

Measurement of Individual Clinical Productivity in an Academic Anesthesiology Department

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Background: The ability to measure productivity, work performed, or contributions toward the clinical mission has become an important issue facing anesthesiology departments in private practice and academic settings. Unfortunately, the practice and billing of anesthesia services makes it difficult to quantify individual productivity. This study examines the following methods of measuring individual productivity: normalized clinical days per year (nCD/yr); time units per operating-room day worked (TU/OR day); normalized time units per year (nTU/yr); total American Society of Anesthesiologists (ASA) units per OR day (tASA/OR day); and normalized total ASA units per year (ntASA/yr).

Methods: Billing and scheduling data for clinical activities of faculty members of an anesthesiology department at a university medical center were collected and analyzed for the 1998 fiscal year. All clinical sites and all clinical faculty anesthesiologists were included unless they spent less than 20% of their time during the fiscal year providing clinical care, i.e., less than 0.2 clinical full-time equivalent. Outliers, defined as faculty who had productivity greater or less than 1 SD from the mean, were examined in detail.

Results: Mean and median values were reported for each measurement, and different groups of outliers were identified. nCD/yr identified faculty who worked more than their clinical full-time equivalent would have predicted. TU/OR day and tASA/OR day identified apparently low-productivity faculty as those who worked a large portion of their time in obstetric anesthesia or an ambulatory surgicenter. tASA/OR day identified specialty anesthesiologists as apparently high-productivity faculty. nTU/yr and ntASA/yr were products of the per-OR day measurement and nCD/yr.

Conclusion: Each of the measurements studied values certain types of productivity more than others. By defining what type of service is most important to reward, the most appropriate measure or combination of measures of productivity can be

chosen. In the authors' department, nCD/yr is the most useful measure of individual productivity because it measures an individual anesthesiologist's contribution to daily staffing, includes all clinical sites, is independent of nonanesthesia factors, and is easy to collect and determine. (Key words: Clinical days, compensation; mission-based management; time units; work.)

THE ability to measure individual clinical productivity, work performed, or contributions toward the clinical mission has become an important issue facing anesthesiology departments—both in private and academic settings. In the private setting, the measurement of individual work performed for the group has been the basis of compensation, especially profit distribution.¹ In academic anesthesiology departments, the need to measure clinical productivity is being demanded by medical school administrators and budgetary committees who often may not understand the fundamental factors that determine the work output of anesthesiologists in comparison to other specialties.^{2,3}

A variety of measures have been proposed that would quantify the work performed by individual faculty members. For nonanesthesiologists, productivity measures are based primarily on Resource-Based Relative Value Scale (RBRVS) units, usually called relative value units, and focus on work-relative value units, which are determined from billed charges. Anesthesia care is not billed using RBRVS-based procedure codes; instead, it is billed using American Society of Anesthesiologists (ASA) units that include both base units and time units. Not surprisingly, nonanesthesiologists have viewed total ASA units as measures of productivity equivalent to work-relative value units used for other departments.^{4,5}

However, total ASA units may not accurately reflect the needs of an anesthesiology department for anesthesiologists to perform required work. Confounding factors include the facts that: (1) anesthesiologist-independent factors influence the number of ASA units charged per billing period (e.g., the number of room sites that must be assigned, the number of cases posted per site, surgeon's speed, type of surgery); (2) total ASA units do not necessarily reflect increased reimbursement (different concurrency issues); (3) not all clinical activities of the department are billed using ASA units (e.g., Intensive Care, Pain Management, Anesthesiology Preoperative Clinic); and (4) staffing requirements of some clinical sites do not vary with workload (e.g., obstetric anesthesia, in-hospital night call) (see Web Enhancement for examples).

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Table 1. Department of Anesthesiology Clinical Sites

Hospital	Descriptor	Clinical Sites	Billing Method for Services
A	Tertiary and Trauma Hospital	OR suite (22 ORs) Labor and delivery suite Surgical ICU Pain management clinic Day surgery preoperative clinic	ASA units ASA units RVUs RVUs Not billed
B	Ambulatory Surgical Hospital	OR Suite (4 ORs) Anesthesia preoperative clinic	ASA units Not billed
C	Shriners Burn Institute	OR Suite (3 ORs) ICU	Not billed—contract for services provided

All sites were staffed on a regular basis by the Department of Anesthesiology. Only those sites billed using American Society of Anesthesiologists (ASA) units are included in the operating room (OR) full-time equivalent (FTE) and OR days calculations.

