A Psychological Basis for Anesthesiologists' Operating Room Managerial Decision-Making on the Day of Surgery

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BACKGROUND: We investigated whether, without prompting, anesthesiologists tend to make managerial decisions to increase the clinical work per unit time of the sites to which they are assigned during their scheduled time present. Although a sound basis for decision-making involving individual ORs, the heuristic is often suboptimal economically when applied to decisions involving multiple ORs.

METHODS: Two studies were performed at one hospital. 1) A retrospective analysis was made of anesthesiologists' managerial decisions when caring for sequential lists of patients. 2) Patients' and surgeons' waiting on nights and weekends were studied before/after education on optimal decision-making.

RESULTS: 1) Anesthesiologists' decisions resulted in an increase in their clinical work per unit time, not a reduction in patient waiting. 2) Paradoxically, such efforts on nights and weekends caused increased patient and surgeon waiting. Decisions were unchanged after education on a different way to assign cases.

CONCLUSIONS: In a companion article, we showed that clinicians tended to make decisions that increased the clinical work per unit time at each moment in each OR, even when doing so resulted in an increase in overutilized OR time, higher staffing costs, unpredictable work hours, and/or mandatory overtime. The current studies show that such efforts to work fast cannot be explained as a consequence of efforts to reduce surgeon and patient waiting. Rather, the heuristic followed is consistent with increasing one's personal clinical work per unit time at one's assigned anesthetizing location.

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In our companion article, we investigated the impact of displays on anesthesiologists', operating room (OR) nurses', and housekeepers' managerial decisions on the day of surgery (1). Participants making decisions without command displays, specifically text pager recommendations, performed no better than random chance in terms of increasing the predictability of work hours, reducing overutilized OR time, and increasing OR efficiency (2,3). An explanation is that without prompting clinicians tended to make decisions to increase the clinical work per unit time of the sites to which they were assigned during their scheduled time present, even when doing so was suboptimal economically for the surgical suite as a whole. For single ORs, this *heuristic* (i.e., simplified, rule-of-thumb approach) (4,5) is the same as working fast to get the cases done. The focus of this article is to use observational data to investigate further our hypothesized explanation for how clinicians use information to make managerial decisions (6,7).

The statistical basis for operational decision-making on the day of surgery is well understood (2,3). Readers not fully familiar with the science of the efficiency of use of OR time can refer to the Background of the companion article (1), Table 1 of the companion article (1), and/or two recent review articles (2,3). Economically rational decisions arise from the use of the following ordered priorities (2): i) performing all scheduled cases unless there is a patient safety concern, ii) reducing overutilized OR time, iii) reducing patient and surgeon waiting times, and iv) satisfying personal priorities, professional satisfaction, etc.

Consider a cancer hospital with 20 ORs allocated Monday to Friday from 7 AM to 5 PM. Staff scheduling is also from 7 AM to 5 PM, such that nursing overtime begins at 5 PM and anesthesiologists receive incentive

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(bonus) payment for work after 5 PM. All ORs are full to at least 3 PM every day, but because of costs versus reimbursement the workday has not been extended past 5 PM (8,9). OR #1 has two cases realistically scheduled 7 AM to 10:30 AM for surgeon A and 11:00 AM to 3:15 PM for surgeon B. OR #2 has one long head-and-neck case with reconstruction scheduled to end at 8 PM. At 7 AM, the anesthesiologist assigned to ORs #1 and #2 is standing outside of the rooms. The Certified Registered Nurse Anesthetist (CRNA) from OR #1 is wheeling her first patient down the hall. The CRNA for OR #2 is nowhere to be found, and the anesthesiologist is not sure of the patient's status either. Results of our companion article (1) are that, without prompting from a command display, many anesthesiologists would get the case started in OR #1, hoping that by then the situation in OR #2 would be addressed. Doing so increases the clinical work per unit time of the ORs to which the anesthesiologist is assigned at each moment the anesthesiologist is present.

However, the staffing is planned to 5 PM in OR #1. There will be no overutilized time in OR #1 regardless of whether the case starts at 7 AM or 7:15 AM. The anesthesiologist should first determine what is happening to OR #2, because every minute waiting to start OR #2 is an additional minute of overutilized OR time and higher costs (2,3). The reduction in costs is a higher priority than patient and surgeon waiting at the hospital because, otherwise, the ORs would have been allocated and staffing would have been planned beyond 5 PM (3,10). In addition, a scheduled delay would have been planned between the first and second case (surgeons) in OR #1, so that if the first case finishes unexpectedly late the second case would still start on time (2,11,12).

