ORIGINAL ARTICLE

Benchmarking Anesthesia-Controlled Times at a Tertiary General Hospital in the Philippines

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ABSTRACT

The need to measure and improve quality in the health care management setting necessitates the development of performance standards. The drive for operating room (OR) efficiency has led administrators to investigate the anesthesia-controlled times (ACTs), which are the specific periods of anesthesia task completion including preparation for anesthetic induction, anesthetic induction itself, and the wake up time or time to emergence from anesthesia.

Objectives. This study aims to conduct an internal benchmarking of ACTs using a secondary analysis of the data collected in a cross sectional survey of randomly selected elective surgical cases from October 2011 to January 2012, looking into the efficiency status of the operating room under the Department of Surgery of the Philippine General Hospital (PGH).

Methods. Mean observed times for each of the milestone comprising the ACT were calculated, taking in consideration the various anesthetic techniques, type of surgical procedures, duration of the operation and the anesthesiologist's experience. Analysis of variance and Fisher's exact test were used to determine the association of these factors with the length of the ACT. For those where an association was noted, a multivariate analysis was done to determine its impact on the actual ACT.

Results. Based on data from 539 cases, a set of benchmarks for ACT that better reflects the local setting, is proposed for the different surgical procedures and anesthetic techniques. This includes times for anesthesia preparation of 5 mins, anesthesia induction of 10 minutes and emergence times of 10 mins for total intravenous anesthesia; 20, 15, and 15 mins for inhalational anesthesia; 15, 10, 10 mins for spinal anesthesia; 20, 25,10 mins for epidural anesthesia and 10, 25, and 15 minutes for combined general-regional anesthesia.

Conclusion. It is imperative to standardize ACTs in order to reduce variability and improve efficiency. The first step in achieving this goal is to describe the standards in a particular institution, which in turn may be used as a benchmark by other institutions in a similar setting.

Key Words: anesthesia-controlled time, anesthesia preparation, anesthesia induction, emergence time, OR efficiency, benchmark

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Introduction

The drive for operating room (OR) efficiency has led to increased interest in the time taken by OR personnel to do their specific tasks or processes, anesthesiologists included. Assessment and monitoring of quality improvement implies a prospective comparison of actual versus desired performance; outcomes take on meaning only when compared to referents, or standards of comparison. Thus, benchmarks for which to standardize the specific periods of anesthesia task completion are needed. Reliable anesthesiologists-centric performance measures have been proposed by the Association of Anesthesia Clinical Directors (AACD),[1] who provided the semantics for data acquisition and comparison of procedural times, and Dexter et al[2] who defined "Anesthesia-Controlled Time" (ACT).

ACT essentially begins when a member of the anesthesia team starts to prepare the patient for anesthetic induction and ends when the anesthesiologist in charge declares that the patient may be safely placed under postoperative supervision, minus the actual surgical preparation and operative times in between, which are beyond the sole control of the anesthesiologist. The AACD further divided ACT into three timing milestones: (1) patient preparation time or the time when the anesthesiologist receives the patient and starts to attend to him or her, such as placing monitors and intravenous lines, (2) the anesthesia induction time itself, and (3) the wake up time or time to emergence.

In a recent OR efficiency study by Lapitan et al,[3] conducted at the Philippine General Hospital (PGH), it was found that anesthesia preparation time, induction and handover time, and wake up time were within the pre-determined targets of 15 minutes for each period, for more than three quarters of all cases. However, the variable lengths of time to anesthetize patients depend on a number of factors, for which adjustments are needed to make valid evaluations. Foremost would be the type of anesthetic induction technique applied.[4,5]

The difference in the induction times in the regional techniques for example, is not unexpected, as "straight" epidural anesthesia is inherently more time-consuming than performing a subarachnoid block.[6] To safely administer epidural anesthesia, the epidural catheter must be threaded carefully and securely taped, a test dose must be given and the patient observed for 3-5 min to exclude intravenous or intrathecal placement, and the entire local anesthetic dose must be administered incrementally. Furthermore, the onset of epidural anesthesia is slower than that of spinal anesthesia which often is almost instantaneous. Complex techniques involving peripheral nerve blocks or the placement of a central venous line or an epidural catheter for example, are likely to be more time consuming than simple placement of a laryngeal mask airway (LMA).

