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Should Anesthesia Groups Advocate Funding of Clinics and Scheduling Systems to Increase Operating Room Workload?

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Background: **Knowledge of patterns related to patient visits in a multispecialty group is important for helping anesthesia groups make strategic and tactical decisions relevant to increasing anesthesia workload.**

Methods: **The authors studied surgery at an outpatient surgery center over 6 months and analyzed every clinic visit that preceded surgery by 2 yr. They also studied surgery that occurred at either the outpatient center or a tertiary surgical suite over 3 months, including all preceding clinic visits.**

Results: **Results were similar whether data were analyzed by number of cases or by American Society of Anesthesiologists' Relative Value Guide units. The median number of visits to the surgeon before surgery was 2 (95% confidence interval 2–2). Most patients have one visit with the surgeon, decide to have surgery, and then have one preoperative visit. Fewer than 20% of American Society of Anesthesiologists' Relative Value Guide units for outpatient surgery arose from patients seen by a primary care or nonsurgical specialist before referral to the surgeon. Patients with more than one previous surgery at the facility accounted for less than 6% of American Society of Anesthesiologists' Relative Value Guide units.**

Conclusion: **Investment in outpatient primary care clinics, nonsurgical specialty clinics, or scheduling systems to facilitate patient appointments would not materially affect anesthesia workload. The workload of the anesthesia department depends on facilitating surgeon-dependent processes: (1) open access to operating room time on any future workday, (2) well-calculated blocks to permit high surgeon productivity, and (3) open access to surgeon clinics to reduce days from referral to first appointment.**

MANY departments of anesthesia would like to increase their workload or prevent declines in workload. This article applies to those anesthesia departments that are part of multispecialty groups, such as many academic practices, or to those groups that practice together with surgical groups at one hospital. The anesthesia department provides all of the anesthesia services for the group's surgeons and *vice versa*. Strategic and tactical decisions made by the anesthesia department alter workload by influencing the physicians (*e.g.*, surgeon *vs.* primary care) who determine patient referrals. Our hypothesis is that examination of factors that influence the decision of the patient to have surgery at the anesthesia department's hospital will provide valuable information about the role of different types of physicians in determining the workload of the anesthesia department. Examples of use of the information are below.

(1) The head of the anesthesia department is attending a multispecialty group meeting where representatives are deciding whether to invest in a new primary care outreach clinic or an expanded sports medicine program. Should the anesthesia head keep quiet (*i.e.*, stay out of the controversy), focus on sports medicine because it relates to orthopedics, or advocate for primary care because it may feed so many different types of surgery?

(2) A capital spending committee is considering a decision between new surgical equipment for one specialty and an enhanced clinic scheduling system for all clinics. The scheduling system would facilitate improved management of patients who have multiple visits with their surgeon over many months. Does the anesthesia department have a stake in the duration of patient waiting in the surgeon's office because it may influence patients' decisions to remain with that surgeon? Alternatively, the new information system may be valuable to the anesthesia department by providing flexibility in the process of referral to the surgeon. This may be so if a large fraction of anesthesia workload were attributable to external referrals, with each patient seeing his surgeon for only a limited number of appointments.

(3) Surgeons complain of a lack of operating room (OR) time. An OR committee is addressing surgeons' use of OR time and is currently focused on many small delays throughout the day. The surgeons say that they are "going to see consults." If most patients are only seen once by the surgeon in a consultation before scheduling of surgery, then leaving the OR to see consults may be reasonable. If, in contrast, a large portion of anesthesia workload is attributable to patients seen multiple times during repeated visits to the surgeon, then surgeons should not be letting the OR sit idle while complaining of a lack of OR time.

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(4) The anesthesia group's orthopedic surgeons want to open a branch outpatient surgery center in the suburbs. They explain that a nice location with good parking will attract patients. On the one hand, increasing the number of anesthetizing locations at a separate facility would tend to reduce anesthesia productivity. On the other hand, maintaining or growing anesthesia workload is important. To what extent does the typical patient have experience with the ORs that would influence his decision whether or not to have surgery with the multispecialty group based on location and convenience of parking?

By participating in decisions about assignment of resources in the multispecialty group, the anesthesia department influences its own workload. Absent additional information, management decisions for physician practices are reasonably based on the most common patient. We therefore examined the most common patient patterns related to surgical visits. Analyses of workload were based on American Society of Anesthesiologists' Relative Value Guide (ASA RVG) units. We investigated the number of clinic visits with the surgeon before surgery and the months until surgery. We examined the number of visits with a primary care physician before seeing the surgeon. We also measured the number of previous surgeries the patient underwent at the facility. Later in the article, we show how this information aids in tactical and strategic planning from the perspective of anesthesia providers within a multispecialty group.

