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Does resident autonomy in colectomy procedures result in inferior clinical outcomes?

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ABSTRACT

Background: The amount of time surgical trainees spend operating independently has been reduced by work-hour restrictions and shifts in the health care environment that impede autonomy. Few studies evaluate the association between clinical outcome and resident autonomy.

Methods: The Veterans Affairs Surgical Quality Improvement Program database was queried to identify patients undergoing partial colectomy for neoplasm between 2004 and 2019. Rectal resections, emergency procedures, and those involving postgraduate year 1 and 2 residents were excluded. Records were categorized as performed with the attending scrubbed or not scrubbed. Hierarchical logistic regression was used to identify factors independently associated with operative time, morbidity, and mortality.

Results: In total, 7,347 patients met inclusion criteria; 6,890 (93.6%) were categorized as attending scrubbed and 457 (6.4%) as attending not scrubbed. The cohorts were similar in terms of patient demographics, including age, race, body mass index, and American Society of Anesthesiologists class. There were no differences between cohorts in terms of operative time (attending not scrubbed 3.02 hours, attending scrubbed 3.07 hours, $P = .42$). On hierarchical logistic regression adjusted for age, gender, race, body mass index, functional status, cancer location, facility operative level, wound class, American Society of Anesthesiologists class, length of operation, operative modality (open or minimally invasive), postgraduate year of resident, and year, there were no differences in odds of complications, major morbidity, or mortality based on attending involvement.

Conclusion: Colectomies performed by residents with appropriate levels of autonomy are efficient and safe. Our results indicate that attending surgeon judgment regarding resident autonomy is sound and that educational environments can be designed to foster resident independence and preserve clinical quality, safety, and efficiency.

Introduction

Recent changes in the health care environment have increased pressure on providers to increase efficacy while maintaining safety and quality. With new surgical techniques and training requirements before general surgery graduation and duty-hour restrictions, trainees are learning more in less time, often resulting in limited autonomy before graduation. This has led to increasing concerns on the part of the public and surgical faculty members regarding graduating residents' preparedness for independent practice.[1] In one recent survey of fellowship program directors, 30% stated that residents starting fellowship were unable to perform a laparoscopic cholecystectomy independently.[2] Two-thirds did not believe that new fellows were able to operate in a major procedure for 30 minutes independently.[2]

Partial colectomy is a general surgery procedure that is a core competency for graduating surgical residents. Residents are

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currently required to complete 40 large intestine procedures as part of the 180 required alimentary tract operations.[3] Although residents are required to take part in these procedures, it is not known the exact role that these residents take in completing the operation and leading the procedure.[4] The impact of recent trends in resident autonomy on their ability to safely perform this essential operation has not been formally evaluated. On one recent assessment of resident performance and autonomy, only 71% of residents in their last 6 months of training were considered "practice ready" when completing a partial colectomy.[1]

The Veterans Health Administration (VA) is one of the largest health care delivery systems in the United States and is a crucial training site for many medical schools and residency programs. The Veterans Administration Surgical Quality Improvement Program (VASQIP) collects data regarding the role and involvement of the attending surgeon during all surgical procedures performed within the VA system. For each case, the operating room team identifies the primary surgeon, the resident postgraduate year, and the degree of involvement of the attending in the operation. In the current study, we use VASQIP data to evaluate the association between resident autonomy and clinical outcome for partial colectomy. We chose partial colectomy as a model given that it is a procedure central to general surgery but also one with readily measured clinical outcomes to assess perioperative status.

Methods

Data source and patient population

The VASQIP database was queried to identify patients who underwent a partial or total colectomy for primary malignant neoplasm between 2004 and 2019. Cases completed for neoplasm were selected because they were thought to be more easily reproducible and a more reliable assessment of resident skill and judgment. Colectomy cases for complicated diverticulitis or inflammatory bowel disease have different challenges and complications than those completed for neoplastic disease and were therefore excluded to create a more homogenous study population. We believed it would be hard to adjust for the variability in these complex diverticulitis cases when building our models. The complex diverticulitis cases would be ones where an attending would be less likely to provide a resident autonomy. Limiting the sample to elective colectomy for neoplasia provides a more reproducible operation that involves oncologic principles and carries some risk of measurable morbidity but also allows for more appropriate adjustment of relevant determinants of outcome.

