The Journal of Education in Perioperative Medicine

Original Research

More Even Distribution of ACGME-mandated Cases Improves Residents' Perceptions of Fairness and Balance

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Introduction

As medical students progress through medical school and into their residency and fellowship training, the structure of their medical education also progresses from carefully designed didactic experiences in the classroom to more variable clinical experiences in the hospital. This reality creates a perennial challenge for medical educators to provide trainees with the maximum breadth of real-world clinical experiences in an environment where they have only limited control over which patients are on the wards or in the operating room. The Accreditation Council for Graduate Medical Education (ACGME) provides structure for clinical experiences by mandating a minimum number of specific cases and procedures prior to graduation in at least 15 specialties, including anesthesiology. Clinical assignments, however, are often made on the basis of time spent on a rotation rather than the number of opportunities for these specific ACGME-mandated cases.

Anesthesia residents at our institution have historically voiced concerns to the program directors during their midyear reviews about the fairness of case distribution among residents rotating through the same subspecialty in a given month, particularly for the subspecialties with lower case volume. These concerns are valid given that daily clinical assignments for the entire anesthesia department at our institution – and many others – are made by a single attending physician with no automated way to visualize which kinds of cases have already been assigned to individual residents over the course of a month-long rotation. A resident-driven, case-based scheduling system has been reported previously for anesthesia residents.[1] However, when the number of available residents per day is often larger than the number of available ACGME-mandated subspecialty cases (eg, craniotomies and open vascular procedures), a resident-driven approach is insufficient because residents will necessarily all be requesting the same few cases.

To address this issue, the neuroanesthesia division at our institution undertook a quality improvement project with the aim of more evenly distributing the neurosurgical case volume among residents on the neuroanesthesia rotation. We hypothesized that by creating a system based on the number of opportunities each resident was given for ACGME-mandated neuroanesthesia cases, we could not only decrease the variation in case distribution but also improve resident perceptions of fairness and balance between their education and service obligations on the rotation. In this study, we reviewed case assignments to assess variability in the distribution of ACGME-mandated cases among residents before and after our scheduling intervention. We then surveyed residents to assess their perceptions of their experience on the neuroanesthesia rotation before and after the scheduling intervention.

Materials and Methods

Institutional Review Board Statement

This study was reviewed by the institutional review board at Beth Israel Deaconess Medical Center (Boston, MA) and approved as an exempt study. Survey invitations notified participants that results would be used solely for research purposes and may be published or shared using only aggregate, anonymous data.

Setting and Participants

This study was conducted at Beth Israel Deaconess Medical Center. At our institution, all residents in their first-year of clinical anesthesia residency (CA-1) and second-year of clinical anesthesia residency (CA-2) are required to complete a 1-month rotation in neuroanesthesia. Residents in their third-year of clinical anesthesia residency (CA-3) may elect to complete a third 1-month rotation if they wish. For neuroanesthesia, the ACGME requires a total of 20 intracerebral cases, including endovascular procedures, and at least 11 of these must involve an open cranium (ie, craniotomies). All neuroanesthesia rotations (CA-1, CA-2, and CA-3) completed between January 2018 and October 2019 (N = 91) were included in

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the analysis of case distribution, with some residents completing more than one rotation during this period. The postintervention period (12 months from November 2018 to October 2019) was slightly longer than the preintervention period (10 months from January 2018 to October 2018) to establish the sustainability of our scheduling intervention over an entire year.