Materials and Methods

This study was performed as a process improvement project for an anesthesia department in a multispecialty group. Publication of summary statistics was approved by the Institutional Review Board of the University of Iowa, Iowa City, Iowa.

Our hypothesis involves examination of the extent to which primary care physicians, specialty care physicians, and surgical clinic management have a role in determining the workload of the anesthesia department. Patients may become surgical customers of the study hospital and the anesthesia department for several reasons (fig. 1). (1) Some patients have been followed by surgeons in the group for multiple clinic visits over extended periods, and then the patients have surgery. (2) Some patients have been treated by the group's primary care physicians (or medical or pediatric subspecialists). The patients are then referred to a surgeon within the group, who sees the patient once or twice in clinic before surgery. (3) Some patients have had previous surgery at the outpatient surgery center or tertiary suite. (4) Some patients likely were referred to the surgeon by physicians external to the group practice. The anesthesia department under study had little or no knowledge of the relative impact of these four sources on its workload. We believe most other anesthesia departments have little knowledge, as well.[1,2]

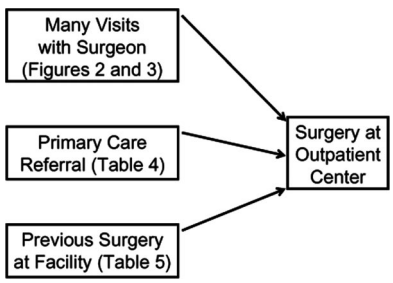

Fig. 1. Factors that potentially influence anesthesia workload at the hospital's ambulatory surgery facility.

We studied patients having surgery at a hospital served by a multispecialty group that included surgeons, anesthesiologists, and primary care physicians. Patients had surgery at the hospital's outpatient surgery center between April 1, 2007 and September 30, 2007. We also studied all patients having surgery at either the hospital's outpatient surgery center or tertiary surgical suite during the first half of this interval, between April 1, 2007 and June 30, 2007. The outpatient surgery center consisted of 6 ORs, and the tertiary suite consisted of 24 ORs. Patients underwent outpatient surgery at either the outpatient center or the tertiary surgical suite. We therefore chose to study (1) outpatient surgery and (2) all types of surgery combined as two independent groups because we could not distinguish between outpatient surgery and same-day-admit surgery based on location. However, 86% of the anesthesia workload as measured by ASA RVG units for "all types" of surgery combined came from the tertiary suite, and we studied medians; results for "all types" were therefore effectively those of the tertiary suite by itself (table 1). All surgeons in the multispecialty group operated exclusively at one or both of these two facilities (excluding the local Veterans Affairs hospital with which the study hospital does not compete), and no other surgeons not in the multispecialty group operated at either of the two facilities.[3]

Table 1. Characteristics of Outpatient Surgery and "All Types" of Surgery

	ASA RVG Units	Cases	Patients
Outpatient surgery center	14.0%	25.5%	26.5%
Tertiary surgical suite			
Outpatient surgery or elective surgery on date of admission	56.2%	49.5%	51.1%
First surgery after date of admission and/or urgent surgery	29.8%	24.9%	22.4%

The sample sizes were 94,913 ASA RVG units, 4,948 cases, and 4,765 patients.

ASA RVG = American Society of Anesthesiologists' Relative Value Guide.

Billing data, OR information system data, and enterprise-wide clinic scheduling data were merged to determine the relative impact of surgical clinics, primary care visits, and prior surgery on anesthesia workload. Workload was measured in terms of both number of cases and number of ASA RVG units. ASA RVG units were calculated as the sum of base units and time units for cases performed in ORs plus the base units for additional procedures performed in the OR or pain clinic on the day of surgery. Procedures with base units only included nerve blocks and placement of arterial lines, central lines, and pulmonary artery catheters. Blocks that were not billed were still included because they contributed to the total anesthesia workload. The "base units" for these procedures were determined using the ASA "Crosswalk" table.