From the experimental design of our companion article (1), we cannot rule out the possibility that the clinicians were not making managerial decisions to increase the clinical work in each OR at each moment, but rather neglecting long- and short-term institutional goals in lieu of decisions that they expected would avoid confrontation. The reason is that the experiments considered decision-making on the day of elective surgery, when decisions to reduce overutilized OR time can conflict with reducing surgeon waiting. In the current article, we take advantage of two unusual situations at a hospital to differentiate between explanations. For Study #1, we review anesthesiologists' managerial decisions when they are performing anesthesia outside of ORs and making independent decisions one case (patient) at a time. The importance of the non-OR setting is that although previous studies of status displays for managerial decision-making involved individual ORs (Table 2 of Ref. 1), activity in one OR often indirectly affects activity in another OR (e.g., based on calls from the OR control desk). For Study #2, we investigate decision-making on weekends, when anesthesiologists' decisions that increase their personal clinical work has the effect of *increasing* surgeons' waiting.

METHODS

Study #1: One List of Patients with Pagers

At the hospital studied, most patients undergoing an anesthetic outside of an OR underwent preanesthesia evaluation on the day of their anesthetic. Patients often excluded were those scheduled to be first cases of the day, having other clinic appointments preceding the anesthetic, or flagged as unusually unhealthy by their primary service (e.g., prior congenital heart disease surgery).

The working day before a patient's procedure, an educational e-mail was sent to the anesthesiologist explaining that he or she would be sent a text page (i.e., active status display) notifying him or her when each patient arrives at the preanesthesia evaluation clinic. The e-mail stated: "If your preceding case finishes early, you can page the patient and make arrangements to start the case early . . . If you are running behind, you can notify your patient . . ."

The patients or parents of a patient were given a pager upon arrival at the preanesthesia evaluation clinic on the day of the anesthetic.

Each anesthesiologist was assigned one sequential list of cases and was paired with one CRNA, resident physician, or student registered nurse anesthetists (SRNA) (i.e., anesthesiologists were not medically directing multiple sites). Consequently, clinicians reasonably had complete knowledge of the information required to make the decision to page patients. The OR control desk was uninvolved.

The use of pages was started at the hospital November 1, 2005. Data were collected through the end of January 2006. The dates and times of uses of the pagers were obtained from hospital telecommunications. The scheduled and actual start and end times of the anesthetics were obtained from the department's billing data. The data for observational Study #1 were these lists of dates and times.

Our explanation for clinicians' decision-making would be supported by two findings. First, routine use of the pagers would be expected for cases that started early, because such use would increase the anesthesia providers' work per unit time. Comparisons were made of 1) times that pagers were used and 2) times that cases were scheduled to start. Second, few pages would be made to patients (parents) to reduce the anesthesia providers' hours worked late. When anesthesia providers who were assigned to locations outside of ORs finished their list of patients, they had completed their daily clinical assignment. Relief from ORs was rarely, if ever, available, meaning those providers finished their list. Because cases were not scheduled into overutilized time, the overutilized time occurred when cases were taking longer than scheduled. If pages were sent frequently, but rarely on days with overutilized anesthesia time, then the decision to page was unlikely to have been made based on reducing expected hours of overutilized anesthesia

time. For each patient receiving a pager, the time of the actual end of the workday was known. Analysis was made of page/no-page versus overutilized anesthesia time/no overutilized anesthesia time.

Study #2: Impact of Education on Decisions Involving Multiple ORs

Administrators at a hospital were concerned about the perception of inconsistent managerial decision-making by anesthesiologists on nights and/or weekends. Consequently, 31 anesthesiologists working nights and/or weekends underwent one of six 45 min training sessions to learn decision-making on the day of surgery (2). The curriculum was a series of seven scenarios of increasing complexity, based on the examples in reference (2). The slides used are online at www.FranklinDexter.net/education.htm (accessed September 15, 2006). Active learning using groups of three people were used to reinforce concepts. A one page summary of principles (2) was posted at the OR control desk to serve as a reminder of course content at the site of decision-making (Table 1 of Ref. 1). After 6 wk, each anesthesiologist received an e-mail after his or her call with quantitative feedback (13,14) and a list of each patient's and surgeon's waiting, if applicable.

