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Specialization and the Current Practices of General Surgeons

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Abstract

Background—The impact of specialization on the practice of general surgery has not been characterized. Our goal was to assess general surgeons' operative practices to inform surgical education and workforce planning.

Study Design—We examined the practices of general surgeons identified in the 2008 State Inpatient and Ambulatory Surgery Databases of the Healthcare Cost and Utilization Project (HCUP) for three US states. Operations were identified using ICD-9 and CPT codes linked to encrypted physician identifiers. For each surgeon, total operative volume and the percentage of practice comprised of their most common operation were calculated. Correlation was measured between general surgeons' case volume and the number of other specialists in a health service area.

Results—There were 1,075 general surgeons who performed 240,510 operations in 2008. The mean operative volume for each surgeon was 224 annual procedures. General surgeons performed an average of 23 different types of operations. For the majority of general surgeons, their most common procedure comprised no more than 30% of total practice. The most common operations, ranked by the frequency that they appeared as general surgeons' top procedure, included: cholecystectomy, colonoscopy, endoscopy, and skin excision. The proportion of general surgery practice comprised of endoscopic procedures inversely correlated with the number of gastroenterologists in the health service area ($Rho = -0.50$, $p = 0.005$).

Conclusions—Despite trends toward specialization, the current practices of general surgeons remain heterogeneous. This indicates a continued demand for broad-based surgical education to allow future surgeons to tailor their practices to their environment.

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Keywords

General Surgery; Workforce; Surgical Education; Specialization; Case-Mix

Introduction

The field of surgery is becoming increasingly specialized. As the majority of graduating general surgery residents pursues fellowship training¹⁻², the traditional five-year general surgery residency needs to be re-evaluated. Disciplines that historically were part of the general surgical curriculum, including obstetrics and gynecology, orthopedics, otolaryngology, and urology, are no longer practiced by the majority of general surgeons and are therefore not emphasized or are often not included in current general surgical training. As more specialties emerge, the field of general surgery has become more ambiguous. Upon re-certification, 32% of board certified general surgeons reported having a subspecialty certificate in Surgical Critical Care, Pediatric Surgery, Vascular Surgery, Surgery of the Hand, Colorectal Surgery, Plastic Surgery, or Thoracic Surgery³. An untold number of other general surgeons have subspecialty practices in Surgical Oncology, Advanced Gastrointestinal and Laparo-endoscopic Surgery, Breast Surgery, Endocrine Surgery, Transplantation, or Acute Care Surgery.

This prevalence of specialization might suggest that many surgeons solely perform a defined subset of procedures and only use a portion of the general surgical education that they obtained in residency. This would favor a system with 3 years of general surgery and 3 years of specialty training, or 5 years of subspecialty integrated training, which has been proposed and implemented in some disciplines⁴⁻⁷. However, preparing trainees for contemporary practice requires an understanding of what general surgeons actually do in practice. This study sought to determine whether general surgeons tend to specialize in a small number of procedures or maintain a broad, heterogeneous case-mix.

Understanding general surgeons' case-mix will not only inform surgical education, but will also assist in workforce planning and allocation of health services. The Affordable Care Act has mandated that 75% of new residency positions be designated for either primary care or general surgery, in an effort to prevent projected physician shortages⁸. A previous study by Stitzenberg and Sheldon projected that progressive sub-specialization within general surgery would lead surgeons to narrow their scope of practice, leading to a shortfall of surgical services². To cover the breadth of demand for surgical services, it was postulated that a larger number of surgeons would be required. As general surgical education is re-designed to meet current demands, it will be important to understand which procedures general surgeons perform and how varied their case-mix is.

Methods

Design

This was a retrospective observational study of a population-based cohort.

Data Sources

Data from the 2008 State Inpatient and State Ambulatory Databases of the Healthcare Cost and Utilization Project (HCUP) was obtained from Maine, South Carolina, and Wisconsin. These states were chosen because their datasets were among the few statewide datasets that included information on surgeon specialty. At the time of this study, 2008 data was the most current available in all states.