ICU = intensive care unit; RVUs = relative value units.

Because of the difficulties involved in using total ASA units to assess productivity, alternative methods have been proposed, including the use of total time units.^{1,6} However, time units, similar to total ASA units, are confounded by the issue of concurrency in groups, such as academic departments, that use an anesthesia care team model. Another alternative method involves using days worked in a clinical setting as a productivity measure. Although this measure addresses the daily staffing needs and the contribution to meeting those needs, it is not clear whether this system would accurately measure the productivity of individual anesthesiologists.

Because it is unclear how each of the productivity measures would perform in meeting the needs of academic anesthesiology departments, we compared the following methods of measuring individual clinical productivity: normalized clinical days per year (nCD/yr), time units per operating room (OR) day worked (TU/OR day), normalized time units per year (nTU/yr), total ASA units per OR day (tASA/OR day), and normalized total ASA units per year (ntASA/yr). Normalized measurements allow for the comparison of individual anesthesiologists with different clinical time commitments. This adjustment of all anesthesiologists' measurements to an equivalency of 100% clinical time is accomplished by dividing each anesthesiologist's data by the percentage of clinical or OR commitment.

Methods

Billing data and scheduling data for clinical activities of individual faculty anesthesiologists of the Department of Anesthesiology at the University of Texas Medical Branch were collected and analyzed for the fiscal year 1998 (September 1, 1997, to August 31, 1998). All sites where anesthesiologists provided clinical services were included. All faculty anesthesiologists who provided services during the fiscal year and were in the department as of September 1, 1998, were examined. Anesthesiologists and their data were excluded if they spent less than 20% of their time during the previous year providing

clinical care (*i.e.*, < 0.2 clinical full-time equivalent [FTEs]).

Clinical Sites

The Department of Anesthesiology at the University of Texas Medical Branch provides clinical services at a variety of sites, including three hospitals (three different OR suites with a total of 29 ORs), two surgical intensive care units (ICUs), and one pain management clinic (table 1). Pain management clinic and ICU services are not billed using ASA units. In addition, services provided in the day surgery unit preoperative clinic are not billed.

Full-time Equivalent: Clinical and Operating Room

The clinical FTE was determined by how many days per week a faculty member worked in the scheduling template (table 2). For example, a full-time anesthesiologist with a clinical FTE of 1.0 would spend 100% of his or her time providing clinical work, *i.e.*, would be scheduled to work 5 days per week in a clinical setting. A more realistic example is a full-time faculty member contracted as 0.8 clinical FTE (80% clinical) who is scheduled to work 4 days per week in a clinical setting and 1 day in a nonclinical setting.

For those anesthesiologists who joined the faculty during the fiscal year, the clinical FTE was multiplied by the percentage of the year spent as faculty to determine the final FTE. For example, a new faculty member working 90% of the time in a clinical setting (0.9 clinical FTE) who joined the department in July (2 months of the fiscal year) had a final clinical FTE of 0.15 (= 0.9 × 2/12). In this case, this faculty member and his or her productivity would be excluded from the analysis because his or her clinical FTE is less than 0.2.

Because not all services are billed in the same manner, for any measurement based on ASA units, an "OR" FTE was used instead of the clinical FTE. An OR FTE for each anesthesiologist was determined by calculating the percentage of clinical days that were spent in sites where ASA time units were billed (table 1) and multiplying this percentage by the percentage of clinical FTE. Example

Table 2. Examples of Clinical FTE and OR FTE Calculations

Faculty	Monday	Tuesday	Wednesday	Thursday	Friday	No. of Clinical Days	No. of OR Days	Clinical FTE	OR FTE
1	OR	OR	NC	OR	OR	4	4	0.8	0.8
2	OR	NC	Preop	OR	OR	4	3	0.8	0.6
3	ICU	ICU	ICU	ICU	NC	4	0	0.8	0.0
4	OR	OR	Pain	Pain	NC	4	2	0.8	0.4
5	NC	NC	OB	OB	OB	3	3	0.6	0.6

Calculation of clinical and operating room (OR) full-time equivalent (FTE) is based on the scheduling template used to prepare the faculty 5 day/week work schedule for five hypothetical faculty members (labeled 1–5). Clinical FTE is based on number of days working in a clinical setting, independent of billing method. OR FTE is based on clinical days worked in a setting that uses American Society of Anesthesiology units for billing (see table 1).

