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Does surgery residency prepare residents to work at critical access hospitals?

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Abstract

BACKGROUND: Operations performed by surgeons working at Critical Access Hospitals (CAHs) and surgery residents have not been compared.

METHODS: Procedure codes logged by general surgery residents graduating from our institution in 2013 and 2014 were obtained. Procedure codes were obtained for all CAHs in our state for 2012 to 2013. Clinically relevant categories were compared among residents and general surgeons at CAHs.

RESULTS: A total of 34,246 procedures logged by general surgeons at CAHs were compared with 31,977 procedures logged by surgery residents. Endoscopy comprised 56.1% of cases done by general surgeons versus 9.1% of cases by residents ($P < .001$). Excluding endoscopy, rural surgeons had higher percentages in hernia, skin/soft tissue, cholecystectomy/common bile duct, rectal/anal, and breast cases. Residents who completed a rural surgery rotation had higher numbers in small/large bowel, hernia, breast, and endoscopy.

CONCLUSIONS: Surgery residency provides less exposure to endoscopy compared with a general surgery practice at CAHs. A rural rotation increases endoscopic exposure.

There is a predicted shortage of 30,000 surgeons at the national level by 2030[1]. This shortage will be more acute in rural communities[1] in which surgeon numbers are already declining and makes recruitment and retention of surgeons in rural areas particularly important. At the same time, there is an increasing number of surgical residents pursuing fellowships.[2] Of the residents who decide to go into general surgery practice, before or after fellowship, a smaller subset go into practice as rural general surgeons. Through this study, we wanted to describe the procedures that surgery residents have done after graduating from a general surgery residency and compare them with procedures done by general surgeons at small rural hospitals in the same state. We wanted to determine if general surgery residency provides a similar training experience to procedures currently performed in a rural practice. In addition, we wanted to determine if a rural rotation offers additional preparation for such practice.

We chose to study Critical Access Hospitals (CAHs) because there are over 1,300 hospitals nationwide and they meet standardized eligibility criteria.[3] To be eligible, a hospital must have fewer than 25 inpatient beds and be located in a rural or frontier area. Once the designation is

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attained, a CAH is able to get cost plus 1% reimbursement from Medicare and can have flexibility in staffing as well as other benefits.[4]

Patients and Methods

After obtaining Institutional Review Board approval, we accessed the Oregon Association of Hospital and Health Systems (OAHHS) database for the calendar years 2012 and 2013. CAHs were identified in the database and their Current Procedural Terminology (CPT) codes and International Classification of Diseases, Ninth revision (ICD-9) codes were extracted for both inpatient and outpatient procedures. We then obtained a list of CPT codes entered into the Accreditation Council for Graduate Medical Education Resident Case Log by general surgery residents graduating from our program in 2013 and 2014. Residents who completed the rural surgery elective were identified. All residents met the American Board of Surgery training requirements for certification in general surgery. Procedures from residents and surgeons were combined into one database.

We used Clinical Classification Software (CCS)[5] to condense CPT and International Classification of Diseases, Ninth revision codes into 244 unique CCS codes. Codes 245 and 246 were created to cover liver and pancreas procedures not included in CCS codes as done by Harris et al.[6] The CCS codes were further classified into clinically relevant categories as previously described,[6,7] including 14 general surgery and 8 specialty procedure categories (Table 1, Fig. 1).

To identify procedures performed by general surgeons at each CAH, we used the National Provider Identification (NPI) number associated with each procedure in the OAHHS. We accessed the National Plan and Provider Enumeration System Downloadable File[8] and matched NPI numbers to taxonomy codes. Procedures were identified based on which primary taxonomy code of each NPI number corresponded to the code for general surgeon "208600000x".

IBM SPSS statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY) was used to build the databases. Chi-square was used to compare frequency distributions between general surgeons and residents and a Mann–Whitney *U* test was used to compare case medians of residents with or without a rural rotation.

Results

There were 31,977 procedures logged by 21 general surgery residents graduating in 2013 and 2014 from our program, while general surgeons working at CAHs logged 34,246 cases in 2012 and 2013. Residents logged a smaller percentage of general surgery procedures than CAH general surgeons: with those procedures constituting 77.8% of their caseload (n = 24,914) versus 92.4% (n = 31,691) for CAH surgeons ($P < .001$).