Intervention

Starting in November 2018, a single neuroanesthesia attending sent daily requests to the anesthesia department scheduler to assign each resident on the neuroanesthesia rotation to a specific operating room. Requests were made with the primary goal of evenly distributing the ACGME-mandated neuroanesthesia cases (ie, intracerebral cases and craniotomies) and the secondary goal of evenly distributing the overall neurosurgical case volume, including spine surgeries. Case complexity was a secondary consideration. If multiple ACGME-mandated cases were available on a given day, the most complex case was given to the most senior resident; however, junior residents were not excluded from complex cases if it would adversely affect the overall proportion of ACGME-mandated cases they were assigned during their rotation. At the beginning of the rotation, residents were notified that scheduling requests would be made on their behalf and that data on all case assignments would be provided to them at the end of the rotation. A spreadsheet was maintained for each resident showing which days they were available to be assigned to neuroanesthesia cases (ie, not post-call, on-call at another site, on vacation, or otherwise not available) and which types of cases they were assigned each day. A second spreadsheet was maintained with a running tally of how many of each case type each resident on the rotation had already been assigned. At the end of the rotation, each resident was given both their personal daily spreadsheet and the spreadsheet with the final totals for each neuroanesthesia case type for all residents on the rotation that month.

Survey Instrument Design

Survey items were developed through an iterative process using cognitive interviews and a concurrent verbal probing approach[2] with current or recently graduated anesthesia and pulmonary and critical care medicine fellows to improve content validity. This group was chosen based on their proximity in experience and training level to the residents who would be taking the survey. The 2 survey items addressing the balance between education and service were adapted directly from the 2018-2019 ACGME resident survey to apply to the neuroanesthesia rotation specifically (Supplemental Online Material). Cronbach alpha for all survey items was calculated using JMP Pro 14 (SAS Institute Inc, Cary, North Carolina).

Survey Distribution

We took advantage of the natural experiment created by our scheduling intervention and defined our experimental group as all residents who completed their CA-1 neuroanesthesia rotation under the old scheduling system and their CA-2 neuroanesthesia rotation under the new scheduling system (n = 15 residents). We used a retrospective pre-post survey design for this group by distributing the survey assessing their experiences during their required CA-1 and CA-2 rotations only at the completion of their CA-2 rotation. This approach allowed us to attenuate response-shift bias and more specifically measure the impact of our scheduling intervention. We also defined our control group as all residents who completed their CA-2 neuroanesthesia rotation in the year prior to the scheduling intervention (between November 2017 and October 2018; n = 16 residents) to control for changes in resident perceptions of the rotation that were attributable to increasing seniority. Surveys were distributed to the control group coincident with the scheduling intervention in November 2018. To minimize recall bias, we did not include residents who completed their CA-2 rotation prior to November 2017. Surveys were distributed using Qualtrics Survey Software (Provo, Utah), and all responses were anonymized.

Statistical Analysis

Statistical analyses were done using JMP Pro 14. The proportions of intracerebral cases and craniotomies assigned to each individual resident out of the total number of cases available that month were graphed on Shewhart p-charts in a phased analysis (preintervention [Pre] and postintervention [Post]) with 3-sigma control limits. Based on a mode of 4 residents on the neuroanesthesia rotation each month at our institution and limitations on their availability because of call schedules, we chose an initial benchmark goal for each resident to be assigned at least 15% of the available cases. Based on our overall neurosurgical case volume, we similarly chose a benchmark goal for each resident to spend less than 15% of their available days assigned to nonneurosurgical cases. The proportion of residents who failed to meet these benchmarks was compared between the Pre and Post phases using χ^2. Two-sided P values <.05 were considered statistically significant.

Survey results were analyzed using JMP Pro 14. Responses to Likert-type items were modeled as continuous variables, and responses for the CA-1 and CA-2 neuroanesthesia rotations were compared within subjects using the Wilcoxon signed-rank test. The change in responses between the CA-1 and CA-2 rotation was compared between groups (experimental vs control) using the Mann-Whitney U test. Two-sided P values <.05 were considered statistically significant. Effect size was measured using the Cohen d.