For outpatient surgery, the total workload for 6 months was 27,980 ASA RVG units derived from n = 2,582 cases on n = 2,396 unique patients. For all types of surgery, the total workload for 3 months was 94,913 ASA RVG units from n = 4,948 cases on n = 4,552 unique patients. From the perspective of an anesthesia department planning staffing needs, ASA RVG units is a more accurate and effective measure of workload than cases because it is directly tied to labor requirements and resource-intensity and because it forms the basis for reimbursement. For example, suppose we have two cases, carpal tunnel (6 units including time) and liver transplantation (70 units including time). The total number of units (76) is a better measure of workload than cases.[2] When weighted by resource intensity in the form of ASA RVG units, the liver transplantation case is 92% of weighted cases and the carpal tunnel is 8%.

Our initial analyses explored differences in cumulative probability distributions for both the number of presurgical visits with the surgeon and the months until surgery. We compared each variable twice, once with cases weighted by ASA RVG units and once with cases weighted equally. The 69 outpatient surgical cases and 1 tertiary suite case with 0 ASA RVG units were included even though no anesthesia provider was present; such cases would be included in analyses performed by a hospital. Consequently, we slightly underestimated the potential equivalence of results between ASA RVG units and cases.

We determined the number of clinic visits with the surgeon that preceded surgery. For the few patients who underwent multiple surgeries during the 6 months (outpatient) or 3 months (all types), only the first surgery was studied if the surgeon was the same for each visit or hospitalization. If a patient had an outpatient visit and/or hospitalization with more than one surgeon, we studied the first visit or hospitalization for each surgeon.

We studied the months from the first clinic visit with the surgeon until the day of the first surgery with that surgeon for patients receiving care at the outpatient facility. We did not study this endpoint for all types of surgery because a hospitalized patient may have been admitted to the medical intensive care unit, had first surgery on the 40th day of admission, and undergone another surgery on the 100th day. For inpatients, therefore, the time from first clinic visits to surgery could not be compared directly to values for outpatients. Our analyses of all types of surgery included all cases, because they contribute to total anesthesia workload and the objective of the study was to determine the importance of referral on total workload.

To assess the equivalence between plotting a variable as a function of either cases or ASA RVG units, Q-Q plots were generated. The Q-Q plots graphed percentile on the y axis, which was visits before surgery, months to surgery, or dollar charges, based on ASA RVG units. Percentiles were also graphed on the x axis, now based on number of cases. Percentiles are quantiles that are integer multiples of 100. Each variable can be divided into 100 percentiles.

Performing analyses weighted by ASA RVG units is far more complex and time intensive than analysis by cases. The former requires alignment among databases containing surgical schedules, anesthesia billing data, and primary care appointments. The latter just involves counts.[4] The Q-Q plots allow an immediate determination of the equivalency between plotting a variable based on ASA RVG units or cases. If the percentiles are equal and the graph passes through the origin, the two plots would be equivalent. Q-Q plots are cumulative distribution functions.

The number of observed presurgical visits and the months from first clinic visit to surgery may be influenced by secondary factors. First, geography may be an issue. Therefore, we repeated analyses after excluding patients living in the same county as the hospital. For outpatient surgery, ASA RVG units were 20.0% less and cases were 21.6% less. For all types of surgery, ASA RVG units were 12.7% less and cases were 15.5% less. Second, 20 of the 80 surgeons studied joined the multiple specialty practice after the start of the data collection period, thereby potentially reducing the number of visits they could have had with patients. Therefore, we repeated analyses after excluding the patients of these surgeons. For outpatient surgery, ASA RVG units were 13.8% less and cases were 14.0% less. For all types of surgery, ASA RVG units were 23.3% less and cases were 22.3% less.

We explored the potential influence of primary and nonsurgical specialty care on the anesthesia workload. For both cases and ASA RVG units, we determined whether the patient had two or more visits with a primary care physician in the multispecialty group before first seeing the surgeon. For inpatient surgery, the first encounter with the surgeon was considered to be on the date of admission. The primary care visits studied were those located within the hospital campus or

within the multispecialty group's network of multiple offices throughout the hospital's county and contiguous counties. Primary care was defined as family medicine, obstetrics, or nononcological gynecology. Note that this definition will likely markedly overestimate the actual incidence of routine primary care. We knowingly overestimated the incidence of primary care even more by including the group's specialty clinics of internal medicine and pediatrics. Internal medicine could include an interventional cardiologist as well as a general internist following the patient for hypertension.

We explored prior patient surgical experience at the facility. Surgery with length of stay less than 24 h was considered an admission to the hospital. A patient who was admitted with a burn injury and underwent five surgeries was counted as one admission but five anesthetic cases because there was one previous decision (by someone) for the patient to receive care at the hospital *versus* another facility.

