Opportunities to Create New General Surgery Residency Programs to Alleviate the Shortage of General Surgeons

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Abstract

Purpose
To estimate the capacity for supporting new general surgery residency programs among U.S. hospitals that currently do not have such programs.

Method
The authors compiled 2011 American Hospital Association data regarding the characteristics of hospitals with and without a general surgery residency program and 2012 Accreditation Council for Graduate Medical Education data regarding existing general surgery residencies. They performed an ordinary least squares regression to model the number of residents who could be trained at existing programs on the basis of residency program-level variables. They identified candidate hospitals on the basis of a priori defined criteria for new general surgery residency programs and an out-of-sample prediction of resident capacity among the candidate hospitals.

Results
The authors found that 153 hospitals in 39 states could support a general surgery residency program. The characteristics of these hospitals closely resembled the characteristics of hospitals with existing programs. They identified 435 new residency positions: 40 hospitals could support 2 residents per year, 99 hospitals could support 3 residents, 12 hospitals could support 4 residents, and 2 hospitals could support 5 residents. Accounting for progressive specialization, new residency programs could add 287 additional general surgeons to the workforce annually (after an initial five- to seven-year lead time).

Conclusions
By creating new general surgery residency programs, hospitals could increase the number of general surgeons entering the workforce each year by 25%. A challenge to achieving this growth remains finding new funding mechanisms within and outside Medicare. Such changes are needed to mitigate projected workforce shortages.

Predicting the makeup of the optimal surgical workforce and the number of residents needed to provide surgical care for the U.S. population has been a difficult task. In 1980, the Graduate Medical Education National Advisory Committee released a report projecting a significant oversupply of physicians and general surgeons. Nearly two decades later, in 1997, the existing surgical workforce, 7.53 general surgeons per 100,000 people, was considered optimal to deliver timely surgical care.[1] However, several groups raised concerns about a general surgical workforce shortage in the future, as projections of surgeon supply and health care utilization changed.[2–4] By 2005, the ratio of general surgeons per 100,000 people had fallen to 5.69 in urban areas and 4.67 in rural areas.[5] According to statistics from the Health Resources and Services Administration, demand could outstrip supply in several specialties by 2020; non-primary-care specialties, for example, are forecasted to experience a shortage of 62,400 doctors.[6] Predictions also indicate that general surgery will be among the hardest-hit specialties, with a shortage of 21,400 surgeons. The number of practicing general surgeons has been projected to fall to 30,800 by 2020, from 39,100 in 2000.[7,8]

In anticipation of the predicted shortages of surgeons and medical specialists within the next decade, the Association of American Medical Colleges embarked on expanding medical school enrollment by 30% from 2002 levels (by 2015).[9,10] Despite this increase in medical school enrollment, the number of general surgery categorical residency positions has remained relatively stable since 1981 (between 900 and 1,200 positions offered annually).[4] In fact, the number of federally funded residency positions overall has been held constant since the passage of the Balanced Budget Act (BBA) of 1997, which capped federal funding of graduate medical education (GME) at 1996 levels.[11] As these federal dollars are the primary funding mechanism for most residency programs, expansion of nearly all residences has stopped.[12] Any increase in the number of residency positions likely will depend on changing GME funding sources or lifting the BBA cap. Unfortunately, increasing medical school output will only result in a bottleneck at entry to residency, unless a concomitant expansion of residency programs takes place. Currently, general surgery fills 99% of its available categorical residency positions each year.[13]

In addition, the number of general surgery residents being trained does not offset the number of surgeons who are inactive or retire annually, and we have yet to address the existing and impending increase in surgical demand of our growing population. The number of years from graduating medical school to beginning general surgery practice (typically five to seven years) and the changing population dynamics resulting in shifting care needs have been key drivers in increasing workforce demand projections. Specifically, the existing

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surgical workforce shortage is driven by the confluence of a growing and aging population and a shrinking, aging, and increasingly specialized surgical workforce.[12,14] For example, nearly 70% of surgical residency graduates pursue fellowships, which not only reduces the number of general surgeons practicing but also delays time to entry into the workforce.[15]