Results

There were no significant differences between the Pre and Post phase in the mean number of residents assigned to the neuroanesthesia rotation each month (3.60 Pre vs 3.92 Post, P = .34), the total number of intracerebral cases available (23.40 Pre vs 28.92 Post, P = .051), or the total number of craniotomies available (22.10 Pre vs 22.08 Post, P = .89; Table 1). The p-chart of the proportion of intracerebral cases assigned to each resident showed wide variation in the Pre period, with two 2 causes above the upper control limit and 2 points at the lower control limit (0%), and less variation in the Post period, with no special causes or points at the lower control limit. Significantly more residents also failed to meet the 15% benchmark for intracerebral cases in the Pre period (8/36, 22.2%) than in the Post period (4/55, 7.2%; P = .039; Figure 1A). For craniotomies, there was

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also wide variation in the Pre period, with 2 special causes above the upper control limit and 3 points at the lower control limit (0%), and less variation in the Post period, with no special causes or points at the lower control limit. Once again, significantly more residents failed to meet the 15% benchmark for craniotomies in the Pre period (10/36, 27.8%) than in the Post period (2/55, 3.6%; $P = .0009$; Figure 1B). For the proportion of days assigned to nonneurosurgical cases, significantly more residents exceeded the 15% benchmark in the Pre period (26/36, 72.2%) than in the Post period (12/55, 21.8%; $P < .0001$; Figure 1C).

The survey response rate was 13/15 (86.7%) in the experimental group and 10/16 (62.5%) in the control group. Cronbach alpha for the entire set of survey items was 0.70 for the experimental group and 0.80 for the control group. In the experimental group, responses for the CA-2 rotation showed significant improvement compared to those for the CA-1 rotation for all domains except compromise of education for service. There were no significant differences between responses for the CA-1 and the CA-2 rotation in the control group (Table 2). The change in responses from the CA-1 rotation to the CA-2 rotation was significantly larger in the experimental group than in the control group for the breadth of cases assigned ($P = .0024$), the fairness of ACGME-mandated case distribution ($P = .0057$), and the balance between education and service ($P = .036$; Table 3).

Discussion

This study illustrates how failing to closely monitor subspecialty case assignments and simply expecting that case distribution will even out over the course of a month-long rotation (or an entire residency) can result in a highly variable distribution of ACGME-mandated cases among residents. Our results also show that a case-based targeted scheduling system like the one described here can more evenly distribute ACGME-mandated cases and improve residents' perceptions of fairness and balance between their education and service obligations on a subspecialty rotation. Typically, residents spend a specified amount of time on individual subspecialty rotations, and program leaders hope that the cases will be reasonably evenly distributed over the course of the month and that the residents will naturally meet their minimum case requirements. While this approach may be adequate for high-volume cases, it is likely insufficient for low-volume cases as shown here for neuroanesthesia at our institution. We were particularly struck by a few instances in the Pre phase where a resident was assigned no ACGME-mandated cases at all during their rotation while another resident that same month was assigned nearly half of the available cases (Figure 1A, 1B). Prior to this study, we did not appreciate the degree of inequality present under the standard scheduling system, and we suspect that other training programs may be similarly surprised if they take a detailed look at their subspecialty case assignments. It was not clear from our data whether it was simply random chance or implicit bias on the part of the schedulers with regard to perceived resident strength or seniority that led to such discrepancies in case assignments under the standard scheduling system. Fortunately, regardless of the source of bias, our new scheduling system succeeded in bringing greater parity to case assignments.