Finally, we studied how other anesthesia departments can use brief surveys to learn about the influence of clinic scheduling for multiple recurrent appointments on their workloads. When each patient arrives on the day of surgery, the patient could be asked, "Not including today, how many office visits did you have with your surgeon related to the problem for which you are having surgery today: 0, 1, 2, 3, 4, > 4?" After 5 days of surveying, the median could be calculated. To assess the validity of this approach for facilities with few (approximately 20) cases per day, we created 20,000 random samples (with replacement) of n = 100 outpatient cases, where 100 represents 5 days to complete the survey × 20 patients surveyed per day. This analysis was performed using Excel 2003 Visual Basic for Applications (Microsoft, Redmond, WA).

Statistics

Kolmogorov-Smirnov two-group test was used to compare cumulative probability distributions (SYSTAT 12; Systat Software, Inc., San Jose, CA). Confidence intervals were calculated for every percentage in the Results and Tables by using the Clopper-Pearson method[5,6] programmed using Excel 2003 Visual Basic for Applications (Microsoft). Both of these statistical methods are distribution-free. Because the absolute difference between every reported percentage and its lower and upper 95% bound was less than 1.5%, the confidence intervals are not repeated throughout the paper. Confidence intervals for quantiles of waiting times were calculated by using the same method. General linear modeling was used to study the relationship between total time (dependent variable) and counts of presurgical visits (independent variable) while treating the type of procedure as a fixed effect (SYSTAT 12). The linear model used no intercept. The type of procedure was modeled by the Agency for Healthcare Research and Quality's Clinical Classification Software's grouping of Current Procedural Terminology codes.§

Results

Figure 2A shows surgeon visits, both number of visits before surgery and months from initial visit. The Q-Q plots show percentiles plotted against percentiles. At all percentiles, results based on case were the same as results based on ASA RVG units (fig. 2A). The 25th, 50th, and 75th percentiles are shown in red. For number of visits, the maximum absolute difference between all possible quantiles of each cumulative distribution function was 1.0% for outpatient surgery and 3.0% for all types of surgery. The 1.0% absolute difference was not significant for outpatient surgery ($P = 0.98$), whereas the 3% difference was statistically significant for all types of surgery ($P = 0.0005$). However, a 3% difference is of negligible importance managerially. As a comparison to show that quantiles can indeed differ markedly between cases and ASA RVG, we used a financial endpoint as a control. Figure 2B is an analogous plot for hospital charges instead of number of visits or months to surgery.

Most patients undergoing outpatient surgery had few preoperative clinic visits with their surgeon. Outpatients had a median of two visits (95% CI 2–2 visits), with each case weighted by its ASA RVG units. The medians and confidence intervals were identical for all other comparisons: outpatients weighted by cases, all types of surgery weighted by ASA RVG units, and all types of surgery weighted by cases. The medians and confidence intervals were unaffected by potential bias due to data censoring caused by surgeons who had recently joined the practice. They were also unaffected by potential bias due to additional visits from patients residing in the hospital's county.

As expected, median preoperative clinic visits differed significantly among types of procedures (table 2). For example, patients undergoing corneal transplant had more visits than those undergoing dacryocystorhinostomy. These results serve as a positive control. The important result is that, even for corneal transplant, the median was only three preoperative visits with the surgeon. Figure 3 shows that outpatients with four or fewer preoperative clinic visits with their surgeons accounted for 82% of ASA RVG units. Percentages of patients having four or fewer visits were essentially the same for all types of surgery by ASA RVG units (84%, fig. 3), for outpatients by case (83%), and for all types of surgery by case (84%).

Our report is essentially a case study of one anesthesia department. Other anesthesia departments may have practices that have a different number of clinic visits

§ Healthcare Cost and Utilization Project. Available at www.hcup-us.ahrq.gov/tools_software.jsp; accessed July 18, 2008.