One way to grow the surgical workforce is to increase the capacity of existing residency programs. However, many barriers to this approach exist, a number of which relate to the funding challenges we described above. Another way is to seek out underused hospitals as potential sites for new programs. A recent survey of surgical residency program directors revealed that although a majority believe their program could accommodate an increase in resident complement (based on hospital size and average surgical case volume), the average increase was only 1.9 additional residents per program, resulting in only 378 possible additional positions.[16] On the basis of these findings, and accounting for the progressive specialization of general surgeons and the five- to seven-year lead time from medical school graduation to independent practice, this change would result in only 249 additional general surgeons entering the workforce each year.[16] This total is not sufficient to offset the number of surgeons who retire annually, much less increase the number of practicing surgeons.[7] As there is insufficient capacity to expand existing general surgery programs to meet current and future demand, we must identify the capacity for, and encourage the establishment of, new general surgery programs. We therefore sought to evaluate the capacity for new general surgery residency programs in hospitals with existing GME offices that currently do not offer surgical training and to model the prospective number of residents these new programs could support.

Method

We used the 2011 American Hospital Association (AHA) Annual Survey Database, which contains hospital-specific, self-reported data from over 6,500 hospitals in the United States, with information regarding organizational structure and operative and surgical services.[17] We limited our data to those hospitals with 100 or more beds (N = 3,095) and excluded those hospitals without GME offices (N = 1,841), those without operating rooms (N = 72), and specialty hospitals (N = 5). We also excluded hospitals currently training general surgery residents (N = 802), hospitals with American Osteopathic Association general surgery residency programs (N = 3), stand-alone Veterans Affairs hospitals (N = 3), and hospitals with newly accredited but not yet active general surgery programs (N = 2) because duplicate surgery programs at the same hospital would likely be counterproductive. We considered the remaining 367 hospitals to be candidate hospitals for new general surgery residency programs.

We then chose hospital characteristics a priori as variables suggestive of the hospital's ability to provide the necessary surgical case mix and case complexity (i.e., requiring cancer, bariatric, or trauma surgeries) or case volume to meet the Accreditation Council for Graduate Medical Education (ACGME) Residency Review Committee (RRC) requirements for general surgery training. These variables included number of hospital beds, number of general medical–surgical beds, number of medical–surgical intensive care unit (ICU) beds, number of pediatric beds, annual inpatient surgical volume, annual outpatient surgical volume, annual total surgical volume, number of operating rooms, presence of a GME office, presence of a cancer hospital, presence of a bariatric surgery program, presence of a trauma surgery program, and presence of kidney or liver transplant programs.

We obtained a list of the 250 ACGME-accredited general surgery residency programs in 2012.[18] We excluded 11 military residencies and 2 programs that had lost accreditation and closed. For the final list of 237 programs, we determined the number of categorical residency positions and hospitals affiliated with each through a Web site search or by contacting the program coordinator via e-mail. If we identified no other affiliated training hospitals using this method, we classified the program as being located at a single hospital.

As most surgical residency programs train their residents at more than one hospital, we grouped together the AHA data for all training hospitals affiliated with each program, creating program-level variables. We defined the number of categorical residency positions offered annually as our dependent variable and our newly created program-level variables as the independent variables.

We used an ordinary least squares regression to model the number of residents who could be trained at existing programs on the basis of our independent, program-level variables. We then systematically examined combinations of covariates, and their functional forms, to optimize the adjusted R^2. Final covariates in the best prediction model included number of general medical–surgical beds, number of medical–surgical ICU beds, number of pediatric beds, annual inpatient surgical volume, annual total surgical volume, number of operating rooms, presence of a cancer hospital, presence of a bariatric surgery program, presence of a trauma surgery program, and presence of a kidney transplant program. The final adjusted R^2 on the full sample of existing programs was 0.845.