We argue that while the results in the previous study were satisfactory, relying on just one target time for the different types of anesthesia techniques and different surgical procedures may yield non-comparable data which may not be appropriate to use for future quality improvement efforts. Likewise, there is no publication describing any standard anesthesia procedural times that reflect the local setting. Furthermore, while the terms and timing milestones were developed for purposes of efficiency and economic analyses, we propose that it can also be used in internally benchmarking or setting a "best practice" standard for anesthesiologists, particularly in an academic setting, where trainee Residents can have a goal for which they can compare their pace and performance of the various anesthesia tasks. Thus, to address these concerns, we explored the effect of several variables in the three procedural timing milestones and proposed data-derived internal benchmarks for anesthesia-controlled times in the hospital of study.

Methods

The investigators conducted a secondary analysis of the data collected in a cross sectional survey of randomly selected elective surgical cases from October 2011 to January 2012, that looked into the efficiency status of the operating room under the Department of Surgery of the PGH.[3] The survey included operations in both the Private Service (performed by consultant/attending surgeons) and the Charity service (performed by surgery residents). The survey excluded cases done by other surgical departments, *i.e.* Otorhinolaryngology, Orthopedics, Neurosurgery, and Obstetrics and Gynecology. The Thoraco-Cardiovascular service operations were excluded as well, as they were performed in its own OR complex, with a separate surgical, anesthesia, and nursing staff. Also excluded from this study were emergency and outpatient operations, elective surgeries scheduled after the working day has started and cancelled cases.

For each operation, the following timing milestones, derived from the "Standardized Glossary of Times Used for Scheduling and Monitoring of Diagnostic and Therapeutic Procedures," were noted: time of patient arrival at the OR complex, time of entry in the OR itself, anesthesia preparation start time, anesthesia start time, anesthesia end time, surgical preparation start and end times, procedure start and end times, time the patient was declared ready for transfer out of the OR, and the time the patient was brought out of the OR. Based on the milestones, the following time periods were computed: patient wait time, entry lag, anesthesia preparation and standby time, anesthesia induction and handover time, surgical preparation time, time out prior to surgery, surgery duration, wake up time, and exit lag (see http://perioperativesummit.org/uploads/3/2/2/1/3221254/aacd-ptgv2013a.pdf). These time periods constituted the OR efficiency parameters used in the original analysis.

The secondary analysis focused on the three timing milestones that were classified as anesthesiologist-controlled: Anesthesia Preparation/Stand by Time, Anesthesia Induction and Handover Time, and Wake Up/Emergence. The duration of each time period, as well as taken in total, were reported as means and standard deviations. Data were then grouped and evaluated within the context of the anesthetic technique or procedure used in the case, surgical operation done, total duration of the surgical operation (used as a surrogate to the complexity of the procedure and/or patient conditions), and experience of the anesthesiologist-in-charge—patient, procedure and operator-related characteristics that might influence the anesthetic time lengths. As this was a benchmarking study, the data analysis excluded complex and rare cases which may skew the data. Initial internal benchmarks were then derived from the mean of the anesthesia-controlled time periods in the different categorizations.

Analysis of variance (ANOVA) was used for continuous, normally distributed variables while Fisher's exact test was used for nonparametric data to determine the association of the parameters (i.e. type of surgery, length of surgery, and experience of anesthesiologist) with the length of the ACT. For those where an association was noted, a multivariate analysis was done to determine its impact on the actual ACT. Statistical significance was accepted when $P<0.05$.