Population-level Data

Hospital identifiers and hospital zip codes were used to link the HCUP data with the 2009 Area Resource File⁹, a national county-level health resource information database of the Health Resources & Services Administration. The Area Resource File was used to identify health service areas (HSAs). HSAs were defined according to the National Center for Health Statistics, which designates them as a single county or cluster of contiguous counties that are relatively self-contained with respect to hospital care. Hospital identifiers and hospital zip codes were not available in the data for South Carolina. Therefore HCUP data from Maine and Wisconsin were used to analyze population-level practice patterns.

Individual Surgeon-Level Data

Encrypted physician identifiers were used to analyze practice patterns and case-mix at the level of each surgeon. General surgeons, surgical sub-specialists, and gastroenterologists were identified using HCUP physician specialty codes. The codes are based on attending physician specialty as provided by the data organizations, which included Maine Health Data Organization, the South Carolina Budget and Control Board Office of Research & Statistics, the Wisconsin Hospital Association and Wisconsin Department of Health Services. South Carolina reports physician specialty as the area in which the physician spends the most hours per week, as reported by the physician at license renewal. If the physician does not report hours, South Carolina assigns physician specialty as the first practice type reported by the physician.

Information from patient encounters was linked to individual general surgeons for analysis. Patient encounters included in the analysis involved a general surgeon as the admitting/primary provider, without a secondary provider; or a general surgeon as the consulting/secondary provider. All other encounters were excluded.

Procedure Variables

Surgical procedures were identified using ICD-9 and CPT codes, then classified into categories using modified HCUP Clinical Classification Software (CCS)¹⁰⁻¹¹. The HCUP-CCS categories were modified to capture all procedures that a general surgeon could potentially perform, and classify them into surgically meaningful categories. Three surgical research fellows independently reviewed the HCUP-CCS categorization of each procedure code. Redundant or indistinct HCUP-CCS-defined categories were eliminated, and their ICD-9 and CPT codes were re-assigned to modified categories. The final classifications were revised and reviewed by a board-certified general surgeon. Ultimately 210 types of procedures were designated as operations that a general surgeon could potentially perform. The primary procedure for each patient encounter was analyzed.

Analysis

The total number of general surgeons in each state and the number of general surgeons per 100,000 people in each state were calculated using 2008 US Census data¹². The total annual volume and number of different types of operations were calculated for each surgeon. General surgeons who performed fewer than 10 procedures annually were excluded from the analysis, as case-mix could not be reliably determined. Additionally, general surgeons with more than 1,000 procedures per year were excluded in order to achieve a representative sample for analysis and avoid skewing results toward those with the highest case-volumes. Hence, general surgeons at both extremes of the case volume spectrum were excluded in order to characterize the case-mix of the typical general surgeon and avoid skew toward the extremes.

The most common operation was then identified for each surgeon and the percentage of practice comprised of that operation was calculated. The volume of each surgeon's most common operation was measured in proportion to the statewide total volume for that type of operation. The most common operations for all general surgeons were identified by ranking according to the frequency that they appeared as a general surgeon's top procedure. To determine whether the top procedure was indicative of case-mix, surgeons were grouped by their top procedure and the second most common procedure for the majority of these surgeons was assessed for similarity. To assess the overall volume of procedures in the cohort, the procedures with the largest overall volume in the cohort were then identified.

Correlation between the number of procedures performed by general surgeons and the number of specialists in a health service area was measured using the Spearman correlation coefficient. A subgroup analysis was performed to analyze the practices of high volume surgeons who performed 25% or more of the statewide total for a given type of operation.

Results

Cohort

Of 1,540 general surgeons identified in HCUP data from 2008, 443 were found to have fewer than 10 annual procedures and were excluded from the cohort as described above. This excluded 18 of 188 (10%) general surgeons in Maine, 43 of 327 (13%) in South Carolina, and 382 of 1025 (37%) in Wisconsin. An additional 22 (2%) general surgeons had over 1,000 annual procedures and were excluded from the cohort to achieve a representative sample. The majority of these surgeons' procedures included colonoscopies, upper endoscopies, and wound debridement. The final cohort included 1,075 general surgeons in the three states. There were 6 general surgeons per 100,000 people in South Carolina, 12 per 100,000 in Maine, and 11 per 100,000 in Wisconsin (Table 1).