Next we performed an out-of-sample prediction for the number of possible categorical residency positions among the candidate hospitals to identify potential new general surgery residency programs. This list contained hospitals with 100 or more beds, an annual surgical volume greater than zero, and the presence of a GME office (N = 367). For accreditation of a surgical residency program, hospitals are required to have a GME office with an accredited residency program in another specialty and a minimum of two categorical residency positions per year. Following sample prediction, we further excluded candidate hospitals if we predicted that they would have fewer than two residents per year (N = 214). We only considered single hospitals as potential sites for new surgical training programs, rather than combinations of hospitals. Meeting these inclusion criteria for final analysis were 153 candidate hospitals (see Figure 1). All analyses were completed using STATA software (Version 12, StataCorp, College Station, Texas). The institutional review board at the University of North Carolina at Chapel Hill School of Medicine deemed this study exempt.

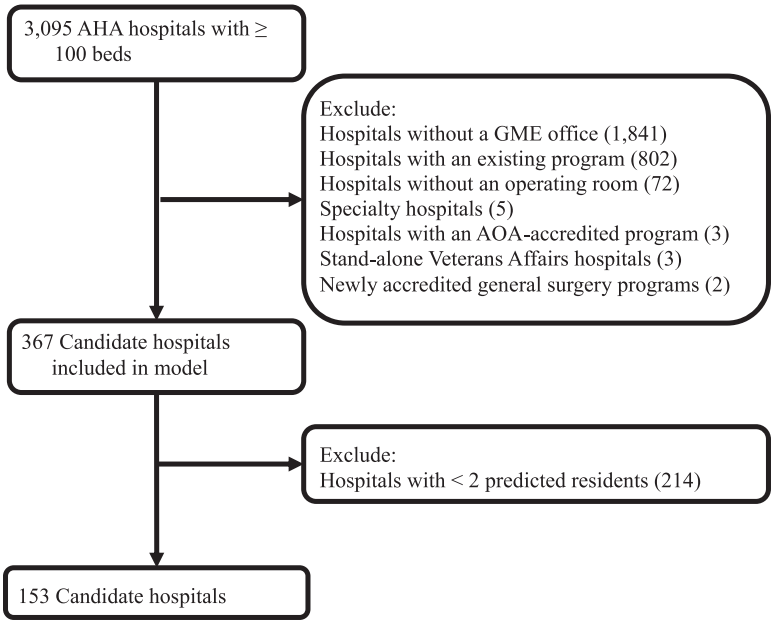

Figure 1 Inclusion and exclusion criteria used to identify U.S. hospitals with the capacity to support new general surgery residency programs. AHA indicates American Hospital Association; GME, graduate medical education; AOA, American Osteopathic Association.

Results

On average, each existing surgical residency program used 3.36 hospitals, with a mean of 743 general medical–surgical beds and 104 ICU beds, to train 4.87 residents. The mean annual surgical volume among existing programs was 25,386 inpatient and 36,503 outpatient surgical procedures performed in 76 operating rooms. A very large percentage of the 237 existing programs had an American Cancer Society (ACS)-verified cancer center (232; 98%), a bariatric surgery program (230; 97%), a trauma surgery program (235; 99%), a robotic surgery program (228; 96%), or kidney (216; 91%) or liver (167; 70%) transplant programs (see Table 1).

Characteristics of the initial 367 candidate hospitals are shown in Table 1. On average, the candidate hospitals had 180 general medical–surgical beds, 20 ICU beds, and an annual inpatient surgical volume of 4,010 procedures in 15 operating rooms. Of the candidate hospitals, 244 (66%) had an ACS-verified cancer center, 158 (43%) had a bariatric surgery program, 150 (41%) had a trauma surgery program, and 145 (40%) had a robotic surgery program. Very few had kidney (9; 2%) or liver (1; 0.3%) transplant programs.

