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Does implementing a general surgery residency program and resident involvement affect patient outcomes and increase care-associated charges?

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ABSTRACT

Background: Variable results regarding general surgery residency program (GSRP) impact on patient outcomes and charges are reported. The aim of this study was to determine any significant differences in patient outcomes and cost with a new GSRP.

Methods: We analyzed all laparoscopic appendectomies (lap-ap), cholecystectomies (lap-chole), and inguinal hernia repairs (IHR) performed before and after implementing a GRSP.

Results: Operative time significantly increased for lap-ap ($p < 0.0001$), lap-chole ($p < 0.0001$) and IHR ($p = 0.03$). Time to close the incision significantly increased for lap-ap ($p < 0.0001$), lap-chole ($p = 0.006$) and IHR ($p = 0.03$). Length of stay only increased for lap-ap ($p = 0.04$). Complication rates did not increase for any procedure. However, charges significantly increased for lap-ap ($p < 0.0001$), lap-chole ($p < 0.0001$), and IHR ($p = 0.03$).

Conclusions: Although a newly implemented GSRP caused increases in overall operative times, times to close incisions, and charges, it did not negatively impact patient outcomes.

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1. Introduction

Performing surgery is an imperative component of surgical education. Along with this long-term educational benefit, surgical residencies also raise concern about increasing hospital charges and/or diminishing quality of patient care due to the residents' inexperience. To address these issues and to ensure the best patient outcomes, much recent medical literature has been devoted to improving general surgery residency programs (GSRP). The focus of these studies has been to improve specific methods of operative training and educational techniques.[1,2]

There are far fewer studies that address the financial impacts of the surgical training programs. Existing data pertain mainly to non-surgical residencies and present widely varied results. It has been shown that the implementation of an Emergency Medicine Residency Program (EMRP) may result in decreased charges.[3] It has also been demonstrated that Family Medicine Residency Programs (FMRP) can cause hospital charges to slightly exceed revenues. This observation, however, is largely inconclusive because charge outcomes were shown to depend largely on FMRP quality and mean patient outcome.[4] From a surgical standpoint, it has been observed that operative times of otolaryngology procedures significantly increase when residents are present. This increase in operative times translated to several hundred additional dollars charged per case.[5] Conversely, it was also observed that the presence of an orthopedic surgery training program does not negatively impact arthroplasty outcomes.[6] Numerous other studies investigating the health charges and implications of training programs for various other surgical specialties also show that such programs do not adversely affect patient care.[7–10] Not all current literature, however, yields the same positive conclusion about surgical education. Some papers have shown that hands-on training can be detrimental to patient outcomes.[11]

These widely varied results demonstrate that the care-related charges of a residency program are largely inconclusive and depend mainly upon specialty. Thus, no valid conclusions can be drawn about the charges of a training program in a specialty where there is little related literature. The data pertaining to the care-related and financial charges of implementing a GSRP are extremely scarce and examine only explicit charges.[12,13] Therefore,

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no accurate conclusion can be drawn regarding the care-related charges of a GSRP. In order for an accurate analysis to be done, data must be collected using both general and specific metrics for breadth and depth.

2. Methods

After IRB approval, data were collected from the General Surgery Department at Cleveland Clinic Florida (CCF) 11 months prior and 11 months after instituting a GSRP. All primary laparoscopic appendectomies (lap-ap), laparoscopic cholecystectomies (lap-chole), and inguinal hernia repairs (IHR) during this time period were evaluated. These basic procedures were included as they are operations traditionally performed by residents under staff supervision and with staff assistance. Operations from August 2011 through July 2012 (prior to GSRP) were the pre-residency group (pre-RG) while procedures performed between July 2012 and June 2013 (with GSRP) in which a resident participated were the post-residency group (post-RG), where residents participated in the procedure. In all instances, the residents were the surgeons supervised and assisted by staff surgeons. Patients who had undergone surgery within two weeks prior to the date of the index operation and/or who underwent a synonymous procedure were excluded. There were no changes to nursing or other protocols. The groups were compared within each operation by the following metrics:

