
Trends in Pediatric Surgery Operative Volume among Residents and Fellows: Improving the Experience for All



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- BACKGROUND:** The ACGME requires general surgery residents (GSR) to perform 20 pediatric surgery cases as part of the total 750 cases before graduation.
- STUDY DESIGN:** We queried the ACGME General Surgery (1999 to 2014) and Pediatric Surgery (2003 to 2014) Case Logs for all pediatric operations performed during training. Means (\pm SD) and medians (10th:90th percentiles) were compared, and R^2 was calculated for all trends.
- RESULTS:** The number of pediatric surgery fellows (PSF) increased 63% (23 to 39; $R^2 = 0.82$), while GSR numbers increased 12% (989 to 1,105; $R^2 = 0.77$). Total and average pediatric surgery case volume for GSR decreased from 39,309 to 32,156 ($R^2 = 0.90$) and 39.7 ± 13 to 29.1 ± 10 ($R^2 = 0.91$), respectively. Meanwhile, average PSF case volume increased from 980 ± 208 to $1,137 \pm 202$ ($R^2 = 0.83$). These trends persisted for inguinal/umbilical hernia (GSR 22.1 ± 13 to 15.6 ± 10 ; $R^2 = 0.93$; PSF 90.5 ± 17.6 to 104.4 ± 20.7 ; $R^2 = 0.34$), pyloric stenosis (GSR 3.9 ± 3 to 2.8 ± 3 ; $R^2 = 0.60$; PSF 29.6 ± 15 to 39.7 ± 16.8 ; $R^2 = 0.69$), and intestinal atresia (GSR 1.3 ± 2 to 1.1 ± 2 ; $R^2 = 0.34$; PSF 4.3 ± 4 to 11.8 ± 8 ; $R^2 = 0.21$). The mean number of GSR pediatric operations diminished for both junior (37.1 ± 20 to 27.3 ± 16 ; $R^2 = 0.88$) and chief (2.6 ± 5 to 1.7 ± 5 ; $R^2 = 0.75$) years. Teaching cases in pediatric surgery decreased at all levels. Although the percentage of GSR teaching cases performed during chief years fell modestly (6.6% to 4.7%; $R^2 = 0.53$), median teaching cases dropped from 2 (0:11 [10th:90th percentiles]) to zero (0:0 [10th:90th percentiles]). Mean PSF teaching cases declined (100.7 ± 396 to 44.5 ± 42 ; $R^2 = 0.72$), while the percentage of operations that were teaching cases decreased more sharply (10.3% to 3.5%; $R^2 = 0.82$).
- CONCLUSIONS:** Total pediatric surgery cases and PSF operative volume have increased, while GSR operative volume has decreased. Opportunities may exist to increase resident participation while providing further teaching opportunities for GSR, improving the quality of both resident and fellow training. (J Am Coll Surg 2016;222:1082–1088. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)
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The Accreditation Council for Graduate Medical Education (ACGME) has established criteria for graduation from general surgery residency programs, including target case volumes by categories, such as trauma, vascular, and

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pediatrics.¹⁻⁴ The ACGME currently requires that general surgery residents perform a minimum of 750 cases, of which 20 must be identified as pediatric surgery cases (defined as patients under the age of 13) before graduation. This is divided into subgroups of umbilical/inguinal herniorrhaphy ($n = 8$), appendectomy ($n = 6$), and unspecified cases ($n = 6$).⁴

The ACGME similarly has established requirements for graduation from pediatric surgery fellowship. Fellows are required to log 800 major pediatric surgical cases as primary surgeon during the 2 years of fellowship, with at least 25 operative resections of tumors and 75 neonatal cases.¹ Although minimum requirements for operative volume exist within both general surgery residency programs and

pediatric surgery fellowship programs, there are no data that ensure competency based on these figures.^{5,6}

Pediatric surgical education for residents varies greatly among residency programs and institutions, and it is often limited to a few months during the entire 5-year general surgery residency.^{2,4} Beyond operative requirements, residents are responsible for the diagnosis and management of pediatric surgery patients.⁴ Given the limited exposure of residents to this discipline, it is critical that residents receive optimal exposure, education, and experience during pediatric surgery rotations.² This experience presumably ensures a minimum competency in pediatric surgery for graduating residents.¹

Our previous reports of trends in operative experiences of general surgery residents over time have revealed decreases in the number of cases residents perform, overall and in the role of teaching resident.^{3,7} Little is known about the pediatric surgery experiences of graduating residents and fellows over time. We sought to evaluate trends in operative case volume for general surgery residents and pediatric surgery fellows to identify possible strategies to improve the education of both groups.