NC = nonclinical day, preop = preoperative anesthesia clinic, ICU = intensive care unit, pain = pain management clinic, OB = obstetric anesthesia care.

calculations of clinical FTE and OR FTE for faculty are illustrated in table 2.

Normalized Measures

Because of the varying clinical and OR FTEs, normalizing individual anesthesiologists' productivity measures for yearly totals allows for interindividual comparison. Normalization extrapolates data to the "equivalent" of 100% clinical time (1.0 clinical FTE) or 100% OR time (1.0 OR FTE), respectively. For example, if a 50% clinical (0.5 clinical FTE) anesthesiologist works 100 days and an 80% clinical (0.8 clinical FTE) anesthesiologist works 160 days, then both would have 200 normalized days worked (100 days/0.5 clinical FTE and 160 days/0.8 clinical FTE).

Because all faculty members would be "equalized" in normalized measures, very low FTE, e.g. less than 0.2, would have the same impact on the mean as high FTE, e.g., 0.9. To avoid distortion of data by low-FTE faculty, any clinical or OR FTE less than 0.2 was excluded from the study.

Productivity Measures

Information concerning productivity measures (clinical days, time units, and total ASA units) can be found in

tables 3 and 4. Definitions of different measures, determination of FTEs, and benchmarks used are summarized in table 3. Table 4 lists specific measurement variables and their calculations for individual productivity.

Analysis and Statistics

We determined the mean, median, and SD for individual measures for nCD/yr, TU/OR day, nTU/yr, tASA/OR day, and ntASA/yr. Outliers were defined as data more than 1 SD from the mean.

Results

Thirty-five faculty anesthesiologists were identified but nine were excluded from all of the measurements because their clinical FTE was less than 0.2. All of the excluded faculty except one were new faculty who joined the department in the month of July during the fiscal year. Hence, there were 26 faculty included in the clinical days measurement. Of these, four faculty members were excluded from the other measures because their OR FTE was less than 0.2. The excluded faculty worked in either the ICU or Shriners Burns Institute

Table 3. Overview of Productivity Measures Comparison

	Definition	FTE	Benchmark	Measurement
Clinical days	Days worked in any clinical site	Clinical FTE	No external benchmark	Normalized clinical days for the fiscal year
	Includes in-house calls, preoperative clinic, ICU, pain management clinic Excludes call from home		Internal used = 227 days*	
Time units	From billed charges Excludes services not billed Excludes services not billed with ASA units	OR FTE	No external benchmark	Time units/OR day worked
	Time unit = 15 min			Normalized time units for the fiscal year
Total ASA units	From billed charges Excludes services not billed Excludes services not billed with ASA units	OR FTE	MGMA benchmarks: 75th percentile of private and academic	Total ASA units/OR day worked
				Normalized total ASA units for the fiscal year

* Benchmark defined as 260 days (5 days/week × 52 weeks) minus 8 institutional holidays and 25 days (5 weeks) of normal time off for vacation, sick leave, and meetings.

FTE = full-time equivalent; ICU = intensive care unit; OR = operating room; ASA = American Society of Anesthesiologists; MGMA = Medical Group Management Association.

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Table 4. Individual Productivity Calculations

Productivity Measure	Variable	Calculations
CD	Normalized clinical days/yr	$nCD/yr = \frac{CD/yr}{\text{Clinical FTE}}$
TU	TU/OR day	$TU/OR \text{ day} = \frac{TU/yr}{OR \text{ day/yr}}$
	Normalized TU/yr*	$nTU/yr = \frac{TU/yr}{OR \text{ FTE}}$
ASA units	Total ASA units/OR day	$tASA/OR \text{ day} = \frac{ASA/yr}{OR \text{ day/yr}}$
	Normalized total ASA units/yr†	$ntASA/yr = \frac{ASA/\text{fiscal yr}}{OR \text{ FTE}}$

* May also be calculated as: $nTU/yr = TU/OR \text{ day} \times nCD/yr$. † May also be calculated as: $ntASA/yr = ASA/OR \text{ day} \times nCD/yr$.