Volume

General surgeons performed 274,273 operations in Maine, South Carolina, and Wisconsin in 2008, with a mean total operative volume of 224 procedures (median 132) per surgeon that year. *Most Common Operations* Cholecystectomy was the most common procedure for the largest number of surgeons. When cholecystectomy was surgeons' top procedure, it comprised 6 to 60% of those surgeons' practices (Table 2). Bowel resection was the second most common procedure for the majority of those surgeons (Table 3). Colonoscopy and upper endoscopy played a significant role in many surgeons' practices, as either their top procedure or second most common procedure (Table 2). Skin excision and wound debridement were the most common operations for a significant proportion of general surgeons as well, making up 11 to 100% of their practices. Breast lumpectomy was also among the top ten most common procedures. For surgeons whose most common procedure was breast lumpectomy, cholecystectomy was largely the second most common procedure (Table 3). These analyses were repeated with and without the exclusion of surgeons who had fewer than 10 or more than 1000 annual procedures. Ranking of the first and second most common operations remained in the same order. Procedures were also analyzed by state, and results identified the same top ten procedures with only slightly different rank order for each state.

Individual surgeons' most common procedures (Table 3) were then compared to the largest volume procedures in the overall cohort (Table 4). Colonoscopy made up the largest proportion of the overall cohort case volume.

Individual Surgeon Case-mix

General surgeons performed a mean of 23 different types of operations (Table 1), with a range from 1 to 73 different types of operations. For the majority of surgeons, their most common procedure comprised no more than 30% of total practice (Figure 1). The remaining 70% of most surgeons' practices were therefore made up of over 20 different kinds of operations. Only 2% of general surgeons devoted over 75% of their practice to their most common procedure.

Practice environment

Given that colonoscopy and upper endoscopy were among the most common procedures, correlation was measured between general surgeons' volume of endoscopic procedures relative to the number of local gastroenterologists. The endoscopic procedures included upper GI endoscopy, colonoscopy, proctoscopy, and endoscopic retrograde cholangiopancreatography. The total number of endoscopic procedures performed by general surgeons was inversely correlated with the number of gastroenterologists in a given health service area (Figure 2). The Spearman correlation coefficient was -0.50 and $p = 0.005$, indicating a small but statistically significant relationship between surgeons' case-mix and the number of gastroenterologists nearby.

Subgroup Analysis: High volume general surgeons

There were 31 high volume general surgeons (3% of cohort) whose most common procedure made up 25% or more of their state's total volume for that particular type of procedure. High volume general surgeons' most common procedures included skin graft, gastric bypass, pancreatic resection, pneumonectomy, thyroid and parathyroid surgeries, as well as other less common procedures. For these surgeons, their most common procedure comprised an average of 40% of their individual practice and they performed a mean of 20 different types of procedures annually (Range 1 to 58).

Discussion

Overall this study demonstrates that many general surgeons' practices remain heterogeneous despite trends toward specialization; and there is a broad array of core general surgical procedures that a significant proportion of surgeons perform in addition to their most common procedure.

The number of general surgeons per 100,000 people in the three states was as expected, relative to the 6 per 100,000 people reported nationally¹³. South Carolina had the national average, while Maine and Wisconsin had approximately twice the national average of general surgeons. It is also worth noting that 21% of South Carolina, 66% of Maine, and 79% of Wisconsin's population reside in metropolitan areas while the remaining population lives in rural areas. These proportions can be compared to 90% of the US population that resides in metropolitan areas¹⁴. While the three states studied may comprise an oversampling of the rural US, their data represent the spectrum of both rural and major metropolitan practice settings.