It is perhaps to be expected that our new scheduling system resulted in a more even distribution of cases. Our success speaks more to the inadequacy of the previous scheduling system than the merits of our specific intervention. This is the first study, however, to tie a scheduling system to resident satisfaction metrics with regard to perceived fairness and balance between education and service, which has been identified as a top priority by the ACGME. Perceived fairness in the workplace has also been linked to job satisfaction, organizational commitment, and burnout in a number of settings with parallels to academic medical centers, including government and military organizations.[3-6] To be sure, *fairness* and what qualifies as *education* vs *service obligations* are highly subjective concepts and could be more thoughtfully addressed using a qualitative approach to better understand how residents frame these concepts, but the survey approach presented here represents a first step and parallels the survey approach used by the ACGME. We also did not investigate which component of our scheduling intervention had the largest impact on resident experiences: the decreased variability in case distribution or the transparency of providing final case numbers for all residents on the rotation. It seems unlikely that had we simply shared the highly variable case distributions with residents under the old scheduling system that this would have improved their perceptions of fairness and balance, particularly among those who were assigned significantly fewer cases than their peers. Given the very minimal effort required to share final case numbers with the residents, we would advocate for both components. It is certainly possible that other changes in the residency program concurrent with our study period might have also influenced residents' survey responses, but there were not any significant changes in neurosurgical volume (Table 1), number of residents (Table 1), neuroanesthesia faculty, neurosurgeons, or the neuroanesthesia didactic curriculum.

A targeted scheduling intervention using a resident-driven approach with the goal of maximizing self-directed learning has been previously reported. In that program, residents were given an automated visualization of their ACGME case logs and were able to request case assignments for themselves. The scheduler then used the case logs and requests to make assignments.[1] While the benefits of such self-directed learning in health professions have been well documented,[7] a resident-driven approach is insufficient in settings where there is low case volume and the number of available residents routinely exceeds the number of available cases. Our intervention required a time investment of about 3 hours per month on the part of an attending physician to maintain the spreadsheets and make daily assignment requests. With minimal training, these tasks could easily be delegated to administrative staff or even automated, but we anecdotally found that residents appreciated the involvement of an attending physician who was visibly invested in their education. Furthermore, our departmental scheduling directors reported enthusiastic support for the intervention as it lifted a portion of the burden of their daily scheduling tasks.

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Our study had several limitations. We had good survey response rates (86.7% for experimental vs 68.8% for control), but the final overall cohort was small (n = 13 for experimental vs n = 10 for control). Despite this, the effect sizes for our intervention were large with respect to the most significant survey items (Table 3). Our results were derived from a single department at a single institution, and the benefits of our scheduling system may be less pronounced for high-volume cases. Our use of a retrospective pre-post survey design in the experimental group allowed us to attenuate the response-shift bias that would change residents' perceptions of their CA-1 rotation under the old scheduling system once they had experienced their CA-2 rotation under the new system[8,9] and to more specifically measure the impact of our scheduling intervention. This design, however, precluded direct comparisons between survey responses with regard to a single rotation year between the experimental and control groups (ie, comparing responses for the CA-1 rotation between the experimental and control groups). We included the control group solely to control for changes in survey responses from the CA-1 to the CA-2 rotation attributable to increasing resident seniority. The retrospective design also introduced recall bias given the amount of time that necessarily passed between the clinical rotations in question and survey distribution, although we limited this by only including residents who complete their CA-2 neuroanesthesia rotation in the year prior to the scheduling intervention.

In summary, we have demonstrated the feasibility of designing and implementing a case-based targeted scheduling system to more evenly distribute ACGME-mandated subspecialty cases with positive effects on residents' perceptions of fairness and balance between their education and service obligations. We hope our findings encourage other institutions to examine the variability in their own subspecialty case assignments and to consider implementing a similar scheduling system if the variability is high. We are currently expanding our system to higher volume subspecialty cases at our institution to assess whether the benefits persist. It remains to be seen in a larger cohort if our approach has additional positive effects on resident performance, burnout rates, or competency evaluations.

Acknowledgments

We would like to thank Amy P. Cohen, EdM, Director of Educational Technology at the Harvard School of Public Health, for her assistance using JMP Pro statistical software.

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Financial disclosures: *None*

Abstract

Background: The Accreditation Council for Graduate Medical Education (ACGME) mandates minimum numbers of cases in many specialties, including anesthesiology, but resident scheduling is often done on the basis of time spent on each rotation rather the number of opportunities for specific cases, risking uneven case distribution, particularly for low-volume cases. We used the neuroanesthesia rotation as a model to evaluate a system to more evenly distribute ACGME-mandated cases among residents and assessed the effects on their perceptions of their experience on the rotation.

