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Patient and Personnel Factors Affect Operating Room Start Times

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Abstract

Objectives: Perioperative efficiency has been studied, though little is known about patient and personnel factors associated with a timely operating room (OR) start. We hypothesize that patient, personnel factors, and induction order decisions are associated with anesthesia induction time.

Methods: An institutional database was used to identify the anesthesia induction time of adults undergoing first start, elective operations from January 2014 to May 2017 at an academic quaternary care center. Data included patient demographics, the gender of the surgeon and anesthesiologist as well as their seniority (years since initial board certification), Certified Registered Nurse Anesthetist (CRNA) versus anesthesia resident staffing, and use of neuraxial anesthesia. Times were measured as minutes from scheduled start to induction. Univariate and multivariate analyses were performed to identify factors associated with induction time.

Results: We identified 15,823 cases. Predictors of later induction included add-on cases (1,224 cases were add-on's, 7.73%), ASA 3, neuraxial anesthesia, and CRNA staffing. Surgeon seniority but not gender affected induction time. In 11,093 (70.1%) of cases, the anesthesiologist was scheduled for multiple first starts with a choice of which patient to induce first. Surgeon gender was predictive of induction order, with the cases of male surgeons were induced somewhat first more frequently than female surgeons' (47.0% vs 44.1%; $p=0.02$). Cases staffed by anesthesiology residents were more likely to be induced first compared to those staffed by CRNAs (52.1% vs 41.5%, $p<0.01$).

Conclusions: Patient and personnel factors affect the order of case induction, but induction time is most dependent on patient factors. Hospitals should focus on improving preparedness and limiting bias to create a more equitable and efficient perioperative process.

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Introduction

Surgical procedures are an essential service in any health care system, accounting for nearly 60% of hospital revenue². Inefficiencies in the operating room (OR) delay the delivery of patient care, can affect patient outcomes, and present a substantial cost burden to the health system. Time is most valuable resource of an OR, and a delay in starting the first case can lead to inefficiencies throughout the operative day. OR costs range from \$22 to \$133 per minute, depending on the complexity of the procedure and time of day, with an average cost estimated at about \$62 per minute³. Therefore, efficiency of patient in-room time, on-time induction, and procedure start are critical to managing health care costs. Additionally, OR inefficiencies can lead to considerable frustration among patients and health care personnel. Both perioperative and intraoperative factors associated with lost efficiency have been studied extensively⁴⁻⁷. Interestingly, however, little is known about how patient and personnel factors affect OR start time.

Past studies examining OR efficiency have focused largely on preoperative and intraoperative process improvement as well as scheduling strategies^{4, 6-9}. The effect of patient complexity, demographics, case complexity, and OR personnel on first case, on-time starts remains unknown. Specifically, the impact of the decision-making of the anesthesiologist in terms of induction order is not well understood. Anesthesiologists manage the order of operative start times⁹, and the impact of decision-making has been studied,¹⁰ but the process of making start time decisions and prioritization of case starts is not well understood. When anesthesiologists cover multiple ORs, it is not clear how these ORs are prioritized for time of induction. The prioritization process could be affected by a number of factors, including patient complexity, demographics, case complexity, and implicit gender and seniority bias in both surgeons and anesthesiologists, and thus impact workflow and OR start time.

At our institution, faculty anesthesiologists are often scheduled for two or more first start cases, via supervising either anesthesia residents or certified nurse anesthetists (CRNAs) and must be present for the induction of anesthesia. The time of induction, therefore, reflects the circumstances under which the anesthesiologist determines the workflow for first cases. The anesthesiologist is either presented with a choice of which room to induce first, or a situation where one room is ready for induction before another. Our aim was to better understand how patient complexity, demographics, case complexity, and personnel factors influence induction time. We hypothesized that certain modifiable, patient-specific and personnel factors, including biases related to gender and seniority of surgeon and anesthesiologist as well as anesthesia personnel type affect anesthesia induction and case start time.