From the sample prediction we performed on the final 153 candidate hospitals, we estimated that 40 hospitals could support 2 residents per year (80 residents), 99 hospitals could support 3 residents (297 residents), 12 hospitals could support 4 residents (48 residents), and 2 hospitals could support 5 residents (10 residents), for a total of 435 new residency positions. The characteristics of the candidate hospitals with 2 or more predicted residents (called candidate programs) are shown in Table 2, stratified by the predicted number of residents. According to our model, we found that 188 general medical–surgical beds is the average number needed to train 2 residents annually, and an average of 350 beds is needed to train 5 residents annually. Not surprisingly, inpatient surgical volume increased from 5,005 procedures annually for the 2-resident programs to 15,937 procedures annually for the 5-resident programs. The percentage of candidate programs that had specific features mirrored the percentage of established programs with the same features: an ACS-verified cancer center (130; 85%), a bariatric surgery program (98; 64%), a trauma surgery program (148; 97%), and a robotic surgery program (84; 55%). However, only 9 candidate hospitals had kidney transplant programs, and only 1 had a liver transplant program.

The candidate hospitals were distributed across 39 states and all geographic regions of the United States (see Table 3). The region with the most candidate hospitals was the Midwest, with 55 in 11 states. The Southeast had 34 candidate hospitals in 10 states. The state with the most candidate hospitals was Texas, with 14. Notably, Montana and Idaho, states with no existing surgical residency programs, had candidate hospitals (see Supplemental Digital Table 1 at http://links.lww.com/ACADMED/A316).

Discussion

This study is the first to examine whether hospitals can support new general surgery residency programs, informing health policy regarding the expansion of general surgery training in the United States. Data from the National Resident Matching Program indicated that 1,126 general surgery categorical residency positions were offered in 2013–2014.[19] According to our findings, new general surgery residency programs alone can support only 435 additional positions. With progressive specialization, some of these surgeons will not practice the full scope of general surgery; they will subspecialize in, for example, plastic, cardiothoracic, or vascular surgery. Approximately 66%, however, will specialize within general surgery in, for instance, minimally invasive, colorectal, trauma, transplant, or hepatobiliary surgery. Given the results of the survey of surgical residency program directors[16] and accounting for this progressive specialization, we expect that approximately 126 (29%) of these 435 additional surgeons will go straight into general surgery practice and that 161 (52% of the remaining surgeons) will pursue general surgery-related fellowships, yielding 287 additional general surgeons entering the workforce each year, an increase of 25% over the current numbers.

We have previously estimated that existing general surgery residency programs can support 249 additional residency positions that will produce practicing general surgeons.[16] Thus, together new and existing programs can support approximately 536 additional positions, an expansion of 47%. This estimate is likely conservative, as small hospitals may be able to work together to train surgery residents, allowing for a larger resident complement. In addition, some community programs may be able to send residents to large academic centers for exposure to more complex

Table 1

Characteristics of Existing General Surgery Residency Programs and of Candidate Hospitals That Could Support a General Surgery Residency Program[a]

Characteristic	Existing programs, average per program (N = 237)	Candidate hospitals, average per hospital (N = 367)
Hospitals used (mean, SD)	3.36 (1.59)	N/A
Residents trained (mean, SD)	4.87 (2.11)	N/A
General medical–surgical beds (mean, SD)	743 (413)	180 (114)
Pediatric beds (mean, SD)	119 (86)	10 (12)
Intensive care unit beds (mean, SD)	104 (63)	20 (15)
Inpatient surgeries (mean, SD)	25,386 (13,128)	4,010 (3,345)
Outpatient surgeries (mean, SD)	36,503 (21,671)	6,296 (5,171)
Total surgeries (mean, SD)	61,890 (32,762)	10,306 (8,034)
Operating rooms (mean, SD)	76 (40)	15 (9)
Medical school affiliation (no., %)	237 (100)	365 (99.5)
Council of Teaching Hospitals member (no., %)	232 (98)	18 (5)
American Cancer Society–verified cancer center (no., %)	232 (98)	244 (66)
Bariatric surgery center (no., %)	230 (97)	158 (43)
Trauma center (no., %)	235 (99)	150 (41)
Outpatient surgery center (no., %)	237 (100)	298 (81)
Robotic surgery program (no., %)	228 (96)	145 (40)
Kidney transplant program (no., %)	216 (91)	9 (2)
Liver transplant program (no., %)	167 (70)	1 (0.3)
Graduate medical education office (no., %)	N/A	367 (100)

[a]Data source: American Hospital Association, 2011.[17]

surgical cases, such as liver transplant or pancreatic surgeries.