A separate ethics review was not sought for the current study as the data employed were secondary and extracted from a completed survey which was previously approved by the PGH Ethics Review Board. Each surgeon and anesthesiologist had already received a specific code in the earlier cited study by Lapitan et al that ensured complete de-identification. Further data and information gathered from this study was kept private and confidential, and conducted according to the provisions of the Declaration of Helsinki.

Results

The primary data consisted of 539 cases, performed by 78 different primary surgeons and 66 different anesthesiologists. After screening for missing data and categorizing into anesthetic techniques and surgical operations that can logically be grouped together, the mean anesthesia-controlled times were derived (Table 1).

More than half of the surgeries were done under general anesthesia alone (55.2% using inhalational anesthetics either intubated or with a supraglottic airway device, while three cases had total intravenous anesthesia). The rest were done with a regional technique: 24.7% under spinal anesthesia, 1.5% performed with a continuous lumbar epidural block, 2.6% under combined spinal and epidural anesthesia, while another 15.3% were done in combination with general anesthesia (mostly GA-epidurals).

Total intravenous anesthesia technique understandably required the least amount of time to prepare, induce and emerge from. With spinal anesthesia alone, induction times are usually shorter compared to combined spinal-epidural, or to a purely epidural technique or as seen in general anesthesia. CLEA performed alone or together with GA is associated with prolonged induction times. On the other hand, inhalational general anesthesia techniques were associated with longer emergence times; patients with only regional anesthesia are usually ready for transfer to the recovery room in a few minutes after the surgery. Total anesthesia controlled times were greatest if the following techniques were performed: combined GA-CLEA, CLEA and GA. Induction time and emergence time particular to these techniques contribute significantly to the observed total ACTs.

As seen in Table 2, patients presenting for explore laparotomy usually took longer operative times (>3 hours), followed by breast, thyroid and kidney surgeries (between 2-3 hours), total ACTs for these operations were generally longer than the 45 minutes which was previously proposed. Urologic procedures were usually done in a little over an hour, and their total ACTs were also well within the previous standard. Cleft lip and palate surgeries usually took just 1.5 hours but their ACTs were the longest (> 1 hour). These are accounted for by longer anesthetic preparation and induction involved. Anesthesia preparation exceeded 20 minutes in the MRM/ breast surgery, CTURP and cheilo/palatoplasty groups. Anesthesia inductions were significantly longer in the cleft lip/palate and kidney surgeries, requiring more than 30 minutes.

Noticeable were the longer induction times seen in the pelveolithotomy, nephrolithotomy and nephrectomy group, as well as in the cleft lip and palate surgery group. Total ACTs were likewise shorter in the surgeries wherein spinal anesthesia is the preferred technique (i.e., elective mesh herniorrhaphy, cystoscopy and ureterolithotomy, CTURP) compared to surgeries that are commonly performed under general anesthesia (i.e. breast and thyroid surgeries). The comparison is best observed in cholecystectomy with those performed laparoscopically (and under GA) had slightly

Table 1. Anesthesia-Controlled Time (in minutes) according to anesthetic technique performed

Anesthetic Technique Performed	Anesthesia Preparation (mean ± SD)	Anesthesia Induction (mean ± SD)	Emergence Times (mean ± SD)	Total Time (mean ± SD)
General Anesthesia (256)	20.58 ± 26.99	15.79 ± 13.39	15.18 ± 14.09	51.55 ± 32.58
Spinal Anesthesia (115)	17.32 ± 22.91	7.90 ± 7.14	7.10 ± 9.68	32.33 ± 25.48
Epidural Anesthesia (7)	21.00 ± 23.67	26.00 ± 9.70	12.00 ± 10.95	59.00 ± 26.26
Combined Spinal-Epidural Anesthesia (12)	13.25 ± 11.76	14.83 ± 12.21	6.42 ± 4.12	34.5 ± 17.04
Combined GA-Regional Anesthesia (71)	20.39 ± 27.27	23.39 ± 14.83	17.51 ± 15.75	61.30 ± 34.59
Total Intravenous Anesthesia (3)	3.33 ± 2.89	11.00 ± 8.54	7.33 ± 4.04	21.67 ± 14.57