The OR allocation planned for nights and weekends was three ORs (15,16). Based on that staffing plan, OR nursing and the anesthesia departments scheduled its staff (i.e., determined the individuals who would work each shift on each day) (17). The shifts worked at the hospital were nights 7:00 PM to 7:00 AM the next morning and weekend days 7:00 AM to 7:00 PM. All cases started during these periods were sufficiently urgent that the surgeon's judgment was that they could not wait for the next scheduled workday.

CRNAs, resident physicians, and SRNAs were scheduled in-house. One anesthesiologist was scheduled to work a 12-hr shift in-house to cover 2 ORs. Backup anesthesiologists were on call from home for cardiac, liver transplantation, and nonspecialty cases.

Because cases were almost always finished by the next workday, there was no overutilized OR time to be created by decisions. In addition, following the American Council for Graduate Medical Education's Program Requirements for Resident Education in Anesthesiology (August 4, 2005, line 451), each anesthesiologist medically directed one or two ORs. Consequently, by definition, each decision made by an anesthesiologist that increased his or her clinical work per unit time by not calling in another anesthesiologist to run a third OR resulted in surgeons and patients waiting longer.

For example, one evening an anesthesiologist working in-house made decisions to increase his/her clinical work per unit time during his shift of fixed duration, following our hypothesized explanation of clinicians' managerial decisions. He allowed a second anesthesiologist to go home at midnight while a patient waited safely a few hours until one of two ongoing cases finished. The decision increased the clinical work of the anesthesiologist on call in-house (i.e., satisfied our hypothesis). The department's culture may have rewarded the anesthesiologist intangibly for personally doing so many cases. Nonetheless, the decision was made without consideration of its effect on the unobserved patient, surgeons, emergency department, surgical pathologist, postanesthesia care unit nurses, and surgical ward nurses. A purpose of the OR allocations was to permit staff scheduling decisions to be made independently by these different stakeholders. None of this would have been an issue if the heuristic of working fast had been applied only to decisions involving one OR.

The ORs used on nights and weekends were those along a hallway in front of the OR control desk and the anesthesia supply room. Thus, the anesthesiologists had all of the data required to make the studied decision.

The data used were, for each case, the time when the surgeon reported that he or she and the patient were available, time that the case started, and when it ended. Cases were considered to take 45 min for OR preparation and anesthesia evaluation. Sensitivity analyses were performed with other values to assure that results were unaffected.

If there were zero ORs in use between when a case was submitted and started, the case was not considered to have been waiting for an OR. This assumption was reasonable, based on the authors not being aware of an anesthesiologist or charge nurse at the hospital ever deciding to run zero ORs while a case was waiting other than during a power failure, which did not occur during the studied period. This assumption will also be shown to be supported in the Results by our finding from Study #1. The consequence of the assumption is that the analysis assessed the minutes of patient and surgeon waiting while one or two ORs were in use.

The training sessions started October 2005. The data were analyzed through the end of January 2006. Baseline data were January 2004 through September 2005. There were 3310 cases started during nights or weekends. The data were pooled into 2-wk periods to eliminate the effect of variation in workload by day of the week on results (e.g., as shown in Ref. 16). The intervention period was the last 8 of 54 successive 2-wk periods. No changes were made to staffing or staff scheduling during the 54 periods. The sample size within each 2-wk period was sufficient for pooling as each contained 14 nights and 4 weekend day calls.

RESULTS

The anesthesiologists used the pagers mostly when doing so increased their clinical work per unit time (Table 1). Each increase in the minutes starting earlier than scheduled was associated with an increase in the probability of the patient being paged ($P < 0.001$).

Table 1. Observational Study of Decision-Making with Near Perfect Knowledge of the Status of Individual Anesthetizing Locations (Study #1)

Routine use of pagers was consistent with increasing anesthesia providers' work per unit time, based on significant association between paging and minutes starting earlier than scheduled

Earliness (min)	Paged	Not-paged
0–9	0	3
10–19	2	5
20–29	1	1
30–39	6	0
40–165	5	0
P value of association		<0.001

Few pages were made on days finishing late (6 PM) or potentially expected to finish late (5 PM), as hypothesized because such use would not increase personal clinical work per unit time

	Before 5 PM	After 5 PM	*P* value	Before 6 PM	After 6 PM	*P* value
Paged	19	2	<0.001	19	2	<0.001
Not-paged	19	12		28	3	

For the 52 patients given pagers, there were 21 different anesthesiologists receiving at least one e-mail (i.e., results were insensitive to personal preferences). In the upper half, the Wilcoxon–Mann–Whitney was used to test the relationship between whether a patient was paged and the minutes of earliness. In the lower half, the binomial test was used to determine if more than half of the patients who were paged were among those patients receiving care as part of a list of cases finishing after 6:00 PM (i.e., with overutilized anesthesia time) or after 5:00 PM (i.e., could have been thought to have overutilized anesthesia time). The analysis using 5:00 PM was included as a sensitivity analysis. Statistical analysis with exact *P* values was performed using StatXact-7 (Cytel Software Corporation, Cambridge, MA).