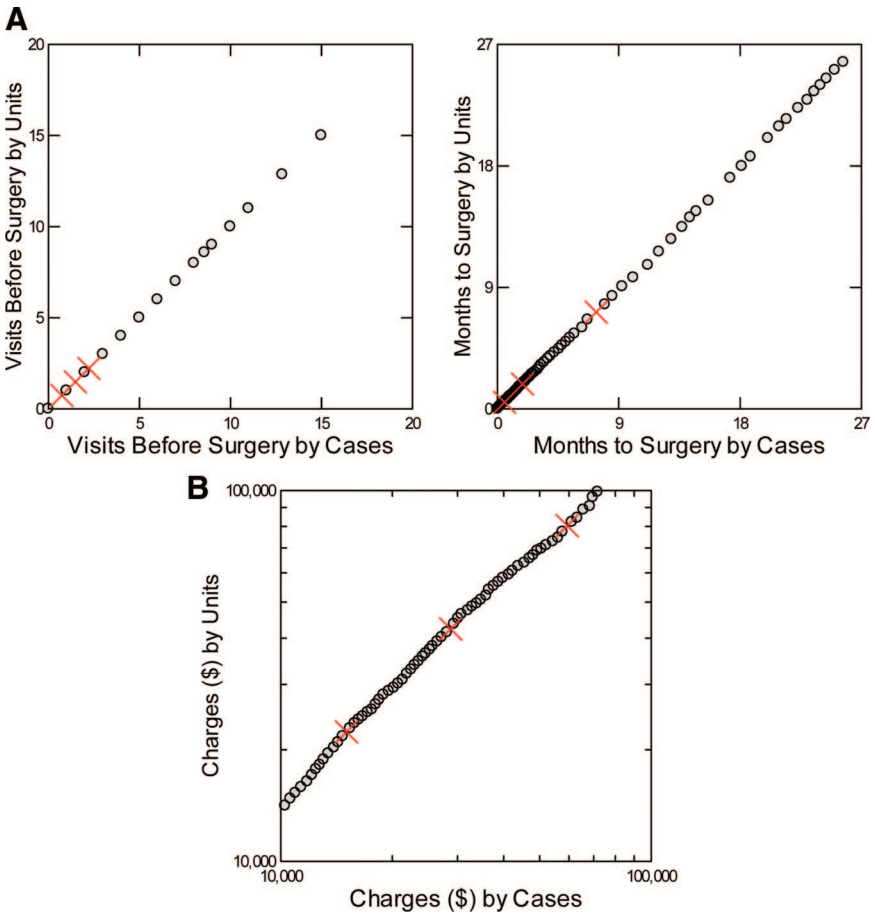

Fig. 2. (*A*) Two-sample quantile plots for outpatient surgery patients showing only percentiles. The plot on the *left* shows the number of months between the first appointment with the surgeon and surgery. The plot on the *right* shows the number of times the patient completed an appointment with the surgeon in clinic during the 24 months preceding surgery. The percentiles were calculated using the Cleveland method. Because of extensive overlap among points, not all 99 points are visible. The 25th, 50th, and 75th percentiles are shown with ×. For the values shown on the *horizontal axis*, all cases had equal weights. For the values on the *vertical axis*, each case was weighted by its American Society of Anesthesiologists' Relative Value Guide (ASA RVG) units. The cumulative probability distributions are indistinguishable (months $P = 0.53$, visits $P = 0.98$). (*B*) Two sample quantile plot for total hospital charges, limited to the 12th to 81st percentiles. The 35th percentile of charges based on ASA RVG units corresponds to the median (50th percentile) of charges based on cases. The 25th, 50th, and 75th percentiles are shown with ×. Fig. 2*B* is a positive control showing the large differences in ASA RVG units and cases for financial criteria.

with the surgeon preceding surgery. We therefore studied how other anesthesia departments can use brief surveys to learn about the influence of clinic scheduling for multiple recurrent appointments on their workloads. When each patient arrives on the day of surgery, the patient could be asked, "Not including today, how many office visits did you have with your surgeon related to the problem for which you are having surgery today: 0, 1, 2, 3, 4, > 4?" After 5 days of surveying, the median could be calculated. For 97.90% of 20,000 random samples, the median was two visits (*i.e.*, 2.1% was the Type I error rate of rejecting the hypothesis of no difference of results from ours). For 100% of the samples, the median was different by no more than one visit (*i.e.*, one, two, or three visits).