CD = clinical days; FTE = full-time equivalent; TU = time units; OR = operating room; ASA = American Society of Anesthesiologists.

(table 1). The pain management clinic and day surgery unit preoperative clinic faculty were included, but their OR FTE reflected only time that they worked in the OR sites.

In table 5, the mean, median, and SD for individual faculty members' measures are shown. Comparisons to available benchmarks are also shown. The difference between clinical FTE and OR FTE represents clinical days in areas where services were not billed *via* ASA units (*i.e.*, pain management clinic, ICU, Shriners Burns Institute, day surgery unit preoperative clinic) and were excluded from the OR FTE.

The numbers of outliers for each of the measurements are noted in table 5. For nCD/yr , the high outliers all had a clinical FTE less than or equal to 0.5. For TU/OR day, low outliers worked a large portion of their clinical time either at the ambulatory surgical center or in obstetric anesthesia. Because nTU/yr is the product of TU/OR day and nCD/yr , outliers are a combination of the two measurements. For $tASA/OR \text{ day}$, low outliers also represented the ambulatory surgical center and obstetric anesthesia. The high outliers represented either cardiac anesthesiologists or pediatric anesthesiologists. Because

$ntASA/yr$ is the product of $tASA/OR \text{ day}$ and nCD/yr , outliers are again a combination of the two measurements.

Discussion

For academic anesthesiology departments, the measurement of both individual and departmental productivity is becoming important for not only individual compensation but also promotion, justification of budgets, and the justification of staffing levels (number of FTEs). Three areas of work—clinical, education, and research—must be included to completely measure overall individual productivity in an academic setting. Although anesthesiology research and education measures may be similar to other clinical departments at an institution, measuring clinical productivity for anesthesiologists presents a unique challenge. Furthermore, individual productivity measures may be different than departmental measures in their metrics and their use by management. In this study, we limited our focus on individual clinical productivity.

Table 5. Productivity Measures: Overall Results

Productivity Measure	Number of Faculty Included	Individual Faculty				
		Mean	Median	SD	No. High Outliers	No. Low Outliers
Clinical FTE	26	0.71	0.80	0.23		
OR FTE	22	0.60	0.56	0.24		
nCD/yr	26	232	229	26	5	3
% Benchmark 1		102	101			
TU/OR day	22	40.90	42.14	5.83	1	4
nTU/yr	22	9,503	9,690	1,662	3	3
$tASA/OR \text{ day}$	22	65.25	67.83	8.25	3	4
$ntASA/yr$	22	15,183	15,143	2,643	5	3
% MGMA private		151	151			
% MGMA academic		95	95			

Benchmark 1 is an internal benchmark for clinical days worked. The 75th percentile of 1999 Medical Group Management Association (MGMA) private and academic total units, respectively.^{4,5} Outliers are defined as greater than 1 SD from the mean. Clinical or operating room (OR) full-time equivalents (FTEs) are defined in the text.

nCD = normalized clinical days; TU = time units; nTU = normalized time units; $tASA$ = total American Society of Anesthesiologists units; $ntASA$ = normalized total ASA units.

Assessment of individual productivity in anesthesiology departments, both private practice and academic, has become an important issue concerning administrators and faculty alike. Measuring individual productivity as a basis for compensation (particularly profit distribution) has become standard for private practice groups. In fact, Venters¹ described the process that her large group of anesthesiologists undertook to determine the income distribution plan. As noted, there is no perfect system for measuring individual work performed or contribution to the group. In Venter's report, the group rejected total ASA units or total charges as the measure because these systems favored specialty anesthesia services (e.g., cardiac anesthesia). Instead, they settled on a system based on time units worked and time units assigned for administrative and call duties. Unfortunately, one cannot simply assume that this system would be best for all anesthesiology practices. For instance, the system described by Venters works well in a physician-only group, where concurrency is not an issue. Hence, the process of discussing the benefits and disadvantages of each productivity measure is valuable to any group and allows the group to make educated decisions on how work will be measured and rewarded.