Table 2. Top 10 most common surgical operations at PGH with corresponding operative lengths and ACTs (in minutes)

Types of Surgery (n)	Mean Length of Operation (mean ± SD)	Anesthesia Preparation (mean ± SD)	Anesthesia Induction (mean ± SD)	Emergence Times (mean ± SD)	Total Time (mean ± SD)
Laparoscopic cholecystectomy (74)	96.05 ± 68.33	17.27 ± 23.57	13.03 ± 10.49	12.54 ± 9.90	42.84 ± 27.71
Explore Laparotomy (54)	196.33 ± 113.15	18.69 ± 17.71	21.70 ± 14.68	16.63 ± 15.21	57.02 ± 25.41
Modified Radical Mastectomy/ other breast surgeries (51)	178.90 ± 71.74	28.37 ± 43.92	14.59 ± 10.72	15.90 ± 10.21	58.86 ± 45.53
Open cholecystectomy (34)	96.26 ± 55.95	15.47 ± 19.22	10.41 ± 7.24	8.53 ± 7.99	34.41 ± 24.34
C-TURP (28)	61.57 ± 39.84	21.0 ± 35.86	6.14 ± 4.43	11.46 ± 17.58	38.61 ± 37.69
Cystoscopy, Ureterolithotomy (27)	65.19 ± 40.66	11.85 ± 9.58	9.59 ± 11.93	14.89 ± 23.97	36.33 ± 28.73
Thyroidectomy / parotidectomy (21)	151.48 ± 61.93	17.76 ± 19.19	11.76 ± 11.12	18.67 ± 25.48	48.19 ± 35.05
Nephrectomy, pelveolithotomy, nephrolithotomy (18)	137.94 ± 27.74	11.11 ± 11.22	30.11 ± 25.34	16.22 ± 8.66	57.44 ± 30.66
Mesh herniorrhapy (17)	112.59 ± 44.35	16.94 ± 19.64	14.76 ± 10.47	7.94 ± 5.83	39.65 ± 20.60
Cheiloplasty, palatoplasty (11)	97.27 ± 26.02	20.00 ± 9.75	33.09 ± 12.17	13.18 ± 5.60	66.27 ± 18.65

longer induction and emergence times compared to those who had open surgeries (and usually with regional anesthesia).

A subset analysis of a type of surgery ("Nephrectomy, pelveo-, nephrolithotomy") that had enough cases done in two different anesthetic techniques (GA vs. combined GA-RA) showed no significant difference in anesthesia controlled times (Table 3).

Table 3. Comparison of ACTs for operations performed under general anesthesia (GA) alone and combined GA-regional anesthesia (n=18)*

	General Anesthesia (n=6)	Combined GA-Regional Anesthesia (n=12)	p-value
Mean Length of Operation (mean ± SD)	130.17 ± 17.75	141.83 ± 31.57	0.4168
Anesthesia Preparation (mean ± SD)	12.83 ± 18.50	10. 25 ± 6.06	0.6592
Anesthesia Induction (mean ± SD)	40.17 ± 38.03	25.08 ± 15.87	0.2451
Emergence Times (mean ± SD)	19.00 ± 12.03	14.83 ± 6.62	0.3513

*Includes nephrectomy, pelvolithotomy and nephrolithotomy only.

The length of operation time was used as a surrogate to the complexity of the procedure and/or severity of the patient's physical status. Table 4 presents the mean ACT milestones across the various lengths of surgery.