About one tenth of general surgeons in Maine and South Carolina, and one third of the general surgeon workforce in Wisconsin performed fewer than 10 procedures annually. A potential explanation for this is the use of locum tenens surgeons who fill short-term service needs. A recent study found that locum tenens surgeons were hired in 15% of surveyed hospitals in small urban clusters of 2,500 to 9,999 people, small towns with high commuting to small urban clusters, small towns with low commuting, and isolated rural areas¹⁵. The proportion of Rural Urban Commuting Areas that meet this description is three times higher

in Wisconsin, compared to Maine and South Carolina¹⁴. The use of locum tenens, the regionalization of healthcare across states^{16,17} as well as the retirement of a large proportion of general surgeons^{18,19} likely explain the proportions of surgeons with fewer than 10 procedures. In this study, general surgeons with fewer than 10 or greater than 1000 annual procedures were excluded to characterize the typical general surgery practice and avoid skew toward the extremes. However, in a post hoc analysis in which all general surgeons were included, we found that the first and second most common operations in Tables 2 & 3, as well as the results in Figure 2, remained the same. This supported the internal validity of our findings.

General surgeons' mean annual operative volume of 224 operations in this study was similar to recently published data from American Board of Surgery certified surgeons in Florida who performed 228 to 456 procedures annually²⁰. The case-mix mean of 23 different types of surgery in our study is consistent with findings from a recent study showing that surgeons manage a wide variety of primary diagnoses, with 136 to 236 different primary diagnoses per full time equivalent (FTE)²¹. The average surgeon in our study devoted less than 30% of their practice to their most common procedure, and their second most common procedure was often unrelated. This demonstrated that there is significant heterogeneity in the practice of general surgery. For example, one might expect that the majority of the surgeons whose most common procedure was lumpectomy would perform mastectomies or breast biopsies as their second most common procedure; but this was not the case, their second most common procedure was cholecystectomy. There were rare cases in which one type of procedure made up more than 75% of a surgeon's practice. Colonoscopy, upper endoscopy, and therapeutic gastric procedures made up 11-98% of some surgeon's practices. Previous studies of general surgeons' practice patterns confirm this demand for endoscopies and colonoscopies, particularly in rural practices^{3,22-24}. We further explored the relationship between the practice environment and the number of endoscopic procedures performed by surgeons. We found a statistically significant inverse correlation between the number of gastroenterologists in the health service area and the number of endoscopic procedures performed by general surgeons. This suggests that general surgeons adapt their practices to the environment and needs of the community, broadening or narrowing their scope in relation to other providers.

Wound debridement and skin excision were also among general surgeons' most common procedures, making up 11 to 100% of a practice when it appeared as surgeons' top procedure. Evidence of general surgeons devoting a bulk of their practice to wound debridement exists in a number of positions available nationwide for full and part-time general surgeons to join wound management practices, podiatry groups, and venous disease clinics²⁵. It is unclear whether this reflects healthcare consumer-driven demand for these subspecialists, need for subspecialists to manage increasingly complex disease, or other surgeons' desire to exclude these types of cases from their practice. Nonetheless there is evidence that only a minority of surgeons have devoted the bulk of their practice to one type of procedure.

Given the increasing efforts by Medicare and healthcare quality agencies to reward high volume centers²⁶, one might expect that surgeons who draw a high volume of referrals for a given type of procedure would devote most of their practice to one procedure. However this study showed that high volume surgeons only devoted 40% of their practice to their most common procedure. These surgeons performed a mean of 20 different types of procedures annually, compared to the entire cohort mean of 23 different types of procedures.

The goal of this study was to assess the operative practice of the typical general surgeon in the United States, and this was achieved with some limitations. Statewide data from the

Healthcare Cost & Utilization Project (HCUP) was used to approximate national trends. However, encrypted physician identifiers and linked physician specialty codes were only available for three states. Despite this limitation, our results consistently demonstrated that the majority of general surgeons' most common procedure made up no more than 30% of individual practice when analyzed by state and in aggregate. Additionally the ten most common operations remained the same, with only slight changes in rank when analyzed by state. The fact that results remained consistent when analyzed both by state and in aggregate lends validity to our findings. It is unlikely that the three states studied represent one extreme in the US surgical case-mix spectrum, given the large geographic and demographic differences between the states^{9,12,14}. Given that the data for this study was limited to three geographically dispersed states, our analysis was unable to capture the case-mix of surgeons who practice in more than one state within a region. This could be one explanation for the proportion of surgeons with fewer than 10 procedures. Another limitation to this assessment of general surgery practice was the availability of current data. At the time of this analysis, 2008 data was the most current data available. HCUP obtains data from state agencies or their designees that manage the original data. For this study, patient level data was merged with provider data from the National Provider Identifier (NPI) file, encrypted physician identifiers were then created by the agency before releasing the data for research. It is possible that trends towards sub-specialization have continued to increase since 2008, which would not be reflected in this study. However, trends toward sub-specialization far preceded this study, with 74% of residents entering fellowships in 1993 and 79% in 2005¹. Therefore we expected sub-specialization to impact the practices of general surgeons in 2008, but we did not find general surgeons' scope of practice to be as narrow as expected.