Methods

Personnel and Cases

An institutional OR database was used to identify patient demographic information and procedure details of adults (18 years of age or older) undergoing elective, first case, weekday surgical procedures with general anesthesia from January 1, 2014 to May 31, 2017 in the main OR at a single academic quaternary care health care system. The data included the

following: patient in-OR time, induction time, procedure start and stop time, primary service (general surgery, neurosurgery, obstetrics and gynecology, ophthalmology, orthopedics, otorhinolaryngology, plastic surgery, thoracic-cardiovascular surgery, transplant surgery, and urology), primary surgeon, surgical assistant (resident/fellow/physician assistant), anesthesiologist, anesthesia resident or CRNA, neuraxial anesthesia (spinal or epidural anesthetic), procedure date and day of the week, primary procedure, inpatient/outpatient status, case class (elective, urgent, emergency, add-on/late post), first case designation, and postoperative destination (acute care floor, home, observation unit, or one of 6 intensive care units or 5 intermediate care units). Add-on cases were elective cases that were posted to the OR schedule within 24 hours of case start. Patient demographics included age and the Physical Status Classification System of the American Society of Anesthesiologists (ASA). Cases involving emergency or urgent procedures, surgery performed on weekends or outside of the main OR, missing surgeon data, missing induction times, no general anesthesia, or anesthesia faculty assigned only one first start room were excluded.

Start time for first elective cases was scheduled for 0730 on all weekdays except Wednesday, which has a start time of 0930. Time to induction was calculated as the difference, in minutes between documented induction time and standard weekday start time. Similarly, time to procedure start was calculated as the difference in minutes between documented times for induction and actual procedure start. Anesthesiologists were assigned one to three first start cases among the included cases. Among these assignments, the case with the earliest induction was designated the “first-induction” case.

Seniority and gender of surgeons and anesthesiologists were obtained from the Clinical Staff Office and merged with the OR data set. Gender as listed in the Clinical Staff Office was used for this study; corroboration with gender self-identification was not sought. Seniority was represented by the number of years from the first board certification date of the attending surgeon or anesthesiologist by their respective professional board and the operative procedure date. Missing certification dates were obtained from the respective boards, including the American Board of Surgery (<https://www.absurgery.org/app.jsp?type=vc&id=27>), the American Board of Orthopedic Surgery (<https://www.abos.org/verify-certification.aspx>), and the American Board of Ophthalmology (<https://abop.org/verify-a-physician/?fn=Phil&ln=Calenda#physician-list-search-results>). Faculty who were not yet board certified had 0 years experience. Training program rosters were obtained from departments and used to determine resident post-graduate-year (PGY). Fellows were included; if residency completion date was not known, then one year was added to the standard duration of the relevant residency program (neurosurgery 7 years; plastic surgery and interventional radiology 6 years; otolaryngology, general surgery, and orthopedics 5 years; obstetrics and gynecology and urology 4 years; anesthesia, ophthalmology, and pain 3 years; and dentistry 2 years) to determine experience.

Statistical Analysis

The primary outcomes were time to induction, time to procedure start, and first case induction. Patient, procedure, and personnel variables were analyzed for these outcomes in univariate analysis. Categorical variables are reported as n (%) and continuous variables

presented as medians [Interquartile Range]. Statistical analysis was performed using χ^2 for categorical variable and Mann-Whitney U test for non-parametric continuous variables to calculate significance. Multivariate linear regression was used to verify the statistical significance of associations found on univariate analysis adjusting for related factors. Analysis was performed using SAS software 9.4, SAS Institute Inc., Cary, NC, USA. A p -value of 0.05 was the threshold for statistical significance. The Institutional Review Board for Social and Behavioral Sciences of the University of Virginia approved this study (#2017-0275-00). In addition, the Perioperative Physician lead and OR Administrator were consulted and granted permission to conduct the study.