An important implication of these findings is that the ease with which recurrent appointments with surgeons are available or can be scheduled conveniently is unlikely to influence anesthesia department workload; few patients have recurrent appointments. Rather, the scheduling characteristics most directly affecting anesthesia workload are those characteristics that facilitate the ini-

Table 2. Most Common Types of Procedures at Outpatient Surgery Center and Median Number of Visits with the Surgeon before Surgery

CCS	Most Common Procedure in CCS	% ASA RVG Units	% Cases	Median Visits (95% CI) by ASA RVG Units	Median Visits (95% CI) by Cases
15	Extracapsular cataract removal with lens insertion	18%	23%	2 (2–2)	2 (2–2)
160	Repair of ruptured musculotendinous cuff (*e.g.*, rotator cuff)	7.4%	6.5%	2 (2–2)	2 (2–2)
21	Strabismus surgery	6.9%	5.8%	2 (2–2)	2 (2–2)
162	Knee arthroscopy and chondroplasty	5.8%	4.6%	2 (2–2)	2 (2–2)
19	Dacryocystorhinostomy	5.4%	5.2%	1 (1–1)	1 (1–2)
13	Corneal transplant	3.6%	2.7%	3 (3–3)	3 (1–4)
6	Neuroplasty median nerve at carpal tunnel	3.0%	4.2%	2 (2–2)	2 (2–3)
	ALL	50%	52%	2 (2–2)	2 (2–2)

The seven Clinical Classifications Software (CCS) listed are those with the largest total number of American Society of Anesthesiologists' Relative Value Guide (ASA RVG) units. They accounted for 50% of all ASA RVG units and 52% of all cases at the outpatient surgery center.

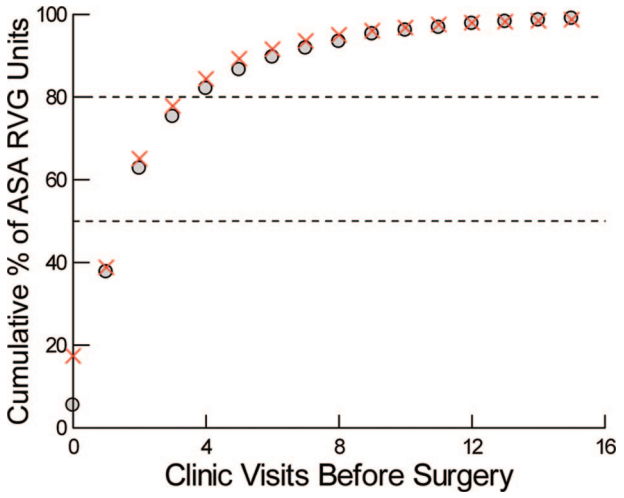

Fig. 3. Number of presurgical clinic visits between each patient and his or her surgeon. The count of visits includes a visit for history and physical. The *filled circles* are for patients having surgery at the outpatient facility. The × are for all types of surgery. The figure shows that the median, or 50th percentile, was two visits for both groups. There were four or fewer visits for 82% of ASA RVG units among patients treated at the outpatient surgery center and 84% of ASA RVG units among patients undergoing any type of surgery at the studied hospital. ASA RVG = American Society of Anesthesiologists' Relative Value Guide.

tial referral of the patient to the surgeon,[7,8] including the time to initial appointment. Previous studies have identified factors that are not useful in facilitating referrals, including having prior knowledge of clinic or surgeon queues at the time referrals are made and use of enterprise-wide information systems to coordinate between clinic days and operating days.[7,8] The principal remaining factor is the time from referral to surgery. We were able to study an underestimate, specifically the time from first visit with the surgeon to surgery. Even excluding the interval from referral to first clinic visit, the median time was at least 1.8 months (table 3), which is considerably longer than the 1 to 3 weeks that is the maximum time that patients in the United States and Germany prefer to wait for surgery.[9–12]

The multispecialty group's primary care network was likely too far removed behaviorally from the anesthesia department to have influenced its OR workload substantively. Fewer than 20% of ASA RVG units for outpatient surgery were for patients seen by a primary care or nonsurgical specialist before referral to the surgeon (table 4). The value was smaller (9%) for patients undergoing all types of surgery, partly because of trauma. Since the percentage was also significantly smaller (11% and 6%) for patients not residing in the hospital's county, these primary care and specialty visits may have been mostly the result of proximity to the hospital and the convenience of visiting primary care providers for a variety of problems rather than consultations that result in subsequent surgery. As described in Materials and Methods, these values overestimate the percentage of patients actually referred to the surgeon by the primary care physicians.