VA facilities are designated using facility operative levels based on operative complexity. Only cases performed at the VA centers of the highest complexity level (complex or intermediate levels) and identified as VA teaching hospitals employing general surgery residents were included in the study. Current Procedural Terminology (CPT) codes (44140, 44141, 44143–44147, 44150, 44151, 44160, 44205–44208, 44210) were used to identify cases of partial or total colectomy. Modifiers were used to identify surgical approach to the operation (laparoscopic versus open) and identify whether an ostomy was created during the procedure. International Classification of Diseases (ICD) 9 and 10 codes (153.0–153.9, C18.0-C18.9) were used to determine the colon portion resected (right, transverse, left, sigmoid, or not otherwise specified/contiguous).

Operations that included a rectal resection, cases where the resident involved in the case was identified as being postgraduate year (PGY) 1 or 2, emergency surgeries, cases with disseminated cancer, outpatient procedures, or patients with preoperative sepsis were excluded. Cases with missing data related to operation performed, age, diagnosis, attending involvement, resident postgraduate year, length of stay, and functional status were excluded from the analysis. Inclusion and exclusion criteria are outlined in Figure 1.

Definition of level of attending involvement

Whether the attending was scrubbed or not scrubbed was the main independent variable of interest in this study. Involvement of the attending surgeon in the operation is assessed by the operating room team for each case and documented in the operative record by the circulating nurse before closure of the surgical package. VASQIP nurse documentation specialists are responsible at each site for education and training of intraoperative nursing staff regarding variable definitions and documentation. The levels of attending involvement include: attending performing the operation, attending in OR and scrubbed, attending in OR and not scrubbed, or attending in the operating suite and immediately available. We defined the attending involvement as "attending not scrubbed" (ANS) if the attending surgeon was in the operating room but not scrubbed or was reported as immediately available in the operating suite. All other cases were defined as "attending scrubbed" (AS).

Additional independent variables included in the modeling

Baseline patient and case characteristics were assessed for the 2 study cohorts (ANS, AS). Age was categorized as <65 years, 65–74, or >75 years. Race was grouped into 3 categories to allow for ease of comparison: White, Black, and Other. Other patient factors included in our modeling were: gender, body mass index class (BMI), preoperative weight loss, functional status (independent, partially dependent, or dependent), smoking history, alcohol use, and American Society of Anesthesiologists (ASA) class. Case characteristics included cancer location, wound class, intraoperative transfusion, ostomy creation, and operative modality. Facility factors included facility operative complexity designation. These are reported here as categorical variables.

Outcome measures

Our primary outcome measures assessed included operative time, return to operating room within 30 days for any reason, any postoperative complication, mortality within 30 days, length of stay, and discharge to facility. Composite outcome measures for medical or surgical complications were created. Medical complications included postoperative cardiac arrest, myocardial infarction, coma, cerebrovascular accident, neurologic deficit, *Clostridium difficile* infection, deep vein thrombosis, systemic sepsis, mechanical ventilation past 48 hours, failure to wean from ventilator, reintubation, pneumonia, pulmonary embolism, urinary tract infection, and acute renal failure or insufficiency. The surgical complication composite measure included postoperative bleed requiring transfusion of greater than 4 units of packed red blood cells, wound dehiscence, anastomotic leak or organ space infection, and superficial or deep surgical site infection. If the patient experienced any one of the listed complications, whether surgical or medical, they were counted as having a complication of that given composite.