It is possible that specialization within general surgery, when faced with continued demands for a wide breadth of surgical services, has led surgeons to narrow their scope less than what was projected by Stitzenberg and Sheldon². Our study shows that many general surgeons still have broad and heterogeneous practices. This conclusion is also supported by findings from previous studies which demonstrated that general surgeons perform a broad variety of procedures that span the sub-specialties³, the clinical classification system²⁰, and various ICD-9 diagnoses²¹. These results have significant implications for surgical education in an era of increasing healthcare specialization. A 2004 survey found that most general surgeons, with and without fellowship training, continued to practice broad-based general surgery and reported that such training was relevant to their current practice²⁷. It is likely that the 2008 cohort in this study would have reported the same.

Findings from our study suggest that surgical education should be broad-based to allow surgeons to tailor their practices to meet the needs of their communities and institutions. The American College of Surgeons has introduced the Transition to Practice Fellowship in General Surgery,²⁸ which may assist general surgeons entering practice in refining their skills while establishing themselves in a new environment. Other innovative approaches, such as surgical coaching,²⁹ can help new attending surgeons transition into practices that will serve the growing need for surgical services in communities throughout the country.

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Abbreviations/ Acronyms

(HCUP)	Healthcare Cost and Utilization Project
(CCS)	Clinical classification Software
(ICD-9)	International Classification of Diseases
(CPT)	Current Procedural Terminology
(FTE)	Full Time Equivalent
(ME)	Maine
(SC)	South Carolina
(WI)	Wisconsin

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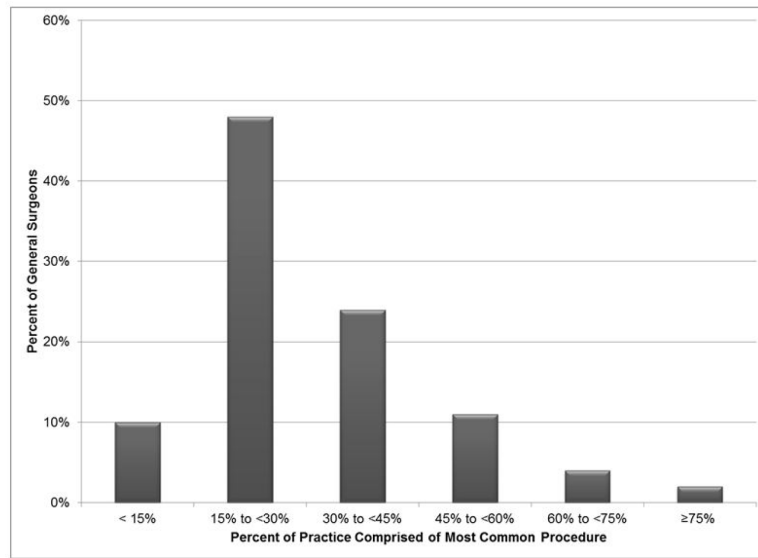


Figure 1. Distribution of general surgeons' practice that is comprised of their most common procedure.