In the current study we focused on a large academic department because academic departments have a broader range of clinical responsibilities than most private-practice groups. The department studied has typical clinical requirements for an academic department. The department's various clinical settings include more than one OR suite, a pain management clinic, ICUs, and pre-operative clinics. The majority of the anesthesia care is delivered by an anesthesia care team with faculty supervising residents or nurse anesthetists, whereas personally performed OR day assignments ("Faculty Rooms") account for approximately 20% of the OR days. In-hospital call consists of two faculty anesthesiologists each night and weekend day. The department also has specialty anesthesia teams (e.g., cardiac, pediatric, neuroanesthesia, and vascular) that provide care for specialty surgical cases. By definition, not all faculty are members of these teams, and hence, specialty cases are not performed equally by all faculty. In addition, the decision-making process for determining the number and type of clinical sites involves nonanesthesiologists (e.g., surgeons) and not necessarily the individual faculty anesthesiologists whose productivity is to be measured.

Difficulty of Measuring an Anesthesiologist's Productivity

Several factors contribute to the difficulty of measuring productivity for an individual anesthesiologist. Multiple clinical sites become a factor when these sites do not bill for services using ASA units or when services are not billed at all (table 1).

Our anesthesiology department is obligated to staff

clinical settings despite daily or weekly variation of workload. For example, two faculty anesthesiologists are in-hospital every night to staff the OR suite and the labor and delivery suite. We are obligated to staff these positions even if there are no cases scheduled. Another example is that the number of ORs to start in the morning is determined by the OR committee. The department is obligated to staff the predetermined number of ORs even if some have few or no cases scheduled. Hence, any measurement of productivity must reflect these staffing requirements that are independent of individual workload.

Concurrency Issue

Because anesthesia care can be delivered in a team model, concurrency can affect different productivity measurements. Obviously, this is not an issue in groups that only provide personally performed anesthesia services (MD-only groups). However, this is an important issue for any department that trains residents. By definition, an academic department must at least have several residents for whom medical direction is billed. Many also have nurse anesthetists as part of the care team. The addition of concurrency confounds the comparison of productivity measures. Posner and Freund⁶ clearly showed that concurrency and productivity as measured by time units per FTE were positively related. The investigators concluded that productivity increased with concurrency. However, this conclusion may not always be accurate. Financially, medical direction reimbursement to the physician by the Medicare program is 50% of the personally performed reimbursement. Therefore, when one moves into the field of medical direction, the ability to maintain the same reimbursement requires at least doubling the ASA units billed. Furthermore, doubling the ASA units produced at least triples personnel requirements (those providing medical direction plus those providing direct care). If concurrency status is not the same, simply examining the amount of units billed per anesthesiologist is not sufficient for identifying a change in productivity (see Web Enhancement).

Unfortunately, trying to adjust units billed by concurrency is not an easy task, because concurrency may change during a case or during a day worked. For example, an anesthesiologist assigned to direct three ORs may have an initial concurrency of 1:3, but this concurrency will fluctuate from 1:3 to possibly 1:1, depending on when surgical cases finish and start. In the department we studied, the standard concurrency assignment is one faculty anesthesiologist to two residents-nurse anesthetists-anesthesia assistants. Most faculty are assigned to single rooms in which they personally provide direct care for approximately 15-20% of the time. Because of the difficulty of adjusting for concurrency and because the standard of concurrency scheduling did not change, concurrency was ignored for measurements of units. If the department had had different standard concurrency

Table 6. Productivity Measures: Anesthesia Services Valued and Devalued

Measure	Services Valued	Services Devalued
Normalized clinical days/yr	All clinical sites measured Days worked are independent of nonanesthesiologist factors.	Specialty anesthesia care Longer workdays or higher workload clinical sites
Time units/OR day	Only clinical sites that bill using ASA units are measured. Time providing billable anesthesia care Medical direction (concurrency >1) Higher concurrency	Not all clinical sites measured Time providing nonbillable anesthesia clinical care, including preoperative evaluation, postoperative care, and administration Personally performed cases compared with medical direction Specialty anesthesia care Low ASA units generating sites, e.g., obstetric anesthesia, in-hospital call Short and fast cases, e.g., in ambulatory surgicenter
Total ASA units/OR day	Only clinical sites that bill using ASA units are measured. Total charges billed Specialty anesthesia care Medical direction (concurrency >1) Higher concurrency	Not all clinical sites measured Nonbillable anesthesia clinical care, including preoperative evaluation, postoperative care, and administration Personally performed cases compared with medical direction Low ASA units generating sites, e.g., obstetric anesthesia, in-hospital call
Normalized time units/yr	= nCD/yr × TU/OR day Services valued and devalued are combinations of these two measures.	
Normalized total ASA units/yr	= nCD/yr × tASA/OR day Services valued and devalued are combinations of these two measures.	

