The July Spike in Operating Room Management: Reality or Perception?

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ABSTRACT

Background Some research has found increased incidence of medical errors in teaching hospitals at the beginning of the academic year and have termed this the "July Phenomenon."

Objective Our primary hypothesis was that the "July Phenomenon" for anesthesiology and surgical residents might manifest itself as operational inefficiency, measured by monthly total operating room (OR) minutes. Secondary measures were monthly elective overutilized minutes (OR workload minus OR allocated time, after 5:30 PM at our institution), 80th percentile number of ORs running at 7:00 PM, and mean last room end time.

Methods Data were collected retrospectively from a 525-bed academic tertiary care hospital from January 2010 to September 2014 and were deconstructed to assess for a seasonal component using local regression (Loess). Variable month length was addressed by transforming the monthly totals to average daily minutes and overutilized minutes. Linear regression quantified significance for all primary and secondary analyses.

Results In the regressions, monthly average minutes showed no significant difference in July ($P = .65$) compared to the baseline month of April. There were no significant differences for any month for overutilized minutes or 80th percentile number ORs working at 7:00 PM. Only August was significant ($P = .005$) for mean last room end time.

Conclusions Data from a single institution study did not show a "July Phenomenon" in the number of operating minutes, overutilized minutes, or the number of ORs working late in July.

Introduction

For 2 decades, authors have commented on a perceived increase in medical complications and errors at the beginning of the academic year and across a variety of specialties and have sought to validate this "July Phenomenon" in hospitals with residency programs.[1–6] For academic anesthesiology departments, this may not be surprising, because anesthesiology requires a technical skill set in a high-pressure environment, in which individuals directly administer medications to patients. Given the specialty's opportunities for single points of failure (eg, medication error, procedural complication), anesthesiology residencies may incur operational inefficiencies as a result of allocating additional activities necessary to prevent or mitigate error.[7]

At the University of Vermont Medical Center, July is when anesthesiology residents begin their specialty training, and it also is a transition time for our surgical trainees. We hypothesized that the acclimatization process for anesthesiology and surgical residents to both the clinical skill sets and daily operational aspects of the operating room (OR) results in increased operative time, overutilized time (actual surgical workload minus allocated block time), the average number of sites running past the end of the scheduled day, and the completion time of the last OR.

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Methods

All data were collected retrospectively between January 2010 and September 2014 from the University of Vermont Medical Center, a 525-bed academic hospital and tertiary care center. The Department of Anesthesiology maintains an automated OR electronic health record, Picis (Picis Clinical Solutions Inc, Wakefield, MA). Statistical analysis was done using R version 3.1.1 (The R Foundation) and RStudio version 0.98.1049 (RStudio, Boston, MA).

We used WiseOR (WiseOR Inc, Palo Alto, CA) to extract the following data: total monthly OR minutes (all cases over all days), total overutilized minutes for elective cases, monthly 80th percentile of the number of rooms staffed at 7:00 PM, and the monthly mean end time for the last case.

The OR suite has 19 sites scheduled to begin at 7:30 AM, Monday through Friday. Overutilized time is

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TABLE
Selected Linear Regression Summary Statistics Using Mean April Minutes as Baseline Constant

	Linear Regression (DV ~ Month): Estimates (SE)			
	Dependent Variable			
	Monthly Minutes	**Average Daily Minutes**	**Monthly Overutilized Minutes**	**Average Daily Overutilized Minutes**
January	630.800 (3986.588)	−150.956 (126.389)	585.800 (856.598)	9.333 (27.917)
February	−9511.600[a] (3986.588)	−0.851 (126.389)	−653.000 (856.598)	−4.441 (27.917)
March	2667.200 (3986.588)	−85.266 (126.389)	563.600 (856.598)	8.617 (27.917)
May	54.800 (3986.588)	−169.537 (126.389)	−566.400 (856.598)	−27.835 (27.917)
June	1100.200 (3986.588)	36.673 (126.389)	91.000 (856.598)	3.033 (27.917)
July	1808.400 (3986.588)	−112.969 (126.389)	839.400 (856.598)	17.514 (27.917)
August	2955.000 (3986.588)	−75.982 (126.389)	1696.000 (856.598)	45.146 (27.917)
September	−3512.600 (3986.588)	−117.087 (126.389)	915.200 (856.598)	30.507 (27.917)
October	4096.300 (4228.415)	−39.166 (134.056)	346.050 (908.560)	1.599 (29.611)
November	−3899.950 (4228.415)	−129.998 (134.056)	430.550 (908.560)	14.352 (29.611)
December	−13 533.200[b] (4228.415)	−607.859[b] (134.056)	−313.200 (908.560)	−19.667 (29.611)
Constant	159 313.200[b] (2818.943)	5310.440[b] (89.371)	8894.200[b] (605.706)	296.473[b] (19.740)
Observations	57	57	57	57
R^2	0.437	0.415	0.228	0.192
Adjusted R^2	0.299	0.272	0.039	−0.005
Residual SE	6303.348 ($df = 45$)	199.839 ($df = 45$)	1354.401 ($df = 45$)	44.141 ($df = 45$)
F statistic	3.172[b] ($df = 11; 45$)	2.903[b] ($df = 11; 45$)	1.205 ($df = 11; 45$)	0.973 ($df = 11; 45$)