Results

A total of 15,823 first start, adult, elective cases were identified within the study period. Demographic information of the patients and providers and case descriptive characteristics are shown in Table 1. The median patient age was 59.0 years [IQR 47.0-68.0], 7,912 (50%) had an ASA class greater than or equal to 3, and 10,465 (66.1%) would remain in-patients after the operation. OF the 15,823 cases, 2,742 (17.3%) were performed by female surgeons, and 5,745 (36.3%) were induced by female anesthesiologists. Median experience of the surgeon and anesthesiologist measured as years post board certification (seniority) was 11.0 [IQR 5.1-18.0] and 7.5 [IQR 2.0-21.8] years, respectively. CRNAs were involved in 7,925 (50.1%) cases, and anesthesia residents were involved in 7,896 (49.9%). Neuraxial anesthesia was administered in 655 (4.1%) cases.

Univariate analysis

Univariate linear regression for induction time (normalized to scheduled start) of all 15,823 first start cases demonstrated numerous independent factors associated with later induction time (Table 2). These factors included cases with patients whose ASA class was 3 (2.9 min, $p<0.001$), the use of adjunct neuraxial anesthesia (13.6 min, $p<0.001$), add-on cases (26.6 min, $p<0.001$), and cases staffed by CRNAs (3.1 min, $p<0.001$). Higher PGY level of surgery resident (-0.73 min, $p<0.001$), female anesthesiologists (-1.05 min, $p=0.007$), surgeon experience (-0.13 min, $p<0.001$), and anesthesiologist experience (-0.06 min, $p=0.001$) were all independently associated with earlier induction times. Surgeon gender did not impact time to induction (female surgeon 0.68 min, $p=0.167$).

Multivariate analysis

Multivariate linear regression for induction time (normalized to scheduled start) of the 15,823 first start cases demonstrated a number of adjusted risk factors associated with induction times (Table 3). These included add-on cases, which added 26.3 ($p<0.001$) minutes to induction time, ASA class 3 (2.6 min, $p<0.001$), cases involving neuraxial anesthesia (14.6 min, $p<0.001$), and cases involving CRNAs (2.5 min $p<0.001$). Surgeon seniority was associated with a faster time to induction of -0.1 minutes per year since first board certification ($p<0.001$). Female anesthesiologists were associated with earlier induction (-2.1 min, $p<0.001$), while female surgeon gender did not affect time to induction (-0.6 min, $p=0.22$). Patient age was not associated with a later time to induction (-0.01 min, $p=0.59$).

Multiple first start sub-group analysis

Of first start cases identified, 11,093 were first start cases, where the anesthesiologist had two or more first start rooms, thus forcing a choice of which room to induce first. Of these cases, 1,912 (17.2%) were performed by female surgeons and 4,045 (36.5%) were performed by female anesthesiologists. Median surgeon and anesthesiologist experience measured as years post first board certification (seniority) was 11.4 [IQR 5.1-18.2] and 8.2 [IQR 2.2-22.5] years, respectively. Male surgeons were more senior than their female counterparts, with a median experience of 12.0 [IQR 5.4-19.2] versus 7.9 [IQR 5.0-13.1] years since board certification ($p<0.001$). Male anesthesiology attendings were also more senior than their female colleagues with a median experience of 15.5 [IQR 4.2-24.2] years versus 3.2 [IQR 0.9-7.0] years, respectively ($p<0.001$). CRNAs were involved in 5,879 (53.0%) of the first start cases, and anesthesia residents were involved in 5,211 (47.0%). Neuraxial anesthesia was administered in 474 (4.3%) cases. Of the scheduled first start cases, 5,157 (46.5%) were induced first, and 5,936 were induced either second or third (53.5%).