Methods: In November 2018, we instituted a targeted operating room scheduling system at our institution by making specific daily assignment requests for anesthesia residents on the neuroanesthesia rotation. We used Shewhart control charts to analyze the variation in case distribution among all resident rotations (N = 91) from January 2018 to October 2019. We then surveyed residents who had experienced both systems (n = 15) and those who had experienced only the old system (n = 16).

Results: Shewhart p-charts of the proportion of ACGME-mandated cases assigned to each resident showed wide variation under the old scheduling system and a more even distribution under the new system. Residents reported significantly greater perceived fairness of case distribution and balance between their education and service obligations under the new system (response rates: 10/16 [62.5%] and 13/15 [86.7%]).

Conclusions: Targeted resident scheduling based on ACGME-mandated case numbers rather than solely time spent on a rotation is feasible and can improve resident perceptions of fairness and balance between education and service, a top priority of the ACGME.

Keywords: Graduate medical education, personnel staffing and scheduling, quality control, resident morale

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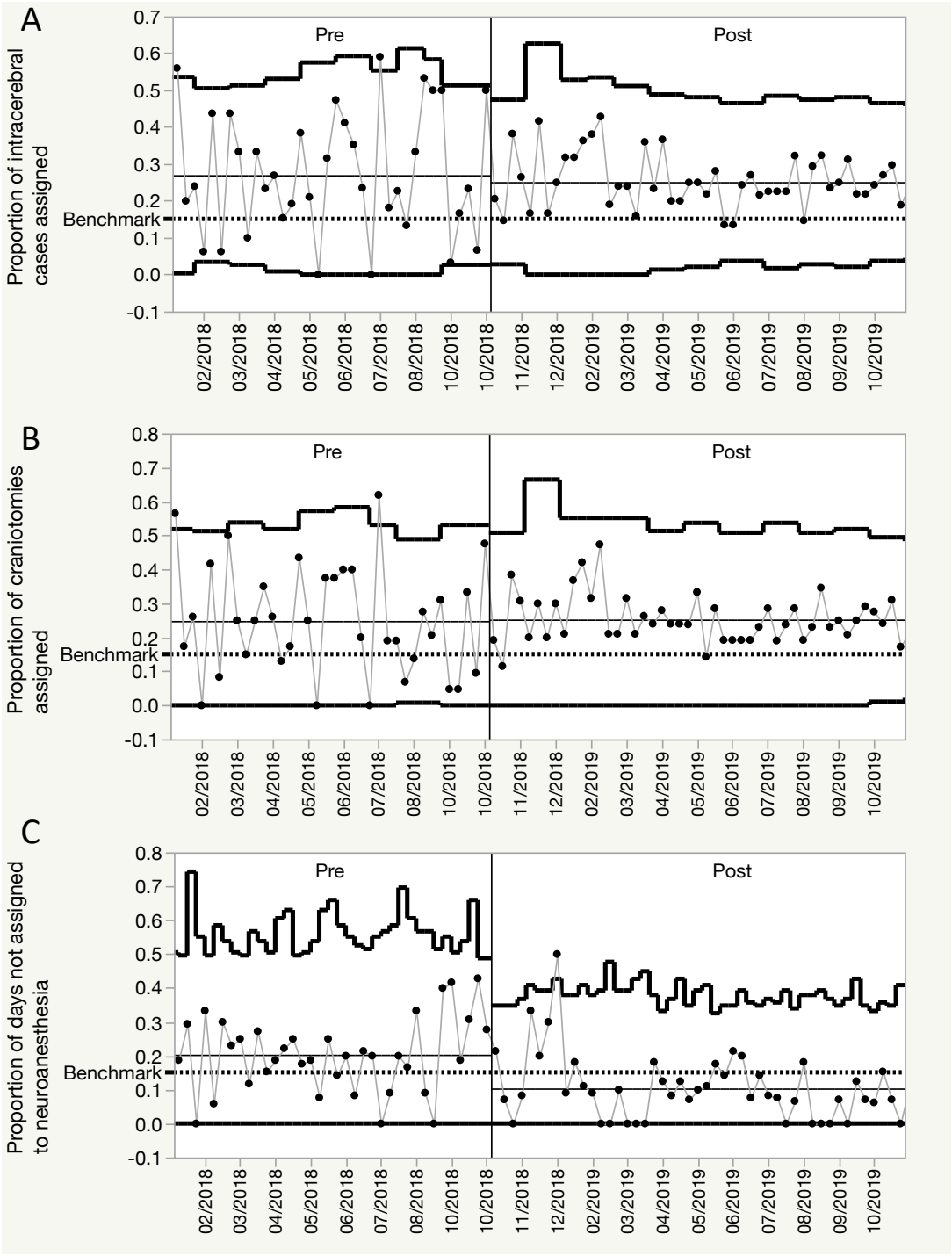
Figures

