Labor Costs Incurred by Anesthesiology Groups Because of Operating Rooms Not Being Allocated and Cases Not Being Scheduled to Maximize Operating Room Efficiency

Amr E. Abouleish, MD, MBA*, Franklin Dexter, MD, PhD†, Richard H. Epstein, MD‡§, David A. Lubarsky, MD, MBA‖, Charles W. Whitten, MD¶, and Donald S. Prough, MD*

*Department of Anesthesiology, The University of Texas Medical Branch, Galveston, Texas; †Department of Anesthesia, University of Iowa, Iowa City, Iowa; ‡Department of Anesthesiology, Jefferson Medical College, Philadelphia, Pennsylvania; §Medical Data Applications, Ltd., Jenkintown, Pennsylvania; ‖Department of Anesthesiology, Perioperative Medicine and Pain Management, University of Miami, Miami, Florida; and ¶Department of Anesthesiology and Pain Management, The University of Texas Southwestern Medical Center, Dallas, Texas

Determination of operating room (OR) block allocation and case scheduling is often not based on maximizing OR efficiency, but rather on tradition and surgeon convenience. As a result, anesthesiology groups often incur additional labor costs. When negotiating financial support, heads of anesthesiology departments are often challenged to justify the subsidy necessary to offset these additional labor costs. In this study, we describe a method for calculating a statistically sound estimate of the excess labor costs incurred by an anesthesiology group because of inefficient OR allocation and case scheduling. OR information system and anesthesia staffing data for 1 yr were obtained from two university hospitals. Optimal OR allocation for each surgical service was determined by maximizing the efficiency of use of the OR staff. Hourly costs were converted to dollar amounts by using the nationwide median compensation for academic and private-practice anesthesia providers. Differences between actual costs and the optimal OR allocation were determined. For Hospital A, estimated annual excess labor costs were $1.6 million (95% confidence interval, $1.5–$1.7 million) and $2.0 million ($1.89–$2.05 million) when academic and private-practice compensation, respectively, was calculated. For Hospital B, excess labor costs were $1.0 million ($1.08–$1.17 million) and $1.4 million ($1.32–1.43 million) for academic and private-practice compensation, respectively. This study demonstrates a methodology for an anesthesiology group to estimate its excess labor costs. The group can then use these estimates when negotiating for subsidies with its hospital, medical school, or multispecialty medical group.

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More than 80% of anesthesia groups nationwide have an exclusive arrangement with one or more hospitals (1). A disadvantage to this type of relationship is that anesthesiology groups often lack negotiating leverage to encourage hospital surgeons and administrators to adopt effective operating room (OR) management decision-making. Often, OR management decision-making is not based on maximizing OR efficiency (2–8); rather, it is based on tradition and surgeon convenience. When OR time is not allocated to each surgical service to maximize OR efficiency (2–6) and when surgical cases are not scheduled into that OR time to maximize OR efficiency (7,8), anesthesiology departments incur excess labor costs because they must provide personnel either for more rooms or for longer intervals to complete scheduled cases.

Because decisions made by hospitals not to maximize OR efficiency typically benefit surgeons at the expense of anesthesiology groups, it is reasonable for anesthesiology groups to seek financial support from their hospital, medical school, or multispecialty medical group. This is true for both private-practice groups and academic departments. For example, more than 40% of anesthesiology groups nationwide receive

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Address correspondence and reprint requests to Amr E. Abouleish, MD, MBA, Department of Anesthesiology, University of Texas Medical Branch, 301 University Blvd., Galveston, TX 77555-0591. Address e-mail to aaboulei@utmb.edu.

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a stipend to provide nonbillable services, such as OR management, availability, or call coverage (1). In academic settings, the medical school practice plan may approve an anesthesiology budget that is more than the expected revenue, with the difference provided by affiliated hospitals or other clinical departments through a transfer of revenue from the medical school administration (9). When negotiating such financial support, heads of anesthesiology departments are often challenged to justify the subsidy necessary to offset the costs incurred by not allocating OR time and by not scheduling cases as efficiently as possible. In this study, we describe a method for calculating a statistically sound estimate of the excess labor costs incurred by an anesthesiology group because of inefficient OR allocation and case scheduling.

Methods

We collected OR information system and anesthesiology staffing data for 1 yr from two academic tertiary-care hospitals (designated Hospitals A and B) in the United States. We used 1 yr of data on the basis of our previously published statistical power analysis (5).