Table 3. Time from First Preoperative Clinic Visit with Surgeon to Surgery at the Outpatient Surgery Center

	Time (Months)	95% Confidence Interval (Months)
Median, analyzed with each case weighted by its ASA RVG units	1.8	1.8–1.9
Excluding patients with a surgeon who recently joined the group	2.1	2.0–2.3
Median, each case given equal weight	1.9	1.7–2.0
Excluding patients with a surgeon who recently joined the group	2.2	2.0–2.4
Mean time per visit	1.6 per visit	1.6–1.7
Stratifying procedure as a fixed effect	1.6 per visit	1.5–1.7

The numbers in the first four rows are the median times from first appointment to surgery. The values in the last two rows essentially represent a ratio, with the numerator being time from first appointment to surgery and the denominator being number of clinic visits from and including first appointment until surgery. The relationship was estimated using general linear modeling without an intercept. ASA RVG = American Society of Anesthesiologists' Relative Value Guide.

Patient satisfaction with prior surgical experience at the hospital likely has little substantive impact on the anesthesia department's workload; very few patients had previous surgery at the facility. Patients who had more than one previous surgery at the outpatient surgery center accounted for only 7% of ASA RVG units. For all types of surgery, patients with more than 1 previous surgery at either facility accounted for only 6% of ASA RVG units (table 5). Of course, we cannot rule out patients who were

Table 4. Percentage of Anesthesia Workload Attributable to Patients Receiving Primary or Specialty Care from Another Physician in the Anesthesia Department's Multispecialty Group

	ASA RVG Units	Cases
Outpatient surgery		
Primary or specialty care		
Among all patients	18%	20%
Among patients not from hospital's county	11%	13%
Primary care		
Among all patients	11%	11%
Among patients not from hospital's county	6%	7%
All types of surgery		
Primary or specialty care		
All patients	9%	12%
Among patients not from hospital's county	6%	7%
Primary care		
All patients	5%	6%
Among patients not from hospital's county	3%	4%

Likely overestimates (see Materials and Methods) for the percentage of American Society of Anesthesiologists' Relative Value Guide (ASA RVG) units and cases for patients who received primary or nonsurgical specialty care with physicians in the multispecialty group of the anesthesia providers. Every 95% upper confidence bound was 0.1–1.3% larger than the listed workload.

Table 5. Maximum Potential Influence on Anesthesia Workload of Previous Visits to the Outpatient Surgery Center or Admissions to the Hospital with Surgery

	Visits	By ASA RVG Units	By Cases
Outpatient surgery	> 0	27%	28%
	> 1	7%	7%
	> 2	3%	3%
	> 3	1%	1%
All types of surgery at either facility	> 0	22%	24%
	> 1	6%	6%
	> 2	2%	2%
	> 3	1%	1%

The percentage of American Society of Anesthesiologists' Relative Value Guide (ASA RVG) units and cases among patients with previous surgery at the outpatient facility (*top*) or any type of surgery at either the outpatient facility or the tertiary care suite. Every percentage's 95% upper confidence bound was 0.0–1.5% larger than the listed value except for the 28% (*upper right*), which had an upper 95% confidence bound of 30%.

so dissatisfied that they elected to have subsequent surgery elsewhere or encouraged their friends to go elsewhere.[13]

Discussion

This article's Introduction explains that our study applies to multispecialty groups, including those at most academic facilities in the United States. The head of an anesthesia department has the opportunity to participate in or refrain from becoming involved in decisions within the group, depending on his or her conceptual model of what influences the workload of the anesthesia department. Absent additional information, physicians reasonably make decisions for their practices based on the most common patient (*e.g.*, average contribution margin [profit] per hour of work).[14–19] This article provides additional information by exploring average patient flow into an anesthesia practice.

The importance of surgical clinics was ascertained on the basis of their effects on anesthesia workload (*i.e.*, ASA RVG units). Most patients undergoing either outpatient surgery or all types of surgery had few (2, 95% CI 2–2) preoperative clinic visits with their surgeon, depending on the type of surgery. This number was amazingly consistent among patient populations, all with CI of 2–2. In addition, patient visits to primary care physicians did not substantively feed the surgical practice. Results did not depend on whether patients resided in the county of the hospital, even though many more patients within the county saw a primary care physician that was part of the multispecialty group. Overall, few patients had visits with a primary care or specialist physician in the multispecialty group before their visit with a surgeon. Prior surgery at the same facility was not important because so few people had prior surgery there. Thus, a reasonable conceptual model for use by the anesthesia group in making decisions is that its representative patient has a visit with the surgeon, chooses to have surgery, has one more preoperative visit, and then has surgery. This conceptual model is our paper's primary scientific result.