Figure 1. *Variability in case distribution. Shewhart p-charts are shown for A) the proportion of intracerebral cases assigned, B) the proportion of craniotomies assigned, and C) the proportion of available days not assigned to neuroanesthesia cases. Each data point represents an individual resident. The upper and lower 3-sigma control limits are denoted by thick black lines, and the center line is denoted by a thin black line. The vertical black line delineates the Pre and Post time periods. The 15% benchmark is denoted by a dashed line. The goal was to be above the benchmark line in A and B and below the benchmark line in C.*



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Tables

Table 1. *Monthly Statistics*[a]

	Pre	Post	***P* Value**
Residents (per month)	3.6 (3.0-4.2)	3.9 (3.6-4.2)	.34
Intracerebral procedures (per month)	23.4 (19.1-27.7)	28.9 (24.2-33.7)	.051
Craniotomies (per month)	22.1 (18.8-25.4)	22.1 (18.9-25.3)	.89

[a] Data are presented as average (95% confidence interval). Values for the Pre and Post period were compared using the Mann-Whitney *U* test. Values of $P < .05$ were considered statistically significant.

Table 2. *Within Group Survey Results for the First-year of Clinical Anesthesia Residency (CA-1) and Second-year of Clinical Anesthesia Residency (CA-2) Rotation*[a]

Question	Group	CA-1	CA-2	***P* Value**
Q1: Balance of education and service	Experimental	3.15 (2.56-3.75)	4.00 (3.57-4.43)	.016*
	Control	3.70 (3.22-4.18)	3.80 (3.24-4.36)	.5
Q2: Compromise of education for service	Experimental	2.46 (1.99-2.93)	2.15 (1.74-2.57)	.31
	Control	2.40 (2.03-2.77)	2.40 (1.80-3.00)	.5
Q3: Breadth of case assignments	Experimental	2.46 (1.70-3.23)	4.31 (3.85-4.76)	.005*
	Control	3.2 (2.32-4.08)	3.7 (2.94-4.46)	.13
Q4: Fairness of ACGME-mandated case distribution	Experimental	2.23 (1.44-3.02)	3.92 (3.46-4.38)	.001*
	Control	3.20 (2.39-4.01)	3.50 (2.89-4.11)	.5
Q5: Fairness of non-neuroanesthesia day distribution	Experimental	2.69 (1.98-3.41)	3.77 (3.33-4.21)	.0078*
	Control	3.40 (2.71-4.09)	3.70 (3.11-4.29)	.5
Q6: Overall neuroanesthesia experience	Experimental	3.08 (2.40-3.75)	4.54 (4.22-4.85)	.0010*
	Control	3.56 (2.78-4.33)	4.22 (3.71-4.73)	.13

Abbreviation: ACGME, Accreditation Council for Graduate Medical Education.