To change the lead time between medical school graduation and independent general surgery practice and to ultimately expand the general surgery workforce in less time, we must address the main drivers of progressive specialization in surgery. The purpose of fellowship training after the completion of a general surgery residency is to provide a focused, intensive educational experience in a recognized subspecialty that may result in increased reimbursement from an improved market share, improved work–life balance, the ability to obtain hospital credentialing, and increased job security.[20] Fellowship training is also likely to result in improved patient and economic outcomes.[20–22] Unfortunately, progressive specialization exacerbates the maldistribution of surgeons in favor of urban hospitals and results in the forced regionalization of surgical care and reduced access to surgical care in some parts of the country.[23,24] Aligning incentives, such as changes in reimbursement to account for practice location, may help counter the progressive specialization that is common in all medical specialties.

This study has several limitations. First, we obtained the data (number of affiliated hospitals, resident complement, etc.) for the existing programs from a single-observer search of surgical residency program Web sites, and as such, the data do not account for annual variations in individual training programs. The AHA data we used to build our model are self-reported and based on 2011 reports. Thus, our model may not have accounted for erroneous or missing data or for changes in hospital systems. Hospitals for which data regarding number of beds or surgical procedures were missing were excluded from our analysis, as these data points were critical to the predictive model's performance. In addition, our predictions were based on current RRC regulations—namely, the existence of a GME office and the ability of a program to support at least two residency positions annually. However, these limitations are likely to have resulted in an underestimation of hospital capacity; if a GME office had been established recently or if the hospital had increased in size or grown its surgical volume since 2011, we would not have captured it as a candidate hospital. In addition, the hospital characteristics we chose as variables to reflect surgical case complexity may lack the specificity to generate precise estimates of the true surgical case mix, and thus the candidate hospitals we identified may not have the breadth of surgical cases necessary to train general surgeons. However, our model performed well using these proxy variables from our existing program sample, and our comparison between candidate and existing program resident complements demonstrated a 56% agreement with the resident complement within one resident and 78% agreement within two residents (see Supplemental Digital Table 2 at http://links.lww.com/ACADMED/A316). Another important limitation of our study is the inability of our model to directly account for a hospital's ability to meet specific ACGME rules, such as the scholarly activity requirement for supervising faculty and residents or the necessary access to sufficient educational resources. However, the presence of a GME office may have mitigated this limitation.

A critical challenge to funding GME remains. Models have estimated that a 15% to 25% increase in the number of federally funded residency positions is necessary to ameliorate the overall physician shortage.[25,26] From 2002 to 2007, however, the number of surgical residency positions increased by only 3.6%, likely because of the cap on federal funding for residency positions imposed by the 1997 BBA.[27] Because of this cap, hospitals have begun to identify other sources of funding for residency education, including state-based Medicaid funding, Veterans Affairs funding, endowments, foundations, and institutional funding.[12,27] However, these alternate funding streams have had minimal effect on the overall number of surgical residency positions. Another avenue for funding may be the creation of new residency programs at hospitals in rural areas because the BBA makes exceptions for such programs. We identified a number of rural hospitals outside the BBA cap that would be eligible for new federal funding. An expansion of the general surgery residency complement to mitigate the

Table 2

Characteristics of Candidate Hospitals That Could Support a General Surgery Residency Program, by Predicted Number of Residents[a]