Table 2. Impact of Education on Decision-Making with Near Perfect Knowledge of the Status of Multiple Operating Rooms (ORs) (Study #2)

	Course (education), quantitative goal, and feedback provided		
	Before	**After**	***P* value**
N (2-wk periods)	46	8	
Cases started daily during nights and weekends	4.4 ± 0.1	4.3 ± 0.1	0.73
Daily hours of OR time	16.3 ± 0.4	16.6 ± 0.8	0.77
Mean daily minutes of waiting for cases to start when one or two ORs were in use	66* ± 3	80 ± 18	0.75†

* The data are reported as mean ± SD. The median waiting times were 62 min before intervention and 66 min afterwards. The values are based on 45 min required for patient preparation. Using 90 min instead, the waiting times were 50 ± 4 min before and 64 ± 17 min after.

† Before–after comparison was made using Student's two-sided *t*-test with unequal variances. As mean daily waiting during each 2-wk period followed a two-parameter log normal distribution (Lillefors' test $P = 0.64$, $N = 54$), mean waiting was analyzed after logarithmic transformation. By analysis of covariance, $P = 0.45$ after controlling for mean daily cases starting and $P = 0.72$ after controlling for mean daily hours of OR time. Analysis by Mann–Whitney $P = 0.73$.

Decisions on nights and weekends also were consistent with the hypothesis that clinicians used a heuristic of increasing their clinical work per unit time (Table 2). Education did not change decision-making or reduce the patients' and surgeons' waiting at the hospital ($P = 0.75$).

DISCUSSION

Although reducing overutilized OR time has advantages for OR nurses, housekeepers, and anesthesia providers (e.g., consistent decision-making, more predictable work hours, fewer handoffs during cases, reduced staffing costs, and less unscheduled [mandatory] overtime) (2,3), such decisions often result in increased surgeon and patient waiting. In our companion article (1), we showed that when decision-making on the day of elective surgery involves multiple ORs, decisions are often made not to reduce overutilized OR time, but potentially to increase clinical work at each moment in each OR. However, as shown by the example in the introduction, an alternative explanation could be to increase surgeons' and/or patients' satisfaction. The two studies of this article show that the latter explanation does not apply. Anesthesiologists' managerial decisions were consistent with a heuristic of increasing their personal clinical work per unit time. In addition, education and near perfect knowledge of status were insufficient to change such decisions. Command displays (recommendations) are needed (1).

As considered in the Introduction of our companion article (1), there is an excellent basis for the heuristic of increasing the clinical work per unit time of each OR. The vast majority of OR management decisions that involve single ORs (18,19), for which decisions are the same as those that reduce both overutilized OR time and expected tardiness from scheduled start times (1,2). The problem is the subsequent application of this heuristic to decisions involving multiple ORs.

Study #1 alone was incomplete, because there was another explanation for the decision-making other than use of the heuristic of trying to increase clinical work per unit time. The times at which the anesthesiologists finished their scheduled lists of cases outside of ORs were generally how late the anesthesiologists worked caring for patients. Thus, the pagers could have been used when the decision to use the pager could result in the anesthesiologists finishing their clinical day earlier. Study #2 shows that the latter explanation is unlikely. During nights and weekends, the work hours were set at 12 h, and still the anesthesiologists made the same decisions. Furthermore, in the experimental study (1), decisions had nothing to do with getting home sooner.

Study #2 alone was also incomplete, because surgeon and patient waiting at the studied hospital may have not changed because waiting resulted from anesthesiologists postponing decisions when they were busy caring for patients. However, that alternative explanation cannot explain the findings of our companion article (1) in which the heuristic was followed despite absence of time requirements or clinical care responsibilities (7). Furthermore, anesthesiologists may have made decisions in Study #2 based on a perception that the allocated OR time at night should have been less than the prescribed three ORs (e.g., fewer providers on-call from home having to do cases, increasing provider satisfaction). However, our companion article (1) studied weekday staffing that had been unchanged at the hospital for 9 yr.

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