[a] For the full list of survey questions and response anchors, see Supplemental Online Material. Responses were scored on a 5-point scale. Values are shown as mean (95% confidence interval). The within group comparisons (CA-1 vs CA-2) were done using the paired Wilcoxon signed rank test.

* Values of $P < .05$ were considered statistically significant.

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Table 3. *Change in Survey Response From the First-year of Clinical Anesthesia Residency (CA-1) and Second-year of Clinical Anesthesia Residency (CA-2) Rotation*[a]

Question	Experimental Δ	Control Δ	***P* Value**	Cohen d
Q1: Balance of education and service	0.85 (0.30-1.39)	0.10 (–0.43-0.63)	.036*	0.90
Q2: Compromise of education for service	–0.31 (–0.76-0.15)	0.00 (–0.58-0.58)	.24	0.39
Q3: Breadth of case assignments	1.85 (1.30-2.39)	0.5 (–0.01-1.01)	.0024*	1.64
Q4: Fairness of ACGME-mandated case distribution	1.69 (1.02-2.36)	0.30 (–0.29-0.89)	.0057*	1.40
Q5: Fairness of non-neuroanesthesia day distribution	1.08 (0.40-1.75)	0.30 (–0.18-0.78)	.058	0.82
Q6: Overall neuroanesthesia experience	1.46 (0.88-2.05)	0.67 (0.00-1.33)	.070	0.86

Abbreviation: ACGME, Accreditation Council for Graduate Medical Education.

[a] For the full list of survey questions and response anchors, see Supplemental Online Material. Responses were scored on a 5-point scale. Values are shown as mean (95% confidence interval). The between group comparisons were done using the Mann Whitney *U* test. Effect size was estimated using Cohen d.

* Values of $P < 0.05$ were considered statistically significant.

Supplemental Online Material

Survey of Anesthesia Residents: Targeted OR Scheduling for Neuroanesthesia

Q1: How often during your Neuroanesthesia rotation was there an appropriate balance between your education and other clinical demands?

	Never (1)	Rarely (2)	About half the time (3)	Most of the time (4)	Always (5)
During your CA-1 rotation					
During your CA-2 rotation					

Q2: How often during your Neuroanesthesia rotation was your clinical education compromised by excessive service obligations?

	Never (1)	Rarely (2)	About half the time (3)	Most of the time (4)	Always (5)
During your CA-1 rotation					
During your CA-2 rotation					

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Supplemental Online Material *continued*

Q3: Do you agree that the cases you were assigned during your Neuroanesthesia rotation exposed you to the full breadth of neurosurgical cases performed at Beth Israel Deaconess Medical Center (BIDMC)?

	Definitely not (1)	Probably not (2)	Might or might not (3)	Probably yes (4)	Definitely yes (5)
During your CA-1 rotation					
During your CA-2 rotation					

Q4: Do you agree that the intracerebral cases (ie, ACGME-required cases) were fairly distributed among you and your co-residents during your Neuroanesthesia rotation?

	Definitely not (1)	Probably not (2)	Might or might not (3)	Probably yes (4)	Definitely yes (5)
During your CA-1 rotation					
During your CA-2 rotation					

Q5: Do you agree that the days spent assigned to non-neurosurgical cases were fairly distributed among you and your co-residents during your Neuroanesthesia rotation?

	Definitely not (1)	Probably not (2)	Might or might not (3)	Probably yes (4)	Definitely yes (5)
During your CA-1 rotation					
During your CA-2 rotation					

Q6: How would you summarize your experience during your Neuroanesthesia rotation?

	Very negative (1)	Somewhat negative (2)	Neutral (3)	Somewhat positive (4)	Very positive (5)
During your CA-1 rotation					
During your CA-2 rotation					

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; CA-1, first-year of clinical anesthesia residency; CA-2, second-year of clinical anesthesia residency.