Table 4. ACTs (in minutes) according to operative length

Length of Surgery (n)	Anesthesia Preparation (mean ± SD)	Anesthesia Induction (mean ± SD)	Emergence Times (mean ± SD)	Total Time (mean ± SD)
< 30 minutes (40)	23.65 ± 30.56	7.68 ± 7.75	9.60 ± 18.03	40.92 ± 34.37
30-60 minutes (91)	16.67 ± 18.22	11.42 ± 10.76	11.43 ± 17.74	39.52 ± 26.97
> 60-90 minutes (74)	23.46 ± 33.84	12.78 ± 10.42	11.07 ± 9.95	47.31 ± 38.80
> 90-120 minutes (76)	18.89 ± 20.48	16.22 ± 12.01	12.99 ± 9.91	48.11 ± 26.71
> 120-150 minutes (65)	18.58 ± 36.97	18.57 ± 18.86	11.08 ± 6.08	48.23 ± 41.79
> 150-180 minutes (44)	12.98 ± 12.13	17.89 ± 12.63	16.18 ± 11.98	47.05 ± 17.97
> 180 minutes (79)	21.49 ± 19.03	19.32 ± 13.35	18.81 ± 15.58	59.62 ± 30.38

p-value = 0.003 (total time <30min vs >180 min)

We found that the difference in ACTs only become statistically significant in surgeries less than 30 minutes and those that exceed 3 hours. Anesthesia induction appears to require shorter time in procedures of 30 minutes or less. Emergence times tend to increase after 2.5 hours of operative time. This can probably be attributed to the use of the inhalational anesthetic isoflurane which is still commonly used in the PGH and is known to have prolonged emergence as the duration of the procedure increases.

Anesthesia tasks were performed faster by consultants/attendees compared to those done by residents, particularly to those on their first and second year of training. Induction time of 2nd year residents were longer compared to the first year residents (Table 5). However, it must be noted that the 2nd year data comprised mostly of cleft lip/palate and kidney surgeries, which involved pediatric patients for the former, and for the latter—combined anesthetic technique and more challenging patient positioning. ACT values of third year residents approached that of consultant level. However, the 3rd year cases were almost entirely endoscopic urologic procedures under spinal anesthesia.

With these data on hand, the following benchmarks are proposed (Table 6). Note that the authors took some liberty in adjusting some of the values (e.g., Epidural Anesthesia) which seemed inconsistent with common logic. In evaluating individual cases, we suggest using the ACTs based on proposed surgery, if they fall under the ten operations listed below otherwise consider the ACTs based on planned anesthetic technique. The values based on expected length and anesthesiologist's experience need further validation.

Discussion

The PGH has one of the most active OR complexes in the country with an average of 560 elective operations by the surgical department alone done monthly.[7] Considering the high number of Anesthesia resident trainees, it is also serviced by one of the largest Anesthesiology staff among all hospitals in the country. The information on the durations of the anesthesia-controlled tasks that this study provided may be utilized to guide the Department of Anesthesiology in monitoring the performance of its consultants and its trainees. This is the initial step to provide a practical approach to measure and then improve the quality of an academic anesthesia department.

Table 5. Comparison of ACTs between anesthesiology consultants and residents

	Anesthesia Preparation (mean ± SD)	Anesthesia Induction (mean ± SD)	Emergence Times (mean ± SD)	Total Time (mean ± SD)	p-value
Consultant (215) + Fellow (1)	20.35 ± 32.65	11.03 ± 10.13	12.06 ± 13.23	43.44 ± 37.02	0.0097
Residents (248)	18.60 ± 17.63	18.55 ± 14.61	14.09 ± 14.08	51.24 ± 27.41	
1st Year (106)	17.84 ± 17.25	18.63 ± 12.61	15.18 ± 11.50	51.65 ± 23.56	
2nd Year (66)	18.32 ± 14.86	27.82 ± 17.14	14.18 ± 13.50	60.32 ± 30.09	
3rd Year (76)	19.91 ± 20.33	10.38 ± 9.11	12.49 ± 17.47	42.78 ± 27.70	