The median time to induction defined as the difference in minutes from standard weekday start time to induction time for all cases was 13.0 minutes [IQR 5.8-23.6]. The median time to induction for first induced cases versus second induced cases was 6.1 minutes [IQR 0.8-11.9] and 21.0 minutes [IQR 13.9-33.9], respectively ($p<0.001$). The median time to procedure start defined as the difference in minutes from induction to procedure start time for all cases was 41.1 minutes [IQR 26.5-52.0]. The median time to procedure start for the first induced cases versus the second induced cases was 38.0 minutes [IQR 26.6-52.5] and 37.0 minutes [IQR 26.4-51.0], respectively ($p=0.03$).

Cases of male surgeon were induced first somewhat more frequently than the cases of female surgeons (47% versus 44.1%, $p=0.02$). The median experience of the surgeons cases induced first was 11.8 [IQR 5.5-18.8] years post first board certification versus 10.9 years [IQR 5.0-17.3] for surgeons whose cases were induced second ($p<0.001$). In the first induced cases, the median seniority difference between surgeon and anesthesiologist was 2.8 years [IQR -7.5-11.4] versus 1.0 years [IQR -9.7-19.0] for second induced cases ($p<0.001$). When an anesthesia resident was involved, 2,714 (52.1%) cases were induced first, whereas 2,442 (41.5%) of cases staffed by CRNAs were induced first ($p<0.001$). In cases where neuraxial anesthesia was used, only 113 (23.8%) were induced first ($p<0.001$) (Table 4).

Multivariate linear regression for induction time (normalized to scheduled start) of the subgroup was performed (Table 5). The factors associated with earlier induction time did not appreciably differ from those of the large group analysis.

Discussion

The increasing cost of medical care in the United States has resulted in an environment of cost-containment and a focus on value care delivery. Operating rooms are a substantial source of hospital expenditure, with case delays increasing cost and decreasing the overall quality of care¹¹. The present study examines factors associated with delays in induction time. We demonstrated that OR induction time is impacted by patient, procedural, and

personnel factors. The independent risk factors for later induction included a higher ASA class, the use of neuraxial anesthesia, add-on cases, and CRNA staffing. Female anesthesiologists, more advanced surgery residents (higher PGY year), and more experienced attending physicians were all independently predictive of *earlier* induction time. Our multivariate model demonstrated similar results, though the adjusted time to induction of cases performed by female anesthesiologists appears to be more important at -2.1 minutes versus -1.1 minutes in the univariate model. In our sub-group comparison, we found that a number of factors affected the choice of induction order by the anesthesiologist, such as how sick patients were (measured by ASA class), whether they were scheduled to be inpatients, the use of neuraxial anesthetic adjuncts, surgeon sex, surgeon experience, the seniority difference between surgeon and anesthesiologist, and CRNA staffing.

While this study demonstrated a number of patient and personnel factors predictive of induction time, the most clinically important of these were patient specific and non-modifiable. For example, add-on cases delayed induction by 26.6 minutes, the use of neuraxial anesthetic adjuncts delayed induction by 13.6 minutes, and ASA class greater than three which delayed induction by 2.9 minutes per ASA designation greater than 3. CRNA staffing delayed induction time by 3.1 minutes and is a modifiable factor. At our institution, anesthesiology residents are required to review the case with the anesthesiology attending on the evening before the operation and formulate a perioperative plan. This protocol does not occur with the CRNA staff, which could lead to inefficiencies in planning the anesthetic and thus delay patient and room readiness. Protocolizing pre-operative anesthetic planning between all anesthesia providers could potentially result in fewer delays on the day of surgery and improve efficiency, though the burden of increased case review between providers may outweigh a three-minute time savings. The CRNA versus resident induction time difference is not just specific to our institution, because another study examining on-time start in the neurosurgery ORs at Vanderbilt University also found that CRNA-staffed cases were more likely to start late¹². Vanderbilt also requires anesthesiology residents but not CRNAs to review cases with their attendings the evening before.