METHODS

The ACGME general surgery and pediatric surgery databases are based on all operations reported by residents and fellows, respectively. The number of operations in each category (eg, pediatric, breast, endocrine, etc) is tabulated and stratified according to the resident's operative role: surgeon chief (cases performed during chief year), surgeon junior (all cases performed during the preceding years in which the resident was the primary surgeon), and teaching assistant (cases in which a senior resident guides a junior resident through the case). The aggregate number of cases for all 5 years, excluding first assistant cases, comprises the "surgeon total," which is essential for graduating residents to receive credit toward certification. There is an additional category for first assistant (cases in which a resident observes and assists when needed); however, this category does not count toward graduate requirements. Similar data are recorded for pediatric surgery fellows. The operative role of fellows is specifically categorized by type of operation and stratified into total surgeon and teaching assistant. The ACGME database provides means, standard deviations, medians, and stratified percentiles (10th, 30th, 50th, 70th, and 90th) for the operative categories.

We queried the ACGME database for overall case volume as well as total and operation-specific pediatric surgery case volume of graduating chief residents between 1999 and 2014. Data for pediatric surgery fellows were also queried and were available from 2003 to 2014. Operation-specific volume was further analyzed for fellow

cases that could be matched to those available for residents (ie, hernia repair, repair of pyloric stenosis, etc).

Standard measures of operative volumes using mean and total case volumes were identified. For years during which total case volumes were not provided (2010 to 2014), estimates were calculated using the total number of residents and the mean case volume for a particular operation. Certain operative categories within pediatric surgery fellow data are divided into open and laparoscopic operations. For the purposes of comparison analysis to general surgery resident case volume, where no such categorization exists, these subcategories were combined and presented as totals for the categories of herniorrhaphy, repair of pyloric stenosis, operation for malrotation or intussusception, operation for meconium ileus or necrotizing enterocolitis, and definitive operation for Hirschsprung's disease or imperforate anus. We further identified percentiles (10%, 50%, and 90%) for both pediatric surgery and total teaching case volumes for general surgery residents to evaluate trends in teaching cases over time. Both means (\pm SD) and medians (10th:90th percentiles) are presented.

Raw data are not available through the ACGME, precluding the application of certain statistical models. However, linear data trends were examined by assessing a goodness of fit model based on the means presented and reported as the value of R^2 (range 0 to 1).

RESULTS

From 1999 to 2014, the total number of general surgery residents increased 12% (989 to 1,105; $R^2 = 0.77$). Total general surgery case volume similarly increased 14% during this interval, from 955,858 to 1,085,331 cases ($R^2 = 0.83$); the average number of cases performed by general surgery residents remained stable (996.5 ± 204 to 982.2 ± 162 cases; $R^2 = 0.09$). During the same period of time, the total number of pediatric surgery cases performed by graduating chief residents declined 18.2%, from 39,309 to 32,156 ($R^2 = 0.90$). The average number of pediatric surgery cases performed by general surgery residents decreased by 26.7%, from 39.7 ± 19 to 29.1 ± 16 ($R^2 = 0.91$). This was evident both for cases recorded during junior resident (37.1 ± 20 to 27.3 ± 16 ; $R^2 = 0.88$) and chief resident years (2.6 ± 5 to 1.7 ± 5 ; $R^2 = 0.75$) (Fig. 1).

Between 2003 and 2014, the number of pediatric surgery fellows increased by 63% (23 to 39; $R^2 = 0.82$). In addition, the average pediatric surgery fellow case volume during this interval increased by 16%, from 980 ± 208 to $1,167 \pm 145$ ($R^2 = 0.87$). Similarly, total cases performed by pediatric surgery fellows increased 49.3%, from 23,516 to 46,363 ($R^2 = 0.90$).

The decreasing number of total and average pediatric surgery operations logged by general surgery residents

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