Table 6. Proposed ACT benchmarks (in minutes) for PGH Department of Anesthesiology

	Anesthesia Preparation	Anesthesia Induction	Emergence Times	Total Time
Based on Planned Anesthetic Technique Performed				
General Anesthesia (GA)				
Total Intravenous	5	10	10	25
Inhalational	20	15	15	50
Regional Anesthesia (RA)				
Spinal	15	10	10	35
Combined Spinal-Epidural	15	15	10	40
Epidural Anesthesia	20	25	10*	55
Combined GA-RA	20	25	15	60
Based on Proposed Surgery				
Mesh herniorrhaphy	15	10	10	35
Open cholecystectomy	15	10	10	35
Cystoscopy,Ureterolithotomy	15	10	10	35
C-TURP	20	10	10	40
Laparoscopic cholecystectomy	20	15	15	50
Modified Radical Mastectomy/ other breast surgeries	20**	15	15	50
Thyroidectomy, parotidectomy	20	15	20	50
Explore Laparotomy	20	20	20	60
Nephrectomy, pelveolithotomy, nephrolithotomy	20	30	15	65
Cheiloplasty, palatoplasty	20	30	15	65
Based on Expected Length of Surgery				
< 60 minutes	20	10	10	40
> 60 – 90 minutes	20	15	10	45
> 90 – 120 minutes	20	15	15	50
> 120 – 180 minutes	20	20	15	55
> 180 minutes	20	20	20	60
Based on Experience of Anesthesiologist				
Consultant/attending	20	10	15	45
1st and 2nd Year Resident	20	20-30	15	55-65

**Changed from 15 min to just 10 min, as regional techniques usually do not need to wake up/emerge from anesthesia and are ready for handover to recovery room staff.*

***Changed from 30 min to 20 min, as there is no additional requirement for anesthesia setup and preparation in these cases as compared to the other surgeries that undergo general anesthesia.*

While the periods of OR processes that are controlled solely by anesthesiologists comprise a small portion of the total OR times,[3] specific causes for delay (*i.e.*, long patient preparation time, slow induction of anesthesia, and delayed emergence from anesthesia) related to anesthesia tasks comprise a predictable proportional variation in OR time. Once the anesthetic plan is known, anesthesia-controlled time can be estimated and used by both the OR Management staff and the entire surgical team as a guide to accurately formulate the predicted case durations for procedures, contributing to the rationalization of the final OR schedule.[8-10] Data from this study can be used to support choices of anesthetic technique for specific types of surgeries, based on its contribution to the efficiency of workflow.[11] Depending on the results, OR managers would be able to provide justification or determine the necessity to adopt parallel processes such as overlapping of anesthetic induction and/or emergence (e.g., use of induction/block rooms and early recovery suites).[12-14]

Results from our study showed that anesthesia controlled times are affected by several factors. Longer induction times were seen in procedures that require a specific position of the patient as seen in renal surgeries. Cases involving small children with its related anesthesia concerns, such as in cleft lip and palate surgeries, also showed longer induction times. Our data also suggest that the choice of anesthesia does not affect the ACTs and that the type of surgery may have a more significant role, as shown in the comparable ACTs in renal surgeries performed under general versus combined general-regional anesthesia. It would be interesting to find out if the same results are to be seen in surgeries such as “Exploratory Laparotomy” which could be performed in various anesthetic techniques depending on the indication and preference of the anesthesiologist. Complexity of the surgical procedure, which in this study is based on the operating time, was shown to influence ACTs to a certain degree. We found that the difference in ACTs only become statistically significant in surgeries less than 30 minutes and those that exceed 3 hours. Anesthesia induction appears to require shorter time in procedures of 30 minutes or less. Emergence times tend to increase after 2.5 hours of operative time. This can probably be attributed to the use of the inhalational anesthetic isoflurance which still commonly used in the PGH and is known to have prolonged emergence as the duration of the procedure increases.