Add-on cases had the most clinically important delay in induction times and were rarely the first to be induced, thus offering the greatest opportunity for improvements in efficiency. This observation could be due to the lack of time for preparing the patient, inability for the in-room anesthesiology team to review the cases the night prior as noted above, or because these patients were frequently already in-patients and required additional on floor nurse preparation and transport to the OR. Systematic improvements such as notifying the assigned anesthesia team at the time the case is posted and OR room is assigned could improve efficiency. The addition of neuraxial anesthetics also causes an important delay in induction. At our institution, a designated Acute Pain Service (APS) performs all neuraxial anesthetics for cases other than first start cases in pre-operative rooms prior to room ready. Because of the number of patients requiring first start, neuraxial procedures, this situation overwhelms the system of performing a neuraxial anesthetic in the preoperative rooms; thus the anesthesia providers in the operating room are responsible for performing procedures instead. Developing a system for performing these procedures prior to the patient coming to the OR could decrease induction delays.

The sub-group analysis was performed to provide some insight into how induction time and therefore case start time is affected prioritization of case induction by the anesthesiologists when they have multiple patients to care for. Anesthesiologists at our center are often scheduled to cover two or more first start cases, and are thus presented with either a choice of which to induce first or one room that is ready before the other. The difference to induction time between first and second induced cases was approximately 15 minutes. Additionally, we found that the time from induction to procedure start was about the same between first and second induced cases, i.e. 38 minutes. Thus, induction time is a strong correlate to procedure start time. The 38-minute timespan between induction and procedure start offers an opportunity for future work on efficiency improvement and focuses largely on the activities of the surgeon and nursing teams. Patient factors, such as higher ASA class and patients staying in the hospital overnight after surgery, lead to a greater chance of second induction likely due to patient complexity. The subgroup, multivariate analysis for induction time was largely consistent with that of the whole population. Although small differences by personnel factors were noted in this large dataset, the factors with the 1 great impact were independent of biases related to seniority or gender.

Interestingly, there appeared to be some gender and seniority bias present in the decision-making of the anesthesiologist for induction order. While our study showed that the cases of female surgeons were not associated with later induction, the cases of female surgeons were chosen to be induced second more often than those performed by their male colleagues. It is unclear why the cases of female surgeons did not correlate with a significant time delay in induction despite being chosen to be induced second more often than the cases of male surgeons. This finding could be explained by the fact that our analysis does not include case type. Female surgeons could be more likely to perform cases that are faster to induce and therefore, are not associated with an overall time delay despite being induced second more often in aggregate. This dataset did not allow further evaluation of the choices of induction order by individual anesthesiologists when paired with both a male and female surgeon on the same day.

The induction order bias toward male and more senior surgeons is unfortunately not surprising, because over 90% of female attending surgeons report having experienced some form of gender discrimination at work¹³. How this translates to the daily work-day is largely unknown. Adding on urgent or emergent cases, prioritization of starting cases, and even resource allocation are all potential opportunities for gender bias to be evidenced. What we demonstrate in this study is likely a form of implicit gender bias against female surgeons which is just as likely to stem from male anesthesiologists as female anesthesiologists; it has been shown that implicit bias against females is gender-independent¹⁴. While the gender effect in this study was small, we believe this finding to be important, because it suggests a social environment permissive of unconscious biases throughout a health care system. The cumulative effect of repeated instances of implicit bias could limit the quality of care, decrease efficiency, and create a poor work environment for personnel. The cumulative effect of relatively minor instances of bias, both conscious and unconscious, has been shown in a number of workplace studies to hinder advancement, satisfaction, and opportunity at the workplace^{15, 16}.

The bias toward prioritizing more senior surgeons is also not surprising, because bias toward people in more senior positions has been demonstrated in a number of workplace studies^{1, 17, 18}. While this effect was statistically significant, it did not result in a clinically relevant time savings overall, with each year of increasing seniority resulting in a 7.8 seconds earlier induction. Notably, there was considerable collinearity between gender and seniority with regard to induction time, with surgeon seniority having a bigger effect than gender. Additionally, male surgeons were more experienced than female surgeons by our definition of experience. It is possible, therefore, that surgery faculty seniority is a driver of gender differences when pertaining to induction time.