Abbreviation: DV, dependent variable.
[a] $P < .05$.
[b] $P < .01$.

defined as the actual surgical workload minus the allocated block time in minutes. At the University of Vermont Medical Center, 5:30 PM is defined as the end of block time and the beginning of overutilized time. For the staffing analysis, we arbitrarily chose 7:00 PM in an attempt to not unfairly bias against those rooms that finished at or shortly after end-of-block. The 80th percentile was used because our staffing decisions are routinely made against this metric to balance understaffing versus overstaffing.

After assessing normality with the Shapiro-Wilk test ($\alpha = 0.05$; $W = 0.9768$; $P = .34$), a seasonal decomposition using Loess[8] was done to total OR minutes to extract the monthly subseries for analysis. Decomposition breaks the data into trend, seasonal (monthly, in this case), and remainder components so that year-on-year analysis can be done without trends in the data biasing results.[8] To correct for suspected differences due to variable month lengths, a transformation was applied to obtain average daily minutes and the corresponding monthly subseries. This same process was performed for both average monthly and average daily overutilized minutes. Linear regression of the means (dependent variable ~ month, baseline intercept = April) quantified significance.

This study was determined by the University of Vermont Institutional Review Board to be research not involving human subjects.

Results

A year-on-year decreasing trend in decomposition was found to be concomitant with operating volume reduction secondary to surgical staff changes. Monthly subseries analysis showed no significant difference in mean July total operating minutes ($P = .65$) in the linear regression compared to the baseline intercept. However, December ($P = .003$) and February ($P = .021$) were significantly different (TABLE). After normalizing for average daily OR minutes, February ($P = .99$) was no longer significantly different; December ($P < .001$) remained significant (TABLE and FIGURE 1). Average daily OR overutilized minutes are shown in FIGURE 2. There were no significant differences in the regressions for any month using monthly total or average daily overutilized minutes (TABLE).

The 80th percentile number of ORs in use at 7:00 PM was found to be 3 in July compared to 2 to 3 for all other months, with no significant difference found for any month. The average completion time for the last case was 11:19 PM for July versus 11:07 PM for all

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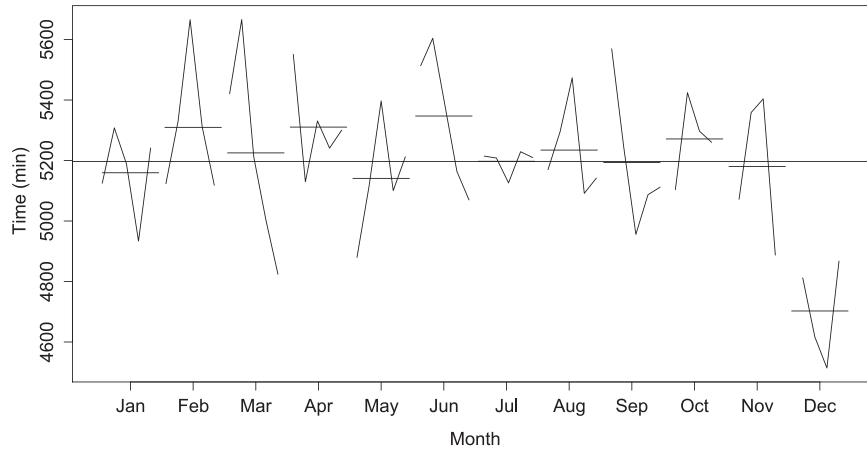

FIGURE 1
Monthly Subseries of Average Daily Total Operating Room Minutes

Note: Horizontal bars are monthly means over the study period; connected points are the individual measurements in each year. Overall average (long horizontal line) was 5196.62 minutes.

other months, with only the mean end time for August being significant (11:36 PM, $P = .005$).