Another implication is that Anesthesiology training in the PGH is made under regressive supervision, that is, as the resident’s proficiency in a particular anesthetic technique improves, the less the amount of consultant and/or senior resident supervision is provided. Interests in monitoring anesthesia residents' performance of the different anesthetic techniques, usually involves success and failure rates.

The decision to decrease or withdraw supervision is often not based on any objective performance measure; however, if efficiency will be factored in assessment, monitoring anesthesia-controlled times can be a used as one parameter to assess readiness of a resident for unsupervised cases, or conversely, the need for continued supervision. Significant deviations of the ACTs compared to the benchmarked times may be used to prompt for additional efforts to avoid technical errors (*i.e.*,prolonged or multiple laryngoscopy and intubation attempts, tube misplacement, etc.), and to fine-tune one's technique and trouble-shooting skills (*i.e.*, management of inadequate epidural blocks, decision to shift from a failed regional technique to GA).

In a Pakistani study[15] using the same definitions of procedural times, the investigators benchmarked their "Anesthesia Ready Time," which is inclusive of "Anesthesia Preparation" and "Anesthesia Induction" times in our study, for general anesthesia as 15 minutes for American Society of Anesthesiologists (ASA) class I and II patients, 30 minutes for ASA III and IV patients, recognizing the precautions given to more complicated cases. They also mentioned adding 15 minutes to the benchmarked times whenever an invasive procedure was performed during preparation and induction. Patients with limited functional status as displayed in the ASA physical status or surgical subspecialties with longer and more invasive surgical procedures may have increased process times not only because they are medically more complex, but also because they are more likely to receive invasive monitoring which leads to increased preparation and anesthesia induction times.[5] A similar scheme for adjusting ACT benchmark can also be appropriate in the PGH setting.

While there was an attempt to compare anesthesia-controlled times among the complex interactions of technique, provider and patient, the groupings still did not allow for weighting according to the expected difficulty of an individual procedure. Our analysis was hindered by having no data on relevant variables, such as ASA physical status classification, ease of performing a technique, or the lack of detail in reporting reasons for delay, particularly for the anesthesia-controlled endpoints. Other patient-related factors that might increase the anesthesia process times, such as obesity, age, or emergency status of the patients, were also not available for analysis. Furthermore, this study was not able to include several complex techniques like fiberoptic intubation or pulmonary artery catheter placement, since too few cases of these types were seen during the period of data collection. Targeting these for internal benchmarking is important since these cases are seen rarely in the OR and evaluating their ACT's will be less amenable to estimates based on recall alone. Also, due to the limitations of the source database, we were not able to analyze cases from sub-specialty services and the other surgical specialties.

It has been suggested that trainees adversely affect the efficiency of anesthesiology-controlled operating room measures.[16] Others have found that the level of training of the anesthesiologists had significant impact on ACT that appeared independent of supervision.[17] This was noted in our data wherein consultants (with or without residents assisting) tend to have shorter induction and emergence times. Another trend observed was the longer ACT in more senior residents, which may be related to increasing case complexity at their level.[17] However, we did not account for possible variables that may have influenced the success and efficiency rates of individual anesthesiologist. As a training institution it may be appropriate to assign benchmarks for intermediate goals according to the expected proficiency in the various anesthetic techniques of residents in the different levels and while performing in a range of subspecialty cases.

Conclusion

We now have usable data for which realistic performance goals can be set against and compared to. The introduction of benchmark for anesthesia-controlled time and its regular monitoring can help standardize operating room scheduling as well as anesthesiology training performance measures. Standards though, are meant to evolve. It is important also to get to know what the rest of Anesthesiology Departments in the country are doing and how well they are performing. The challenge is to attain, emulate or surpass the "best practice" through performance improvement actions.

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