Characteristic	2 residents (N = 40)	3 residents (N = 99)	4 residents (N = 12)	5 residents (N = 2)	Total (N = 153)
General medical–surgical beds (mean, SD)	188 (98)	182 (112)	209 (113)	350 (173)	188 (110)
Pediatric beds (mean, SD)	12 (12)	10 (10)	13 (16)	7 (10)	11 (11)
Intensive care unit beds (mean, SD)	23 (12)	22 (16)	23 (18)	37 (21)	23 (15)
Inpatient surgeries (mean, SD)	5,005 (2,912)	5,135 (3,730)	5,473 (3,179)	15,937 (16,509)	5,269 (3,900)
Outpatient surgeries (mean, SD)	7,870 (5,102)	6,703 (4,890)	11,045 (5,712)	26,099 (21,113)	7,602 (5,777)
Total surgeries (mean, SD)	12,875 (7,306)	11,838 (8,120)	16,518 (7,565)	42,036 (37,622)	12,871 (9,088)
Operating rooms (mean, SD)	17 (7)	17 (10)	21 (10)	24 (17)	17 (9)
Graduate medical education office (no., %)	40 (100)	99 (100)	12 (100)	2 (100)	153 (100)
Medical school affiliation (no., %)	40 (100)	99 (100)	12 (100)	2 (100)	153 (100)
Council of Teaching Hospitals member (no., %)	1 (3)	8 (8)	0 (0)	1 (50)	10 (7)
American Cancer Society–verified cancer center (no., %)	36 (90)	87 (88)	6 (50)	1 (50)	130 (85)
Bariatric surgery center (no., %)	3 (8)	83 (84)	10 (83)	2 (100)	98 (64)
Trauma center (no., %)	35 (88)	99 (100)	12 (100)	2 (100)	148 (97)
Outpatient surgery center (no., %)	40 (100)	99 (100)	12 (100)	2 (100)	153 (100)
Robotic surgery program (no., %)	19 (48)	57 (58)	7 (58)	1 (50)	84 (55)
Kidney transplant program (no., %)	0 (0)	3 (3)	3 (25)	1 (50)	7 (5)
Liver transplant program (no., %)	0 (0)	0 (0)	0 (0)	1 (50)	1 (0.7)

[a]Data source: American Hospital Association, 2011.[17]

growing imbalance between the existing supply of surgeons and the current demand for care, then, will require either revisions to the BBA or a significant new funding mechanism.

In 2014, the Institute of Medicine (IOM) published a report on the governance and financing of GME.[28] Their recommendations included policies to improve GME, with an emphasis on the training of physicians. Specific attention was given to increasing the capacity of the nation's clinical workforce to deliver efficient and high-quality health care that meets the needs of our diverse population.[25] The report also recommended eliminating the separate funding streams for direct GME expenditures (known as direct graduate medical education [DGME] payments) and indirect costs (known as indirect medical education [IME] payments). Instead, the total available funding would be divided into an operational fund to support current programs and a new transformation fund to support innovation as well as new programs in needed specialties and underserved areas. Although this change would stretch already-scarce GME dollars across a greater number of residency positions (the transformation fund could cover new positions as well as existing ones that currently do not receive federal funding because of the cap imposed by the BBA), it also could increase the amount of funding available for actual training by combining DGME and IME dollars.

Yet, the IOM report recommends that the total amount of federal GME funding be maintained at current levels for the next decade; the core of this funding—about $10 billion from Medicare—would continue to be the primary source of federal funding for GME. Although additional residency positions in specialties facing acute shortages could be funded more easily, these positions would be created at the expense of positions in other specialties. We predict that maintaining current levels of GME funding for the next decade will result in competition between primary and specialty care provider groups for those dollars. As the Affordable Care Act extends health coverage to more Americans, our GME system must be able to produce a physician workforce that meets the evolving health needs of the population. To do so, we must acknowledge and support the expansion of existing residency programs and the creation of new ones. We believe that general surgery meets the IOM criteria for additional federal funding for these changes.

Adding general surgery categorical residency positions, by revising the BBA or identifying alternate new funding mechanisms, will be necessary if we are to avoid projected surgical workforce shortages in the next 30 years. Our study demonstrates that U.S. hospitals that

Table 3

Distribution of Candidate Hospitals That Could Support a General Surgery Residency Program and Predicted Number of General Surgery Residents, by Region

Region	No. of states	No. of hospitals	No. of residents
Midwest	11	55	165
Northeast	7	20	57
Southeast	10	34	93
Southwest	3	20	57
West	8	24	63

currently do not train residents have the capacity to support new general surgery residency programs. These programs provide one answer to the question of how to produce a surgical workforce that will meet the needs of our population.

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