Each of these measures values and devalues different types of productivity. By defining what type of services is most important to reward, the most appropriate measurement or combination of measures of productivity can be used.

OR = operating room; ASA = American Society of Anesthesiologists; nCD = normalized clinical days; TU = time units; tASA = total ASA units.

assignments for different clinical sites or time periods, the concurrency factor should not and would not have been ignored.

Benchmarks

The purpose of quantifying individual productivity is to be able to compare a anesthesiologist's current productivity with previous productivity and the productivity of other anesthesiologists. Without external benchmarks or data from other departments, this comparison can only be performed internally. As of the time of this study, the only current benchmarks for anesthesiology are from data from the Medical Group Management Association's annual physician productivity reports. This data is presented as "total units billed per year."^{4,5} Unfortunately, this data falls short of ideal because of a lack of standard definitions and calculations as well as a failure to address concurrency. It is unclear from the data whether the reported numbers represent total ASA units or total ASA units plus total RBRVS units. RBRVS units can occur because of inclusion of services such as the pain management clinic and intensive care. Furthermore, the data are normalized, but the definition does not specify total, clinical, or OR FTE. Finally, the difference between the Medical Group Management Association's private benchmark and the academic practice

benchmark (75th percentile) is very large, with the academic benchmark approximately 50% greater than its private counterpart. Different concurrencies may partially explain this variance. The private data include some physician-only groups that would have an anesthesiologist-to-OR ratio of 1:1, which is unlike the academic model of 1:2 or 1:3.

For clinical days worked, there is not an external benchmark. Without reliable benchmarks, all comparisons of individual productivity between anesthesiologists and from one year to the next must be internal.

Productivity Measurements

In this study, each of the productivity measurements identified different outliers. The evaluation of these outliers and their clinical duties illustrated what productivity was being measured and what was not. In table 6, each measure and the services valued and devalued are summarized. With this understanding of the advantages and disadvantages of each of the measures, a department can decide on what types of service to reward and thus choose the appropriate measure.

Normalized Clinical Days Worked per Fiscal Year

The clinical days measurement is attractive because it measures the individual's contribution to daily staffing.

As any anesthesiologist who is responsible for the daily schedule well knows, one of the largest challenges is staffing clinical sites on a daily basis. Clinical days reflect the individual anesthesiologist's contribution to the clinical mission of the department. Another advantage of this measure is that it can be applied to all clinical work despite the setting and billing practices. The disadvantage is that clinical days do not provide rewards or incentives to work hard on that day of work. In this study, high outliers represented anesthesiologists whose contribution was higher than the average by 1 SD. Because the clinical days worked are normalized, the high outliers are not necessarily those who had the highest FTE. In fact, the results show that anesthesiologists with FTEs less than or equal to 0.5 represent all of the high outliers. This observation could be explained by several factors, including the following: (1) even if an anesthesiologist is 50% clinical, he or she still takes full in-house call; or (2) 50% clinical faculty can take time off for meetings and nonclinical activities during their nonclinical time rather than during clinical time. In either case, the measurement identified those faculty members who worked above average for their assigned FTE. For the lower outliers, the faculty members performed less days than expected by their FTE. The major explanation for this is that each member in question took more than average time off for vacation, meetings, or sick leave.

Operating Room Full-time Equivalent

If ASA units billed are the metric used, then it would not be appropriate to include the time worked in sites that do not bill using ASA units. Therefore, instead of the clinical FTE used in nCD/yr, an OR FTE must be used. Because four faculty members with clinical FTEs greater than 0.2 had OR FTEs less than 0.2, the number of anesthesiologists that could be measured decreased from 26 to 22 in the ASA units measurements. Clearly, the inability to include ICU, pain management, and other clinical work in the measurements is a disadvantage that needs to be considered.