There are a number of limitations to the present study including its retrospective nature which precludes the proof of causality. We are unable to elucidate the specific factors affecting the anesthesiologist's decision of which case to induce first, because the study is retrospective. Additionally, we are limited to data collected in our OR database which does not capture specific reasons for case delays. There is inherently some heterogeneity in surgeon gender breakdown by specialty, and our study does not capture this. We also did not account for case-type in our analysis. The study is limited to our center and is reflective of our individual perioperative process. For example, some services at our institution such as cardiac surgery have a dedicated, specialty-specific team of anesthesiologists, but this is not the case for all services. Therefore, this study is most applicable to institutions operating with similar staffing structure. Future work should focus on process improvements in advance anesthetic planning, place and timing of the delivery of the neuraxial anesthetic, and management of add-on cases. Future study could also examine more closely the processes occurring between induction and procedure start to see if that time period of nearly 40 minutes can be made more efficient. Lastly, additional study is warranted to further understand the role of implicit bias in interactions between health care providers and how this may impact the workplace and patient care.

Conclusions

Both patient and personnel factors affect induction and therefore, case start time, but patient-specific factors are the predominant predictors of delaying induction time. Process changes including review and discussion between anesthesia team members the night before the planned operation, management of patients needing neuraxial adjuncts, and management of add-on cases could lead to improved efficiency in the OR. Gender, seniority, and personnel bias affect anesthesiologist choice with respect to induction order when multiple first start cases are scheduled for one anesthesiologist. The degree to which that bias affects time to induction and therefore, OR efficiency varies. Gender and seniority bias did not translate into a meaningful difference in time to induction, while personnel such as anesthesiology residents did have a meaningful effect. Nonetheless, the cumulative effects of small differences related to bias should not be underestimated. Efforts to establish a more efficient and equitable perioperative process should focus on preoperative staff preparedness and consider the potential biases inherent in the decision-making surrounding the perioperative period.

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Table 1.

Baseline patient and personnel characteristics

Characteristics	All first start cases Patients (n=15,823) N (%)	Multiple first start cases per anesthesiologist patients (n=11,093) N (%)
Median patient age (y)	59.0 [IQR 47.0-68.0]	59.0 [IQR 47.0-68.0]
ASA 3	7,912 (50)	5,502 (49.6)
Inpatients	10,465 (66.1)	7,294 (65.7)
Female surgeon	2,742 (17.3)	1,912 (17.2)
Female anesthesiologist	5,745 (36.3)	4,045 (36.5)
Median surgeon experience (years)	11.0 [IQR 5.1-18.0]	11.4 [IQR 5.2-18.2]
Median Anesthesiologist experience (y)	7.5 [IQR 2.0-21.8]	8.2 [IQR 2.2-22.5]
CRNA	7,925 (50.1)	5,879 (53.0)
Anesthesiology resident	7,896 (49.9)	5,211 (47.0)
Neuraxial anesthetic adjunct	655 (4.1)	474 (4.3)

ASA- American Society of Anesthesiologists; CRNA- Certified Registered Nurse Anesthetists; PGY- Post Graduate Year

Table 2.

Univariate analysis of factors associated with later induction time.

Variable	Induction time in minutes (normalized to scheduled start) N=15,823	95% CI	P-Value
Add-on case	26.6	25.93, 27.27	<0.001
Neuraxial anesthetic adjunct	13.6	12.71, 14.57	<0.001
CRNA	3.02	-5.07, 11.11	<0.001
ASA 3	2.90	2.53, 3.27	<0.001
Female surgeon	0.68	0.19, 1.18	0.167
Patient age	0.004	-0.01, 0.02	0.736
Anesthesiologist experience (minutes per the years since first board certification)	-0.06	-0.08, -0.04	0.001
Surgeon experience (minutes per the years since first board certification)	-0.13	-0.15, -0.11	<0.001
Highest surgery resident PGY	-0.73	-0.83, -0.64	<0.001
Female anesthesiologist	-1.05	-1.06, -1.05	0.007

Table 3.