Table 1 Clinically relevant categories and corresponding Clinical Classification Software codes

General surgery procedures	CCS codes
Appendix	80
Breast	165–167, 174, 175
Cholecystectomy/ common bile duct	84
Endocrine	41924
Endoscopy	68–70, 76, 82
Esophagus/stomach	71, 74, 93, 94
Hernia	85, 86
Liver/pancreas	245, 246
Other abdominal	87–90, 97, 99
Rectal/anal	77, 81
Skin/soft tissue	168–173
Small and large bowel	72, 73, 75, 78, 79, 92, 95, 96
Spleen/lymph	66, 67
Trachea	34, 35
Surgery specialty procedures	**CCS codes**
Cardiothoracic	36–42, 44, 48, 49
Neurosurgery	41707
Obstetrics and gynecology	119–132, 134, 137, 140
Ophthalmology	19
Orthopedics	142, 143, 145–148, 152, 153, 155–164
Otolaryngology	23, 25–27, 30–33
Urology	100, 104, 106, 109–112, 114–118
Vascular	51–57, 59–61, 63

CCS = Clinical Classification Software.

The comparison of procedures performed by graduating general surgery residents and by general surgeons at CAHs is displayed in Table 2. All categories differed significantly. The largest difference was seen in the endoscopy category, where

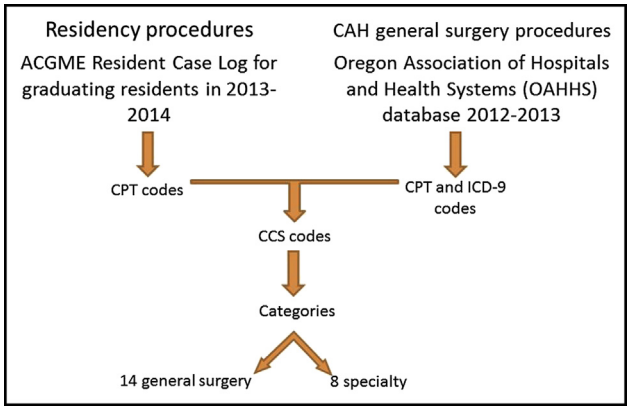

Figure 1 Steps used to convert data from procedure codes to clinically relevant categories.

Table 2 Procedures performed by surgery residents graduating in 2013 and 2014 and general surgeons at Critical Access Hospitals (2012–2013)

	Surgery residents, all procedures (%)	General surgeons, all procedures (%)	*P* value
General surgery procedures			
Appendix	1,779 (5.6)	839 (2.4)	<.001
Breast	1,485 (4.6)	1,048 (3.1)	<.001
Cholecystectomy/common bile duct	2,872 (9.0)	2,190 (6.4)	<.001
Endocrine	638 (2.0)	73 (.2)	<.001
Endoscopy	2,920 (9.1)	19,225 (56.1)	<.001
Esophagus/stomach	1,144 (3.6)	343 (1.0)	<.001
Hernia	3,400 (10.6)	3,006 (8.8)	<.001
Liver/pancreas	714 (2.2)	110 (.3)	<.001
Other abdominal	2,171 (6.8)	693 (2.0)	<.001
Rectal/anal	330 (1.0)	539 (1.6)	<.001
Skin/soft tissue	2,275 (7.1)	1,897 (5.5)	<.001
Small/large bowel	3,953 (12.4)	1,381 (4.0)	<.001
Spleen/lymph	904 (2.8)	345 (1.0)	<.001
Trachea	329 (1.0)	2 (.0)	<.001
Surgery specialty procedures			
Cardiothoracic	1,628 (5.1)	289 (.8)	<.001
Neurosurgery	48 (.2)	124 (.4)	<.001
Obstetrics and gynecology	142 (.4)	227 (.7)	<.001
Ophthalmology	7 (.0)	13 (.0)	<.001
Orthopedics	1,335 (4.2)	427 (1.2)	<.001
Otolaryngology	141 (.4)	41 (.1)	<.001
Urology	240 (.8)	179 (.5)	<.001
Vascular	3,522 (11.0)	1,255 (3.7)	<.001
Total	31,977 (99.9)	34,246 (99.8)	

Table 3 Procedures excluding endoscopy

	Surgery residents, nonendoscopy (%)	General surgeons, nonendoscopy (%)	*P* value
General surgery procedures			
Appendix	6.1	5.6	.024
Breast	5.1	7.0	<.001
Cholecystectomy/common bile duct	9.9	14.6	<.001
Endocrine	2.2	.5	<.001
Endoscopy	–	–	
Esophagus/stomach	3.9	2.3	<.001
Hernia	11.7	20.0	<.001
Liver/pancreas	2.5	.7	<.001
Other abdominal	7.5	4.6	<.001
Rectal/anal	1.1	3.6	<.001
Skin/soft tissue	7.8	12.6	<.001
Small/large bowel	13.6	9.2	<.001
Spleen/lymph	3.1	2.3	<.001
Trachea	1.1	.0	<.001
Surgery specialty procedures			
Cardiothoracic	5.6	1.9	<.001
Neurosurgery	.2	.8	<.001
Obstetrics and gynecology	.5	1.5	<.001
Ophthalmology	.0	.1	.004
Orthopedics	4.6	2.8	<.001
Otolaryngology	.5	.3	.001
Urology	.8	1.2	<.001
Vascular	12.1	8.4	<.001
Total	99.9	100.0	