Total American Society of Anesthesiologists Units

Using total ASA units as a measure of productivity has both advantages and disadvantages. The major advantage is the ease of determination. Another advantage is that nonanesthesiologists view total ASA units as the equivalent to RBRVS units as a measure of productivity. The major disadvantage is that the total ASA units are influenced by factors independent of the anesthesiologist's work or skills (see Web Enhancement). These factors include the number of ORs available each day, the extent of use of available time, the speed of surgeons, differences in base units, and daily assignments (e.g., being assigned to obstetric anesthesia). For the same surgical procedures, anesthesia services provided to a faster surgeon will result in higher total ASA units charged for the

same time period than a slower surgeon because of the front-loaded base units. Furthermore, specialty anesthesiologists' ASA units will be higher than those of general anesthesiologists because of the high base units involved in specialty procedures. In addition, obstetric anesthesia services generally produce less ASA units per workday than the general OR.

Our results confirm these concepts. High outliers for both tASA/OR day and ntASA/yr included specialty anesthesiologists. Low outliers included anesthesiologists that worked in labor and delivery. Therefore, evaluation of ASA units alone suggests that these faculty members are high or low "producers" rather than emphasizing assignment to high-unit or low-unit clinical sites.

Time Units

Time units are an attractive measure of productivity because they are a measurement of time spent providing anesthesia care. The major advantage is that this measure eliminates the base units from productivity measures. In the assignments to more surgeries with higher base units, are rotated equally among all the anesthesiologists, the factor of ignoring base units is moot. On the other hand, in a large group, such as an academic anesthesiology department, subspecialty teams exist, and hence, not all anesthesiologists will provide services to all types of cases. Therefore, using time units as the standard of comparison will deemphasize the apparent financial advantage that accrues to specialty anesthesiologists. The major disadvantage of time units is the issue of concurrency. If concurrency is not controlled, then comparisons between individual anesthesiologists cannot be made. Another disadvantage is that the billing of time units for management of labor analgesia may not reflect the actual time the anesthesiologist must be in the hospital and immediately available. Therefore, it is not surprising that low outliers for time units measurement included obstetric anesthesiologists. Finally, the ambulatory surgical center OR finishes at an earlier time than the main ORs—a fact that is reflected in the time measures. What is not reflected in the time units billed is the preoperative services performed in the afternoon by the anesthesiologist(s) in the ambulatory surgical center. Similar to ASA units, it is unclear whether these faculty members are low producers or whether they are simply working in low-producing clinical sites.

Per Operating Room Day or Normalized Per Year

As seen in Results, total ASA units and time units can be examined by measuring per OR day or normalized per year. The per-OR-day measurements allow for evaluation of productivity per period worked, *i.e.*, the productivity for each work day. The per-year measurement is normalized to equalize the different FTEs but does not address the number of days worked. Therefore, the per-year measurement does not reflect equal periods worked but

reflects "equalized FTEs." In other words, an anesthesiologist may be a high producer under the normalized measure because he or she worked more days in the year but not a high producer per day worked. Once again, the identification of a highly productive anesthesiologist depends on the measurement used to measure individual productivity.

Quality versus Quantity

A major deficit to using any of these measures is the fact that quality of services provided is not quantified. Quality is not easy to define or to measure, yet any definitive measurement of productivity should account for it. Unfortunately, no objective measure is easily performed. Some soft measures that can be used include number of request cases, satisfaction surveys of colleagues (surgeons, nurses, other anesthesia care team members), and satisfaction surveys of patients.

Conclusion

How to measure the individual productivity of anesthesiologists and how to present evidence of individual productivity to medical administrators is a daunting task facing academic anesthesiology departments. In this study, several measurements were examined: nCD/yr, ntASA/yr, tASA/OR day, nTU/yr, and TU/OR day. Each of these measures values certain types of productivity more than others (table 6). By defining what type of services are most important to reward, the leadership of an academic department or private practice group can then choose the most appropriate measure or combination of measures of productivity to be used.

In our department, we have determined that nCD/yr is

the best measure of individual productivity. The nCD/yr measures the anesthesiologist's contribution to staffing all the clinical sites, which is the major day-to-day clinical challenge of academic anesthesiology departments. Furthermore, all clinical sites, independent of workload or billing, are included in this measure. Unlike total ASA units or time units, the number of clinical days worked is influenced by the individual anesthesiologist and is not affected by nonanesthesia factors. Finally, data quantifying clinical-days information are easy to collect and determine.

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