Statistical analysis

Univariate comparison of the demographics and operative characteristics for patients in the 2 cohorts of attending involvement were compared using Pearson's χ^2 test, Wilcoxon rank sum test, and Fisher's exact test as appropriate. Operative time (in hours) and length of stay (LOS; in days) are represented as means plus or minus standard deviations and were evaluated

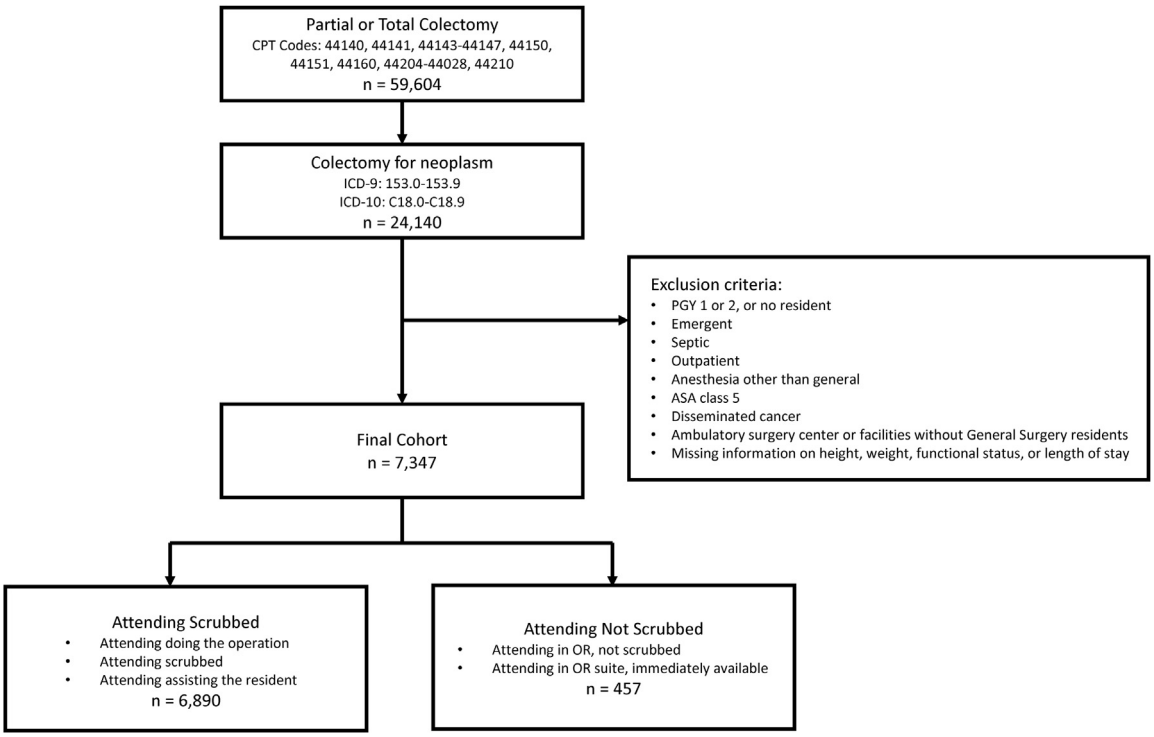

Figure 1. Study inclusion and exclusion criteria. *CPT*, Current Procedural Terminology; *ICD*, International Classification of Diseases; *PGY*, postgraduate year; *ASA*, American Society of Anesthesiologists; *OR*, operating room.

using Student's *t* test. A power analysis was completed to ensure the results of the length of stay analysis were not due to type II error and demonstrated a power of 78%.

Hierarchical logistic regression was used to identify the associations between our primary independent variable and our outcomes of interests: any complication, 30-day mortality, return to the operating room, discharge to facility, and medical and surgical complication composite scores. The hierarchical model was created using a random effect for facility ID to account for patient clustering within hospitals. Variables were included in the final model if there were significant differences between the 2 groups or deemed clinically relevant to the outcomes. The final hierarchical models adjusted for age class, gender, race, BMI class, functional status, smoking status, cancer location, ASA class, wound class, operative approach, postgraduate year of resident, length of operation, and year of procedure. The area under the receiver operating characteristic (ROC) curve was used to assess the goodness of fit of the models.

In an effort to provide an absolute measure of the difference in outcome related to attending involvement, 1:1 propensity score methodology was used to develop matched cohorts of patients for cases performed with the attending scrubbed and those performed with the attending not scrubbed. The matching was performed using a nearest neighbor matching algorithm with goal standardized mean difference <10%. The 2 cohorts were created using propensity scores based on age, race, gender, cancer location, BMI class, ASA class, functional status, wound class, resident PGY, facility operative level, operative approach, and year of procedure. Rates of the selected outcomes for the matched cohorts were compared using Pearson's χ^2 test, Wilcoxon rank sum test, and Fisher's exact test as appropriate. Statistical significance was set at alpha value of 0.05. Statistical analysis was completed using R Studio version 1.3.