Multivariate analysis of factors associated with later induction time

Variable	Induction time in minutes (normalized to scheduled start) N=15,823	95% CI	P-value
Add-on	26.29	25.63, 26.95	<.0001
Neuraxial anesthetic adjunct	14.59	13.70, 15.48	<0.001
ASA 3	2.613	2.24, 2.99	<0.001
CRNA	2.50	2.13, 2.87	<0.001
Patient age	0.01	-0.01, 0.02	0.59
Surgeon experience (minutes per the years since first board certification)	-0.06	-0.10, -0.02	<0.001
Anesthesiologist experience (minutes per the years since first board certification)	-0.08	-0.12, -0.05	<.0001
Female surgeon	-0.58	-1.05, -0.10	0.222
Highest surgery resident PGY	-0.64	-0.83, -0.46	<0.001
Female anesthesiologist	-2.11	-2.51, -1.71	<0.001

Table 4.

Comparison of patient and personnel factors by first induced versus second induced cases where an anesthesiologist staffed two or more first-start cases.

Variable	First induced N=5,157 N (%)	Second induced N=5,936 N (%)	P- Value
Median Patient age (y)	59.0 [IQR 48.0-69.0]	58 [IQR 47.0-68.0]	0.04
ASA 3	2,485 (45.2)	3,017 (54.8)	<.0001
Inpatient	3,212 (44.0)	4,082 (56.0)	<.0001
Median time to induction (minutes)	6.1 [IQR 0.8-11.9]	21.0 [IQR 13.9-33.9]	<.0001
Median time from induction to procedure start (minutes)	38.0 [IQR 26.6-52.5]	37.0 [IQR 26.4-51.0]	0.03
Median surgeon experience (years since board certification)	11.8 [IQR 5.5-18.8]	10.9 [IQR 5.0-18.8]	<.0001
Median anesthesiologist experience (years since board certification)	7.9 [IQR 2.1-22.0]	8.4 [IQR 2.1-20.6]	0.17
Median seniority difference (years)	2.8 [IQR -7.6-11.4]	1.0 [IQR -9.7-9.7]	<.0001
CRNA	2,442 (41.5)	3,437 (58.5)	<.0001
Anesthesia resident	2,714 (52.1)	2,497 (47.9)	<.0001
Neuraxial anesthetic adjunct	113 (23.8)	361 (76.1)	<.0001

ASA- American Society of Anesthesiologists; CRNA- Certified Registered Nurse Anesthetists; PGY- Post Graduate Year

Table 5.

Multivariate analysis of factors associated with later induction time in cases where an anesthesiologist staffed two or more first-start cases

Variable	Induction time in minutes (normalized to scheduled start) N=15,823	95% CI	P-value
Add-on	26.15	24.62, 27.68	<.0001
Neuraxial anesthetic adjunct	14.30	12.30, 16.30	<0.001
ASA 3	3.17	2.31, 4.03	<0.001
CRNA	1.90	1.05, 2.74	<0.001
Female surgeon	0.10	-0.98, 1.19	0.84
Patient age	-0.01	-0.03, 0.02	0.59
Anesthesiologist experience (minutes per year since first board certification)	-0.07	-0.12, -0.03	<0.001
Surgeon experience (minutes per year since first board certification)	-0.08	-0.12, -0.04	<0.001
Highest surgery resident PGY	-0.57	-0.78, -0.34	<0.001
Female anesthesiologist	-1.40	-2.32, -0.47	0.01

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