Discussion

Despite the perception that there is a July spike in OR inefficiency, we were unable to identify this phenomenon from standard operating suite metrics. The significance in total operating minutes during February and December was not surprising and is perhaps due to a shorter working month and a slow holiday period, respectively. The significance of the later end time in August may reflect a return to routine resident staffing, but the effect is not large enough to suggest operational changes. Finally, we showed that last room completion time offered no evidence of greater inefficiency in July, suggesting that whatever inefficiency might be present is not sufficient to recommend staffing modifications beyond those already at this institution.

It is not surprising that new anesthesiology residents take longer as they begin their careers. Another study has demonstrated that trained solo practitioners had shorter start and extubation times than new residents.[9] These delays did not improve after the residents were transitioned through an OR orientation program.[9]

Limitations of our study include data that are specific only to the perioperative service level and the single institution nature of our observation. Furthermore, we aggregated data over monthly time periods.

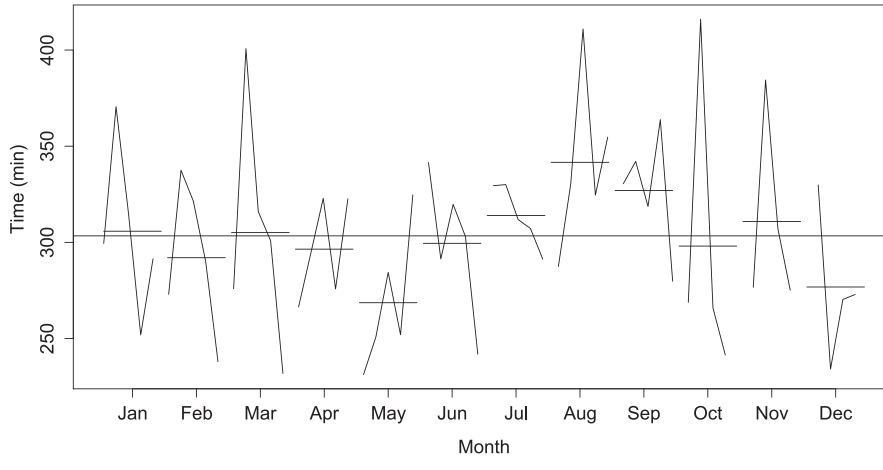

FIGURE 2
Average Daily Elective Overutilization Minutes at Monthly Intervals for Study Period

Note: Horizontal bars are monthly means over the study period; connected points are the individual measurements in each year. Overall average (long horizontal line) was 303.39 minutes.

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We included holidays and weekends as a measure of total suite efficiency because we felt that operational inefficiency during the week might push the surgical caseload out of the workweek into the weekends. Resident inefficiency also may legitimately manifest as long turnover and increased late starts and cancellations, which would not have been detected by examining operating minutes. However, on the assumption that these delays in-block should manifest as increased overutilization, some of our metrics, such as OR end time, seem relevant and reasonable. Future work could look explicitly at these other factors, perhaps in conjunction with breakdowns into yearly resident cohorts. Other metrics that may be of interest include preoperative assessment, wheels-in to incision, procedure complete to wheels-out, and anesthesia stop to anesthesia start.

The perioperative environment is a complex, dynamic system subject to human error and variation attributable to training level and skill. Our findings are perhaps not surprising because anesthesiology and surgical training programs have built-in safety measures, such as scaling staffing ratios to practitioner skill and procedural complexity. For instance, at the University of Vermont Medical Center, many attending anesthesiologists practice alone in July and August to accommodate the direct supervision necessary at the beginning of residency. Some departments may stagger the start dates or distribute incoming residents across sites to minimize the number and impact of new trainees on any given perioperative arena. Finally, all academic training programs tactically schedule their new trainees into relatively simple cases, leaving more difficult, complex patients and cases to more seasoned residents. Despite these differences, anesthesiology residents quickly learn the importance of patient safety, basic anesthetic practice, and operational workflow management, thereby mitigating a "July effect."

Conclusion

In this single institution study, we were unable to demonstrate a decrease in OR efficiency in July with respect to increased number of operating minutes, overutilized time, number of sites at 7:00 PM, or mean last OR end time.

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