Results

Univariate comparison of demographic and preoperative clinical characteristics

In total, 7,347 patients underwent colectomy for neoplasm between 2004 and 2019. Of these, 457 (6%) of operations were completed without an attending surgeon scrubbed; 6,890 (94%) were performed with the attending scrubbed. Table I demonstrates the patient and case demographics of the 2 cohorts. On univariate comparison, there were no significant differences between the ANS and AS groups in terms of age, gender, race, BMI class, preoperative weight loss, functional status, smoking status, and ASA class. The majority of patients were male, Caucasian, independent functional status, nonsmokers, and ASA class 3. Most cases were categorized as a clean-contaminated wound class. The most frequent procedure performed was a right colectomy. A small proportion of cases included a total abdominal colectomy. The proportion of patients undergoing total colectomy in the ANS and AS cohorts was statistically similar (2% vs 2%, $P = .94$). There were lower rates of ostomy creation in the ANS group, but this did not reach statistical significance (6% vs 8%, $P = .06$). The 2 groups had equal rates of utilization of minimally invasive approaches to surgery, whether laparoscopic or robotic (31% vs 31%, $P > .99$; 1% vs 1%, $P = .92$, respectively). Most of the facilities were categorized as complex operative facilities; however, the residents experienced higher rates of autonomy at the intermediate complexity facilities (9% vs 6%, $P = .005$). The rate of ANS cases decreased over the study period, and cases completed ANS were more likely to be completed toward the end of the academic year (both $P < .05$).

Table I
Unmatched comparison of characteristics for attending involvement cohorts

Characteristic	Attending not scrubbed, n (%)	Attending scrubbed, n (%)	*P* value
n	457 (6.2%)	6,890 (94%)	
Age, years			.352
<65	164 (36%)	2,626 (38%)	
65–74	149 (33%)	2,306 (33%)	
≥75	144 (32%)	1,958 (28%)	
Male sex	443 (97%)	6,689 (97%)	.858
Race			.832
White	337 (74%)	5,043 (73%)	
Black	111 (24%)	1,681 (24%)	
Other	9 (2%)	166 (2%)	
Body mass index class			.524
Underweight	10 (2%)	172 (3%)	
Normal	123 (27%)	1,785 (26%)	
Overweight	148 (32%)	2,448 (36%)	
Obese	176 (39%)	2,485 (36%)	
Preoperative weight loss	36 (8%)	561 (8%)	.841
Functional status			.721
Independent	425 (93%)	6,441 (93%)	
Partially dependent	28 (6%)	402 (6%)	
Dependent	4 (1%)	47 (1%)	
Tobacco Use			.389
Active smoker	106 (23%)	1,722 (25%)	
Nonsmoker	351 (77%)	5,168 (75%)	
ASA class			.277
1	2 (<1%)	13 (<1%)	
2	63 (14%)	899 (13%)	
3	329 (72%)	5,150 (75%)	
4	63 (14%)	828 (12%)	
Wound class			.525
Clean	19 (4%)	347 (5%)	
Clean contaminated	412 (90%)	6,117 (89%)	
Contaminated	21 (5%)	376 (6%)	
Infected	5 (1%)	50 (1%)	
Colon cancer location			.073
Right	222 (49%)	2,919 (42%)	
Transverse	39 (9%)	602 (9%)	
Left	25 (6%)	532 (8%)	
Sigmoid	83 (18%)	1,443 (21%)	
Continuous, NOS	88 (19%)	1,394 (20%)	
Facility operative level			**.005**
Complex	414 (91%)	6,468 (94%)	
Intermediate	43 (9%)	422 (6%)	
Intraoperative transfusion			.106
None	425 (93%)	6,250 (91%)	
1–2 units	30 (7%)	536 (8%)	
>2 units	2 (<1%)	104 (2%)	
Ostomy created	25 (6%)	542 (8%)	.063
Minimally invasive procedure			
Laparoscopic	141 (31%)	2,124 (31%)	.991
Robotic	5 (1%)	79 (1%)	.919
Total colectomy	9 (2%)	132 (2%)	.936
Year			**<.001**
2004–2009	214 (47%)	3,026 (44%)	
2010–2014	65 (14%)	2,151 (31%)	
2015–2019	178 (39%)	1,713 (25%)	

ASA, American Society of Anesthesiologists; *NOS*, not otherwise specified.