Table 4 Residents with and without a rural rotation

	Nonrural residents, median (IQR)	Rural residents, median (IQR)	*P* value
General surgery procedures			
Appendix	78 (68–83)	124 (117–128)	<.05
Breast	59 (51–69)	125 (113–135)	<.05
Cholecystectomy/common bile duct	133 (111–153)	190 (139–212)	<.05
Endocrine	29 (25–38)	24 (22–25)	.08
Endoscopy	136 (94–154)	181 (179–203)	<.05
Esophagus/stomach	47 (42–64)	70 (58–83)	.06
Hernia	144 (129–181)	221 (205–226)	<.05
Liver/pancreas	31 (19–42)	42 (22–48)	.41
Other abdominal	94 (72–112)	110 (48–271)	.67
Rectal/anal	13 (8–16)	25 (20–44)	<.05
Skin/soft tissue	104 (63–123)	158 (79–191)	.22
Small/large bowel	186 (128–204)	262 (237–286)	<.05
Spleen/lymph	37 (33–48)	76 (50–80)	<.05
Trachea	15 (10–23)	14 (9–19)	.74
Surgery specialty procedures			
Cardiothoracic	76 (59–88)	117 (53–128)	.36
Neurosurgery	2 (1–3)	3 (3–4)	.10
Obstetrics and gynecology	5 (3–6)	18 (14–21)	<.05
Ophthalmology	1 (1–2)	0	*
Orthopedics	58 (48–80)	51 (32–78)	.41
Otolaryngology	7 (4–10)	3 (2–7)	.22
Urology	8 (6–12)	15 (14–22)	.06
Vascular	146 (116–181)	272 (155–275)	.13

IQR = interquartile range.
*There is insufficient data to calculate significance in this category.

general surgeons in CAHs performed a higher proportion of endoscopies than residents, 56.1% versus 9.1% ($P < .001$).

Excluding endoscopy (Table 3), general surgeons at CAHs performed a higher proportion of hernia, skin/soft tissue, cholecystectomy/common bile duct, rectal/anal, breast procedures, obstetrics and gynecology, and neurosurgery, while residents performed a higher proportion of small/large bowel, cardiothoracic, vascular, other abdominal, liver/pancreas, and orthopedic cases, among others.

Residents completing a 1-year rural rotation did more cases than residents who did not, with a mean of 2,053 versus 1,434. Residents who spent their fourth year in a rural rotation logged 878 ± 169 defined category cases during that year compared with nonrural residents who logged 400 ± 75 defined category cases during their fourth year ($P < .001$). Residents with a rural rotation logged higher numbers in 9 categories, with the largest differences in hernia, small/large bowel, breast, cholecystectomy/common bile duct, appendix, and endoscopy (Table 4).

Comments

This comprehensive analysis of surgical procedures shows striking differences among the procedures general surgery residents are exposed to during training and procedures they might be doing in a general surgery practice at CAHs in the same state. The addition of a rural surgery track, although not entirely bridging this gap, allows for a greater number of cases in some of the same categories where the gap exists, such as endoscopy, breast, and cholecystectomy/common bile duct procedures.

Although there are published data on which surgical procedures are performed in small and large rural surgery practices,[6] there has not been an evaluation of surgical procedures that has focused solely on CAHs. These hospitals share standardized criteria such as their rural location, size, and staffing. There is, however, inherent variation in the surgical procedures performed at each hospital based on its location and practice environment. Combining all procedures at a statewide level for analysis may average this variation. Our data aim to help residents get an idea of the procedures done at CAH, which could be considered when contemplating joining the rural surgery workforce.

Previous authors have found on increasing numbers of specialty procedures performed by general surgeons in rural areas.[6,7] Although we encountered a significant percentage of general surgeons' cases corresponding to specialty procedures (7.4%), general surgery residents at our program performed a higher proportion of specialty procedures (22.1%). Resident training also appeared to overemphasize some areas, such as vascular, cardiothoracic, and orthopedics, and perhaps underemphasize others, such as obstetrics and gynecology and neurosurgery.

Although there has already been a comparison between procedures performed by rural surgeons and the standardized Surgical Council on Resident Education (SCORE) general surgery residency curriculum,[7] our study provides a direct comparison with the clinical training that surgery residents actually receive.

One of the goals of surgery residency is to graduate safe and competent surgeons. The time to attain competency in a procedure category may not be directly related to the number of cases performed in that category. There are other factors, such as level of supervision, and degree of involvement during a case that may affect each learning opportunity for the resident. Therefore, the number of cases to achieve competency may be different for each resident.