Data collected were previously defined (2–4). Data for each surgical case in the OR suite included surgical service, date and time in and out of the OR, number of emergent or urgent cases, and whether the OR day was a holiday. The scheduled numbers of ORs and regular hours were also collected.

Optimal OR allocations were calculated independently by using a statistical software package (CalculatOR™; Medical Data Applications, Ltd., Jenkintown, PA) for each surgical service, as previously described (2–4), to maximize the expected efficiency of use of the OR staff. We were able to determine the smallest-cost, first-shift staffing solution by considering all possible combinations of staffed regular hours and the accompanying numbers of under- and overutilized hours. An underutilized hour of OR time is a regularly scheduled hour (regular hour) of OR time when no surgery is performed and no turnover of the OR is occurring. An overutilized hour of OR time is an hour during which surgery occurs after regular hours. For Hospital A, possible regular hours per OR began at 0 h and progressed incrementally to 8 h, 10 h, 16 h, and so forth. For Hospital B, the possible regular hours were 0 h, 8 h, 10 h, 13 h, 16 h, and so forth. Starting with 0 h, progressively larger numbers of staffed hours were considered until additional increases in the staffed hours caused the weighted sum of under- and overutilized hours to increase. If providing 0 h to a service resulted in less cost than providing the minimum of one OR for 8 h, then no OR was assigned to that surgical group for that day, and all such groups were combined into OTHER service. The solution for the OTHER service was then calculated. At least one OR was allocated for other services for at least 8 h each day of the week. This rule meant that every service had open access to open OR time every workday.

In practical terms, that maximizes OR efficiency corresponds to the number of staffed, regular hours that minimizes the weighted sum of under- and overutilized hours. Mathematically, the weighted sum equals the number of underutilized hours plus 1.75 times the overutilized hours. The cost of an overutilized hour is more than that of a regular hour and, for this study, was considered to equal 1.75 times the cost of a regularly scheduled hour, reflecting overtime, bonus pay, and frustration resulting in increased recruitment and retention costs. For example, if an anesthesiologist and a certified registered nurse anesthetist (CRNA) were scheduled to work 8 h from 7:00 AM to 3:00 PM and instead worked until 4:00 PM, then the labor cost would be equal to the cost of 9.75 regular hours, where $9.75 = (8 \text{ regular hours}) + 1.75 \times (1 \text{ overutilized hour})$.

For actual performed cases, the cost in regular hours was calculated. For Hospital A, the regular hours were the same for all the ORs, which were staffed for 10 h. For Hospital B, regularly scheduled anesthesia staffing was calculated for 28 ORs, each scheduled for 10 h, plus 2 anesthesia providers working from 3:00 PM to 11:00 PM and 2 providers working from 6:00 PM to 7:00 AM. We deliberately underestimated overutilized hours for each hospital by using the OR time where surgery was performed outside of these regular hours.

All cases were scheduled on the same date that they were actually performed. In contrast to the actual data, for the optimal solution, each surgical service was considered to perform its surgery only in its allocated ORs.

The difference in units of labor costs (hours worked) between actual performed cases and the optimal OR time allocation was converted from hours to dollars by multiplying the result by the average cost per regularly scheduled hour for the anesthesia staff in the surgical suite. For this study, we used the nationally reported median annual compensations for academic anesthesiologists ($198,413), private-practice anesthesiologists ($279,977), and CRNAs ($89,160) (10). Using 26% benefits, 2000 clinical hours per year, and a staffing plan of 1 anesthesiologist to 2 CRNAs, the median costs per regularly scheduled OR hour were $118 for academic and $144 for private-practice reimbursement.

For academic groups, the costs per hour were determined for an OR staffed with CRNAs who were medically directed by a faculty anesthesiologist. An OR staffed by a resident was not included because any change in staffing (because of changes in allocation or scheduling methods) would change the number of CRNAs required rather than the number of residents. For example, if the optimal staffing solution resulted in one fewer OR being staffed per day, the reduction in staff would be accomplished by reducing the number of CRNAs rather than the number of residents in the academic program. Because residents would cover some of the ORs of an academic group, the hourly cost for academic departments reflects only the CRNA-physician faculty rooms. For this reason, only the difference between actual and optimal hours was converted to dollar values.