Univariate comparison of clinical outcomes

There was no significant difference in terms of operative timing between the ANS and AS cohorts (181 minutes vs 184 minutes, $P = .417$). This was true regardless of the segment of colon resected (Figure 2). Table II demonstrates the rates of selective postoperative outcomes between the ANS and AS groups. There were no significant differences in terms of mortality, complication rates whether surgical or medical in nature. Lengths of stay for patients in the ANS cohort were shorter than those for the AS cohort (8 days vs 9 days, $P = .037$), but this did not translate into higher rates of discharge to a facility.

Adjusted comparison of clinical outcomes

The results of the hierarchical logistic regression analyzing factors associated with a postoperative complication are displayed in Table III. Age 75 years and older (adjusted odds ratio [aOR] 1.37, 95% CI [1.17–1.59]), obese or underweight BMI class (aOR 1.50, 95% CI [1.29–1.75]); OR 1.72, 95% CI [1.22–2.43], respectively), partially dependent or dependent functional status (aOR 1.48, 95% CI [1.18–1.85]; OR 2.72, 95% CI [1.52–4.88], respectively), and active smoking (aOR 1.28, 95% CI [1.11–1.46]) resulted in increased odds of a complication when controlling for facility-level differences. A clean contaminated or contaminated wound class (aOR 1.35, 95% CI [1.02–1.79]; aOR 1.87, 95% CI [1.31–2.68], respectively), longer

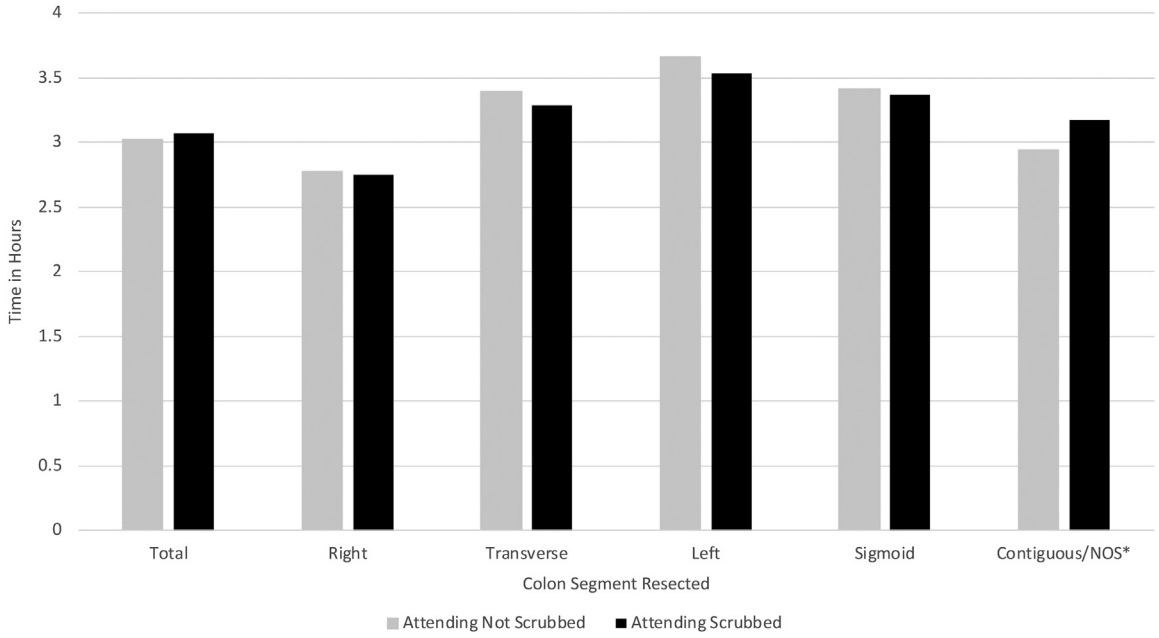

Figure 2. Unmatched comparison of length of operation by segment of colon resected and degree of attending involvement. *NOS*, not otherwise specified.