Since 2002, our surgery program has offered a 6- to 12-month rural surgery immersive experience. After completing a rural surgery rotation, a resident is more likely to enter general surgery practice.[9] Until now, however, it was unclear if rural rotations like this one enhanced rural surgery training and adequately prepared residents who completed them to practice general surgery in small, rural hospitals. The data from this study suggest that the residents participating in the rural rotation do have increased experience in the procedures that rural surgeons perform.

Some of the limitations of this study include the potential failure of residents to log all of their cases. In addition, NPI numbers can be associated with multiple taxonomy codes and by choosing only the primary taxonomy code, we may have included some providers with subspecialty training in the general surgeon category. Also, the OAHHS database includes inpatient and outpatient procedures done at the hospital but not at associated ambulatory clinics. Finally, the work presented here represents the Oregon experience alone and it may correlate with the experience in other states to a variable degree. The surgical training in our program is unique, as it exposes residents to over 7 different hospitals, including a large university-affiliated teaching hospital, a Veterans Affairs hospital, private community hospitals, and smaller rural hospitals. Although our training model provides flexibility to increase exposure to a variety of procedures, further studies comparing other training platforms with procedures done by CAH surgeons would be helpful to assess how translatable are our findings.

An important question still remains: should residents focus their training on procedures that they will likely perform in practice or is broad exposure to many procedures of greater benefit? We believe that the knowledge needed to work in a rural area should not be limited to procedures performed there. With increasing centralization of care, complex patients who had surgery in an academic center return to their rural hometowns. If these patients have a complication or need to see a local surgeon, it is invaluable for these communities to have a surgeon with exposure to a variety of procedures, even if it is not part of his or her daily practice.

Conclusions

Our data suggest that residents who are interested in a rural surgery practice may benefit from an increased caseload in areas such as endoscopy, hernia, breast, and cholecystectomy/common bile duct procedures during their training. With increasing subspecialization, the need to spark interest in rural general practice is greater than ever before. We hope that our research will provide a detailed job description of general surgery practice in the rural setting, and that it will provide motivation to the next generation of rural surgeons.

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Discussion

Mika Sinanan, M.D., Ph.D.: This is another interesting and valuable paper from the group at Oregon Health and Sciences University that compares case volumes and distribution for general surgery residents in one program to those same data for a group of surgeons working in Oregon State

Critical Access Hospitals (CAHs). Training experience was compared to current practice needs of CAH surgeons. Subset comparison to residents doing a "rural" rotation was also carried out. Not surprisingly, the CAH surgeons dealt with more secondary surgical care issues – endoscopy, hernia, lumps and bumps, gallstone disease, anorectal and breast diseases – than surgical residents training in an academic healthcare system. Surgical residents had a higher proportion of tertiary or specialty cases in GI surgery, CT surgery, vascular, hepatobiliary pancreas surgery, and orthopedics. Conversely, it appears that surgeons at CAH's do a majority of the endoscopy, preserving the surgical nature of that franchise despite a general move away from flexible endoscopy elsewhere in surgical practice. Residents exposed to a rural rotation experienced for part of their training, the same case distribution as acute care surgeons, gaining more endoscopy experience than their peers, an observation that has been made in other programs (personal communication, Banner Health System).

I believe the methodology used by Dr. Undurraga Perl and colleagues for grouping cases and identifying surgeons practicing in CAHs is appropriate. The data as presented seems representative of practices at CAHs in Oregon and the experience of OHSU residents taking or not taking the rural track. There are several cautions regarding this report. First, the data come from one state, one residency program, and two years of residency. How translatable this experience might be to other residency programs, with or without a rural track, and to other states remains to be shown. As the authors correctly point out, there have been no prior similar evaluations. I also note that the comparison between resident groups was done statistically with a t-test that requires a normal distribution, which should be clarified. Second, the underlying implication of the research question is that volume of experience mirrors competency, and that there is virtue in having the residency mirror eventual practice. Others have observed the variation between residency experience and rural surgical practice[1] but without a more specific discussion and data of the necessary case numbers to achieve competency, the increasing availability of remote telesurgical consultation[2,3] to facilitate ongoing learning, and the parallel challenge of defining actual transferability of skills from one anatomic focus to another, the value of matching experiences in residency to eventual practice remains unclear. What does appear to be clear is that broad training has significant advantages.[4,5]

Rural surgery training programs are rare[6] yet the need for surgeons to provide critical surgical access in rural communities has never been greater,[7,8] especially with the aging and impending retirement of large numbers of rural surgeons.[9] Programs that support rural training experience and emphasize appropriate skills using the data presented in this report will be critical to supporting access to surgical care in rural America.

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