The daily difference in anesthesia labor costs between the original and the optimal schedule was calculated. Daily differences in cost were averaged among contiguous 4-wk periods (11). The Student's *t*-test was used to calculate confidence intervals for the cost difference by using the results from the 13 4-wk periods.

Results

Two large academic medical center hospitals located in the United States were included in the study. At Hospital A, during 248 workdays in the one study year, 11,587 surgical cases were performed, at least in part, between 7:00 AM and 11:00 PM by 15 surgical services in 22 ORs. At Hospital B, during 252 workdays, 17,507 surgical cases were performed by 12 surgical services in 28 ORs. The planned regular daily work hours were the same for each day for each hospital—252 h for Hospital A and 302 h for Hospital B. Overutilized hours per day were 6 ± 4 h for Hospital A and 7 ± 4 h for Hospital B. The optimal solution for OR allocation and case scheduling reduced the number of regular hours per day to 181 ± 6 h for Hospital A and 247 ± 8 h for Hospital B. Overutilized hours per day were 15 ± 8 h for Hospital A and 17 ± 10 h for Hospital B. The excess in staffing cost per day in units of regular hours worked (where 1 overutilized hour = 1.75 regular hours) was 55 ± 15 h for Hospital A and 38 ± 18 h for Hospital B (Table 1).

The annual anesthesiology group labor costs from not allocating OR time and scheduling cases in the manner that would maximize the efficiency of the use of OR time were $1.6 million and $1.1 million at Hospitals A and B, respectively, on the basis of an academic compensation rate, and $2.0 million and $1.4 million, respectively, on the basis of the private-practice compensation rate (Table 2).

Discussion

Methods to allocate OR time and schedule cases to maximize OR efficiency have been developed to improve OR management (2–8). In this article, we described a new application of the previous work of these studies. Anesthesiology department heads nationwide will find this method useful for calculating costs incurred by anesthesiology departments as a consequence of suboptimal OR allocation and case scheduling. These values can be used in negotiations with hospitals, medical schools, and multispecialty medical groups.

We compared results for Hospitals A and B with the values that we reported previously for CRNA labor costs at nine smaller hospitals (4). Using the first and last columns of table 1 of Ref. 4, we calculated the median difference in cost per OR. Applying methodology similar to that used in this study (national compensation and concurrency data) and multiplying by 26 ORs gives values comparable to the surgical suites reported in this study. The median differences in cost were $1.4 million on the basis of the academic compensation rate and $1.7 million on the basis of the

Table 1. Mean Daily Regular Hours and Overutilized Hours

Variable	Hospital A	Hospital B
Actual performed		
Regular hours[a]	252	302
Overutilized hours	6 ± 4	7 ± 4
Total costs hours[b]	263 ± 7	315 ± 7
Optimal solution		
Regular hours	181 ± 6	247 ± 8
Overutilized hours	15 ± 8	17 ± 10
Total costs hours[b]	208 ± 13	276 ± 19
Difference in labor costs	55 ± 15	38 ± 18

Data are mean ± SD.
OR = operating room.
The difference in labor costs compares actually performed cases and actual schedule with an optimal solution of maximizing OR efficiency by OR allocation and case scheduling. The optimal solution minimizes the weighted sum of over- and underutilized hours. The methods underestimate the difference in labor costs by overestimating the optimal solution's under- and overutilized hours. Hospitals A and B are academic medical center hospitals.
[a] The same number of regular hours were performed every day.
[b] Total costs hours = regular hours + (overutilized hours × 1.75).

Table 2. Estimate of Excess Labor Costs for Anesthesiology Groups Because of Less Than Optimal OR Allocation and Case Scheduling

		Excess annual labor cost from not allocating OR time and scheduling cases to maximize OR efficiency (million) (95% CI)	
Hospital	ORs staffed daily	Academic compensation	Private compensation
A	24	$1.6 ($1.50–$1.70)	$2.0 ($1.89–$2.05)
B	28	$1.1 ($1.08–$1.17)	$1.4 ($1.32–$1.43)

The optimal solution maximizes OR efficiency, meaning it minimizes the weighted sum of over- and underutilized hours. These methods underestimate the difference in labor costs by overestimating the optimal solution's under- and overutilized hours. Hospitals A and B are academic medical center hospitals.
OR = operating room; CI = confidence interval.

private-practice rate. These values are similar to those reported in this study.