A consequence of this result is that, simply put, surgeon clinic appointments are the bottleneck to outpatient surgery, and it is generally in the interest of the anesthesia department to facilitate surgeon-dependent processes. This requires (1) open access to OR time on any future workday, (2) well-calculated blocks to permit high surgeon productivity, and (3) open access to surgeon clinics.[14–21] These findings do not apply to all surgeons, but only those that practice as part of a multispecialty group that is representative of the one studied here. We showed that other factors need not be of primary concern to the anesthesia department for strategic decision-making within the multispecialty group.

For inpatient surgery, both surgeons and the hospital can be bottlenecks. Duke University[22] previously reported that open access in the surgery clinics resulted in large increases in the amount of surgery. Our scientific results plus the information systems work explained below show that their findings are representative of what can be expected by other organizations. However, results may differ when limiting consideration to inpatient surgery when hospital beds may be the bottleneck.[1,15,16,23–30] Both the intensive care unit and wards can limit the amount of certain types of surgery.

On the basis of information learned from these studies and the role of surgeons in anesthesia department workload, we can address the examples posited in the Introduction from the perspective of the head of an anesthesia department.

(1) A new primary care outreach clinic *versus* an expanded sports medicine program: Primary care does not feed the ORs; surgeons do. Choose the sports medicine program.
(2) New surgical equipment *versus* an enhanced clinic scheduling system: Few patients have scheduled multiple visits with their surgeon, so the duration of patient waiting in the surgeon's office is not important to the anesthesia group. In contrast, consider the number of days from referral to seeing the surgeon in the clinic and the number of days until surgery. Since each patient sees his surgeon for only a limited number of appointments, these are important factors.
(3) Surgeons create small delays throughout the day when they see consults: Because most patients are only seen once by the surgeon in a consultation before scheduling of surgery, leaving the OR to see consults may be reasonable.
(4) A branch outpatient surgery center in the suburbs: Few patients undergo multiple surgeries. They would not choose another location because of a bad experience with OR logistics.

The second example above considers the purchase of clinic enterprise-wide information systems with the objective that resulting improved clinic scheduling would generate substantial net profit by resulting in more surgery. Two previous studies examined how surgeon clinic scheduling and management decisions influence anesthesia department workload.[7,8] Both studies modeled surgeons as consultants, seeing patients two times before surgery, including the presurgical assessment. The studies revealed that for such surgical practices there is no advantage to the anesthesia department (or patients) for enterprise-wide information systems to be used to choose referrals to specific surgeons on the basis of knowledge of clinic or surgical queues or to coordinate clinic days of the week and OR days. Such scheduling systems actually cause problems by introducing the "bullwhip effect," which leads to greater variation in days that patients wait for their clinic appointments with surgeons and greater variation in OR workload. In general, investment in scheduling systems will not increase anesthesia workload.

Instead of working with the hospital on clinic and OR information systems, a more effective strategy for the anesthesia department to influence its workload is to focus on the longer-term (tactical) issues of having appropriate number of surgeons and support staff,[14–16] hours of allocated OR time for each specialty on each weekday, and hours of block time.[21] Work to encourage the multispecialty group to focus on ease of access for the first appointment with a surgeon.

One unexpected finding is the strength of the correlation between weighted and unweighted cases. On the one hand, some surgical procedures have few ASA RVG units (*e.g.*, cataracts), whereas others have many units (*e.g.*, aortobifemoral bypass). However, a study of 26 yr of data at one hospital showed that annual changes in anesthesia workload were correlated highly whether quantified using cases or ASA RVG units, with a 5% increase in one endpoint representing a 5% increase in the other.[2] Facilities differ markedly in their relative distributions of procedures; therefore, comparisons made across facilities on a "per case" basis are misleading.[31,32] Nonetheless, our results show that different anesthesia departments can easily compare their results for numbers of presurgical clinic visits to the surgeon with findings from our studied department. Results will apply generally when striving to understand which types of physicians substantively influence the workload of the anesthesia department.

Finally, several findings in this article explain results of earlier work. Data envelopment analysis is a reliable and valid method for identifying potential growth opportunities for inpatient surgery at hospitals that are not located in metropolitan areas, such as the hospital studied here.[15,33–35] We have developed other techniques applicable to all hospitals, especially those in metropolitan areas.[36] Neither uses information about primary care networks or formal modeling of referral networks. Rather, the principal inputs are market visibility of the hospital and overall regional surgical workload. Our current findings explain why these methods perform well and justify omission of primary care networks.

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