21). As for general anesthesia, titrating short-acting anesthetic agents carefully while monitoring the depth of hypnosis (22), may help minimizing anesthesia-controlled time. Choosing a laryngeal mask for airway instead of an endotracheal tube may also save time (23).

The time needed for anesthesia preparation should always be considered, when scheduling a case. Cases requiring invasive hemodynamic monitoring and neuraxial block should not be placed first on the schedule. The first case should be short and predictable in length (24, 25). During the first listed case, anesthesia preparations such as neuraxial blocks can be done either in the induction room, recovery room, or a block room for the second case (17, 26). For inpatients, inserting epidural catheters, central venous catheters, etc. already the day before surgery may speed up the start of the operation the following day.

Changing the way of working

Parallel processing improves OR throughput by shortening NOT. Using separate rooms for anesthesia induction – a common way of working in some countries – shortens NOT and may allow extra cases each day compared with the traditional sequenced induction in the OR (27–30). Emergence from anesthesia can also take place in a separate room (27, 30) while the OR is being cleaned up. However, long procedures with few turnovers per OR seem not to benefit from parallel processing (31).

Using induction rooms may require additional staff, equipment, and facilities and thus have multiple financial implications to consider. It seems, however, that the benefits of the increased throughput, as well as the profits gained, will outweigh the increased costs (28, 29, 32). There are also ways to employ parallel processing without extra costs: redesigning work flow patterns and reassigning tasks of various professionals (33). Obviously, anticipating and preparing for the following case during the ongoing procedure will also help (33, 34).

Considering the fact that the OR is often the most cost-intensive and the most productive unit in the hospital (35), it is important to reduce time running

at idle in the OR. Delays due to unavailability of various professionals, lack of staff, or the patient not being prepared in time can amount up to five working days per month (36). Surgeons have been found to cause delays more frequently than any other profession in the OR environment (37, 38). Moreover, the delays caused by surgeons are significantly longer than the delays caused by any other single reason (16). Substantial improvement can be achieved by increasing communication between the surgeon and the rest of the team, as well as by notifying those often being late (16, 36–38). Sometimes a minor change of the process may help: providing a space and equipment for dictating in the OR (27) or computerizing patient records (33, 34) will keep the surgeons in the vicinity and readily available for the next procedure.

Monitoring OR performance

The effects from organizational changes can be expected to take considerable amount of time. As improvements from changes may take a year to achieve, monitoring the outcome is warranted. To maintain the achievements, monitoring should be frequent, if not real time (39). Useful efficiency measures include output/input-type of measures (40), NOT (27, 28, 30, 34), OR start times (41), and raw utilization (28, 40). Number of operations, overtime, costs, cancellation rate, complications, surgery durations, and under- and over-utilized time may also be worth measuring (42). Measuring patient waiting time is a key to better customer satisfaction and patient safety (25, 40). Statistical process control may help in interpreting the results (43, 44). It is essential that changes are given a clear target and results are reported to everyone involved in the process.

Technical tools for management

The OR management information system should support process management in real time. Of those currently used, most are designed primarily for scheduling and do not have visually high-quality displays for ongoing procedures. An ideal system allows tracking of patients and resources, and monitoring and reporting of the OR performance (45). Most of the currently used systems require manual data input. Wireless patient tracking systems can automatically timestamp key events, thereby decreasing the need for manual data input (39).

Focus on the processes

Well-defined processes enhance mutual understanding of all parties involved in the perioperative care (40). When each person involved has a clear understanding of his responsibilities and duties, the process can run efficiently (33). Multidisciplinary teamwork, parallel processing, careful reorganization, and reallocation of tasks have been shown to diminish the delays and NOT, to speed up turnover times, and to get the first operation of the day to start earlier (37). The process of receiving patients in the morning and the discharge to ward must be carefully planned to avoid 'bottle necks.' Collaboration with other units, timing and sequencing of patient preparation as well as post-operative care, is therefore important.

Preoperative clinic

A well-functioning pre-operative clinic enhances OR efficiency by reducing the number of cancellations and delays (46). Careful consideration between the risks and expected long-term benefits for the patient is needed to make a rational decision whether surgery is justified in a high-risk case. Also, patients that have been on the waiting list for months may need a re-evaluation. This evaluation requires a considerable amount of experience from the surgeon and the anesthesiologist and should therefore be performed by a specialist. To be of any use, the evaluation has to take place well in advance of the planned surgery to allow necessary changes in medication to be made, additional tests and consultations to be arranged, as well as any corrective measures taken during the evaluation to have enough time to take effect.

Facilities

The hospital facilities should be designed to support fluent patient flows (40) and to allow their flexible use for a variety of functions (35, 47). Sometimes a trivial structural feature, such as limited elevator capacity, can be a serious rate-limiting factor. Separate and dedicated processes for emergency and urgent surgery may be a necessity in some hospitals (48). This, although ensuring a quick response in an emergency, may cause inefficiency when these resources have to be reserved at all times, even when not needed.

Personnel

In many countries shortage of anesthesiologists or anesthesia nurses restricts the availability of ORs (49). Sometimes the work flow can be improved by changing the ratio of nurses and doctors: an extra nurse may enable efficient use of induction room with the same number of anesthesiologists. There is also some evidence that financial incentives improve performance (50).

OR work requires high level of professional skills and knowledge, requiring constant updating. Motivation to keep up one's skills is best achieved in an encouraging organizational climate with healthy interdisciplinary relationships (51).

By whom?

Management and leadership

Successful management of the OR requires sound organizational structure, good leadership, as well as interdisciplinary collaboration. Mostly for historical reasons, distribution of roles and responsibilities is not always clear in the OR environment. Yet, it is vital that the status and authority of the person in charge is known and acknowledged by everyone in the perioperative process as well as supported by his/her superiors. This way the conflicts can be solved quickly and locally, and resource allocation can be done efficiently (52). Leadership skills and emotional intelligence are equally important as credentials. The specialty or profession of the leader is of secondary importance.

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