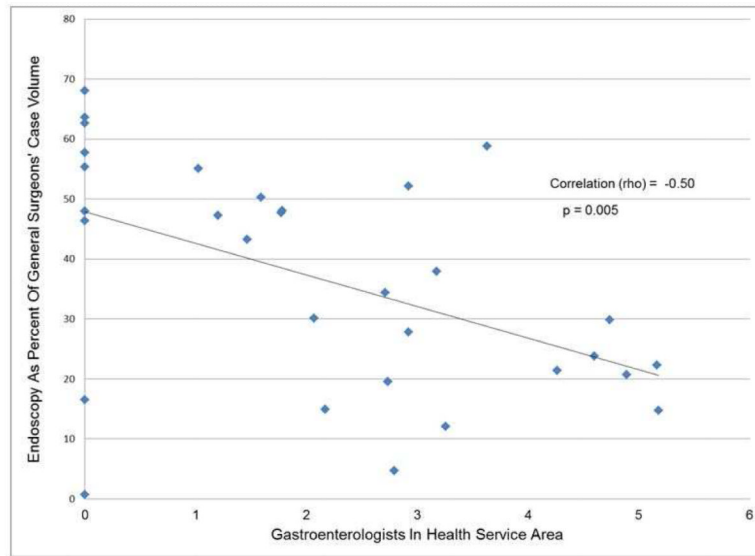


Figure 2. Correlation between endoscopy as a percentage of surgeons' case volume and number of gastroenterologists in the health service area.

Table 1

Summary of Number of Surgeons, Volume, and Case-Mix

State	General surgeons with 10 and 1,000 procedures annually, n	General surgeons per 100,000 people, %	Mean no. of procedures per surgeon, n	Mean no. of different types of procedures per surgeon, n (range)
Maine	165	12.4	303	28 (2- 62)
Sout Carolina	281	6.2	338	35 (2- 73)
Wisconsin	629	11.2	152	16 (1- 51)
Combined	1075	-	224	23 (1- 73)

Table 2

Ten Most Common Operations - Ranked According To Frequency That They Appeared As General Surgeons' Top Procedure

Most common operations	General surgeons, n	Individual practice comprised of top procedure, %, mean (range)
Cholecystectomy	269	24 (6-60)
Colonoscopy	216	38 (11-98)
Upper GI endoscopy	121	33 (13-79)
Skin excision	62	28 (12-100)
Inguinal or femoral hernia repair	59	27 (10-71)
Debridement of wound, infection, or burn	43	33 (11-98)
Breast lumpectomy	32	41 (14-89)
Hemodialysis and peritoneal dialysis access	22	36 (14-73)
Colorectal resection	19	25 (10-47)
Therapeutic gastric procedures	17	34 (15-83)

Table 3

First and Second Most Common Operations for General Surgeons

Top procedures		Second most common operation for the majority of surgeons with the paired top procedure	
	Surgeons, most common procedure, n	Procedure	Surgeons, second most common procedure, n
Cholecystectomy	269	Colorectal resection	39 of 269
Colonoscopy	216	Upper GI endoscopy	109 of 216
Upper GI endoscopy	121	Colonoscopy	42 of 121
Skin excision	62	Cholecystectomy	14 of 62
Inguinal or femoral hernia repair	59	Cholecystectomy	27 of 59
Debridement of wound, infection, or burn	43	Excision of skin/subcutaneous	12 of 43
Breast lumpectomy	32	Cholecystectomy	<12 of 32
Hemodialysis and peritoneal dialysis access	22	Peripheral Vascular Bypass	<12 of 22
Colorectal resection	19	Cholecystectomy	<12 of 19
Therapeutic gastric procedures	17	Cholecystectomy	<12 of 17

Table 4

List of 20 Procedures with the Largest Volume in the General Surgeon Cohort

Procedure	Cohort no. of annual procedures, n=274,273	Cohort case volume, %
Colonoscopy	51,649	19
Cholecystectomy	24,333	9
Upper GI endoscopy	22,987	8
Inguinal or femoral hernia repair	16,900	6
Skin excision	14,568	5
Ventral and paraesophageal hernia repair	11,791	4
Breast lumpectomy	10,541	4
Wound debridement	9,801	4
Lower GI endoscopy	9,705	4
Central venous or arterial catheter	8,322	3
Appendectomy	6,826	2
Incision and drainage of soft tissue	5,922	2
Colorectal resection	5,626	2
Hemo- and peritoneal dialysis access	4,581	2
Therapeutic gastric procedure	4,022	1
Diagnostic lymphatic procedure	4,152	2
Breast biopsy	3,642	1
Hemorrhoid procedures	3,177	1
Thyroid and parathyroidectomy	2,993	1
Major anorectal procedure	2,894	1