In contrast to private-practice groups, academic anesthesiology groups staff ORs with faculty, residents, and CRNAs. Because this study looked at the excess time (i.e., marginal cost) and not the total time (i.e., total cost), the same methodology can be used for both estimates. Because total cost is not estimated in this analysis, the results cannot be reported as a percentage of budgets.

When the most efficient solution was determined, the weighted sum of under- and overutilized hours was minimized. However, when costs were determined, underutilized hours were not considered, because personnel must be present even if no surgery is performed (5). Therefore, the regular cost per hour was calculated, and no additional cost was considered because of the underutilized rooms. In contrast, overutilized hours must be included in the cost determination because the methodology assumes that after the cases are done, the OR is not staffed.

In the statistical method, several assumptions were made when the optimal solution and OR allocation were determined. The first assumption was that in the optimal solution, the surgical service performed surgery only in the allocated OR time. In the actual situation, surgical services would be offered what would otherwise be underutilized time in another service's OR time to complete their cases during regularly scheduled hours. In the optimal solution, each service's OR workload was considered independently of other services so that all services would have access to OR time every workday. The cases were considered to be performed in the original service's allocated OR time. This leads to an increase in over- and underutilized hours. For example, if Service A is allocated 10 hours on Mondays, and on a specific Monday they have 16 hours worth of cases, including turnover times (e.g., one 4-hour case and two 6-hour cases), then the analysis of the cost of the optimal staffing solution assumes that all of the cases were performed in the service's allocated OR time (i.e., 6 hours of overutilized time). In addition, if Service B is also allocated 10 hours on Mondays, and on the same Monday they had 4 hours of cases, the optimal solution would consider this 6 hours of underutilized time. This contrasts the likely progress of an actual schedule. In the actual schedule, the last case of Service A may be moved to follow in Service B's OR. Therefore, for this example, in the actual situation there would be no under- or overutilized hours, and the model would overstate the required labor costs.

The second assumption was that, at both hospitals in our study, the use of regularly scheduled second-shift staff (3:00 PM to 11:00 PM) providing care for urgent cases would increase OR efficiency. However, because we did not know the availability of equipment and staff, we assumed that there would be no regularly scheduled second-shift staff. This assumption also results in optimal costs that exceed the likely costs if the model were used, because second-shift personnel cost less than personnel working during overutilized OR time.

The third assumption was that data were not available for the specific OR to which the anesthesiology clinical director assigned each CRNA scheduled to work during the second shift. Therefore, we considered the CRNAs to have been assigned to whichever OR would have resulted in the smallest possible cost. For example, at Hospital B, the two CRNAs working 3:00 PM to 11:00 PM could take a dinner break from 6:30 PM to 7:00 PM while other CRNAs remained in the ORs. When estimating the cost of OR time for actual staffing, we assumed that the CRNAs scheduled to work after 3:00 PM were always in ORs caring for patients whenever surgeries were in progress. This deliberately biased assumption contributed to an underestimation of the difference between actual and current labor costs. Together, these assumptions led to an overestimation of the optimal costs (regular hours worked and overutilized hours) compared with the likely costs associated with implementing our model. Therefore, the results in Tables 1 and 2 are conservative. Our results overall underestimate the excess costs associated with inefficient OR allocation and surgical scheduling.

From these assumptions, one could predict that the optimal solution would be to include more under- and overutilized hours, but this was not found for both hospitals. Therefore, we must conclude that time was not allocated to maximize the efficiency of the use of OR staff, including anesthesia providers, while providing all surgeons with access to ORs every workday. The goals may have been the same, but the OR allocations were calculated differently (i.e., statistical methods were not used). Alternatively, the goals may have been markedly different.

In this study, only one solution for OR allocation and case scheduling was performed for each hospital. Additional solutions could have been performed with different assumptions, but we chose not to do this. The assumptions underlying our optimal calculations were deliberately selected to underestimate the cost of inefficient OR allocations, as described above. Thus, the costs to the anesthesia department are likely to be larger than the results obtained. We chose our approach to eliminate potential criticism that we biased the study to favor anesthesia departments, because the methodology actually was biased against these groups.

This study demonstrates a methodology for an anesthesiology group to estimate excess labor costs caused by inefficient OR allocation and case scheduling. Anesthesiology groups can use these estimates in negotiating with hospitals, medical schools, or multispecialty medical groups. We recommend that negotiations emphasize that the true costs to the anesthesiology group exceed these conservative estimates.

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