1. *Operative time (OT):* The mean OT in pre-RG and post-RG were separately calculated. The two means were then compared to determine the impact of the GSRP on OT.
2. *Time to close incision:* Closing the incision is the portion of any operation in which surgical residents are most consistently involved. Therefore, any increase in OT with the GSRP would most likely be correlated to an increase in closing time. The mean closing times (CT) in the two groups were separately calculated. The two means were then compared.
3. *Length of stay in hospital (LOS):* A major contributor to hospital charges that is largely affected by surgical outcomes is LOS. Thus, any impact of the GSRP on surgical outcomes would also impact LOS.
4. *Complication rate (CR):* An effective metric for assessing the quality and charge of an operation is postoperative complication rate. The postoperative complication rates of pre-RG and post-RG were separately calculated. The events classified as "complications" included readmission to the emergency room (ER) and/or reoperation within 30 days. Only these metrics were used as complications because they are the most consistently measured and most directly related to operation quality. Also, failed laparoscopies and cholangiograms were included as additional indicators of operative success.
5. *OR time monetary charges:* To more accurately understand the financial implications of any change in OT between the two groups, the difference in OT was converted to a difference in charge. Using the hourly OR charge at CCF, the per minute charge was derived (average charge of 1 h in OR undergoing surgery is $11,728.00, an average of $195.47 per minute. This monetary value was then applied to the difference between pre-RG and post-RG for each operation to find the difference in operative charge with a GSRP. Calculated prices were not adjusted for inflation since all final charges were derived from the same initial per hour value in the OR. The new GSRP included six first year, 6 s year, three third year, and three fourth year trainees. Unfortunately, cost data were unavailable.

The first four aforementioned variables (OT, CT, LOS, and CR) provide general information of a GSRP on care-related outcomes. The fifth metric translates care-quality into a specific monetary value that can be quantified to estimate the charge of a GSRP. For all variables, the null hypothesis (H_0) was that the GSRP has no impact. We did not undertake any subgroup analyses to compare outcomes among residency years and/or to evaluate any changes in results during individual residency years.

2.1. Data collection

The data for this retrospective study were collected from the IRB approved CCF Department of General Surgery database. Data were recorded in a Health Insurance Portability and Accountability Act (HIPAA)-compliant manner.

2.2. Statistical analysis

The sample size equals the population for this study to ensure the greatest possible statistical accuracy; data were collected from June 2013 through July 2013.

Statistical analysis was performed with SAS software version 9.2 (SAS Institute, Cary, NC, USA). Categorical variables were analyzed with Fisher's exact test, and continuous variables were analyzed with Wilcoxon test, reported either by mean ± standard deviation (SD) or median (range).

3. Results

3.1. Demographics

The pre and post RG populations included 437 patients and 430 patients, respectively. As shown in Table 1, the two groups who underwent lap-ap were similar in both size and demographic composition. The 112 patients in pre-RG and the 108 patients in post-RG each consisted of approximately half females and half males (±5.36%), had a mean body mass index (BMI) of 27 kg/m^2, and had an equal American Society of Anesthesiologist (ASA) classification within 0.16 units. The ASA class distributions were similar, with post-RG having 16% more ASA 1 patients and 16% less ASA 2 patients. The mean age of the population in post-RG was 4.3 years younger than in the pre-RG. Demographic similarities also existed in both groups for laparoscopic cholecystectomies. As illustrated in Table 2, pre-RG and post-RG consisted of 228 and 214 lap-chole, respectively. The two populations each had nearly 47.7%

Table 1
Summary of laparoscopic appendectomies. Values are summarized as N (%), mean ± standard deviation (SD) or median (range). BMI: body mass index; ASA: American Society of Anesthesiologist Score.

Laparoscopic appendectomies			
	Pre-RG	Post-RG	*P* value
Number of patients	112 (50.9)	108 (49.1)	
Gender			0.05
Males	51 (55.4)	54 (50)	
Females	61 (44.6)	54 (50)	
Age (yrs)	42.6 ± 15.8	38.2 ± 15.8	0.05
BMI (kg/m^2)	27.2 ± 5.9	26.7 ± 5.5	0.48
ASA I	27 (24.1)	43 (39.8)	0.05
ASA II	72 (64.3)	53 (49.1)	
ASA III	13 (11.6)	12 (11.1)	
Operative time (min)	36.4 ± 11.8	46.9 ± 18.8	<0.0001
Closing time (min)	12.0 ± 4.1	14.3 ± 4.9	<0.0001
Length of stay (hrs)	33.8 (7.8–260)	39.8 (6.9–250)	0.04
Readmission	8 (7.1%)	11 (10.2%)	0.48
Charges ($)	7111.9 ± 2313.5	9170.8 ± 3672.6	<0.0001

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