Table II
Unmatched comparison of clinical outcomes for attending involvement cohorts

Outcome	Attending not scrubbed, n (%)	Attending scrubbed, n (%)	*P* value
n	457	6,890	
Operative time in h*	3.02 (1.21)	3.07 (1.33)	.454
Return to operating room within 30 d	26 (6)	561 (8)	.074
Postoperative complication	101 (22)	1,663 (24)	.352
Medical complication	63 (14)	994 (14)	.757
Surgical complication	61 (14)	993 (15)	.599
Mortality within 30 d	11 (2)	183 (3)	.864
Length of stay in d*	8.13 (6.34)	8.99 (8.62)	**.037**
Discharge to facility	16 (4)	232 (3)	.984

* Mean (standard deviation).

operative times (aOR 1.24, 95% CI [1.17–1.31]), and resection of the transverse colon and contiguous or not-specified colon portion (aOR 1.28, 95% CI [1.05–1.57]; aOR 1.19, 95% CI [1.02–1.39], respectively) were associated with increased odds of a complication. Use of minimally invasive techniques (aOR 0.58, 95% CI [0.50–0.67]) and later year of procedure (2010–2014 aOR 0.85, 95% CI [0.75–0.97]; 2015–2019 aOR 0.45, 95% CI [0.38–0.53]) were associated with significantly lower likelihood of a complication. Attending involvement was not associated with an increased likelihood of any complication (aOR 0.96, 95% CI [0.75–1.22]). The c-statistic for the any postoperative complication model was 68%.

Figure 3 demonstrates the results of the hierarchical logistic regressions for the selected outcomes graphically. The level of attending involvement was not associated with the adjusted odds risk of any of the postoperative outcome. The c-statistics for the models are as follows: return to operating room 67%, medical complication 69%, surgical complication 70%, mortality 79%, and discharge to a facility 88%.

Using propensity scoring matching, 457 patients undergoing AS and ANS colectomy were each identified. There were no significant differences between matched cohorts for any of the variables used in the matching process: age, gender, race, BMI class, ASA class, functional status, colon cancer location, facility operative level, surgical approach, wound class, resident PGY, and year of procedure. All standardized mean differences for the variables were equal to or less than 10%. The outcomes for comparisons of matched cohorts are reported in Table IV. There were no significant differences in mortality, complication rates whether surgical or medical, return to the operating room, or discharge to a facility between the matched ANS and AS cohorts. The lengths of operation were similar between the groups (181 vs 182 minutes, $P = .803$), as were the lengths of stay (8.13 days vs 8.82 days, $P = .126$).

Discussion

In this study we used VASQIP data to compare clinical outcomes for patients undergoing partial colectomy with different degrees of attending involvement. We found no association between the degree of attending involvement in the case and clinical outcome including mortality and complications. The univariate analysis demonstrated similar rates of adverse outcomes between the ANS and AS cohorts. This parity was maintained when controlling for patient, case, and facility factors on the hierarchical logistic regression and when comparing propensity matched cohorts. These findings taken together suggest that residents are capable of performing quality operations with significant degrees of clinical autonomy, that attending surgeons can safely make choices regarding the degree of autonomy, and that educational

Table III
Hierarchical logistic regression evaluating risk of any postoperative complication

	Adjusted odds ratio [95% confidence interval]	*P* value
Attending status		
Scrubbed (Ref*)	1.00	
Not scrubbed	0.96 [0.75–1.22]	.721
Age, years		
<65 (Ref)	1.00	
65–74	1.00 [0.87–1.15]	.983
≥75	1.37 [1.17–1.59]	**<.001**
Sex		
Female (Ref)	1.00	
Male	1.41 [0.96–2.07]	.082
Race		
White (Ref)	1.00	
Black	0.95 [0.83–1.10]	.492
Other	0.79 [0.53–1.18]	.249
Body mass index class		
Normal (Ref)	1.00	
Overweight	1.11 [0.96–1.29]	.160
Obese	1.50 [1.29–1.75]	**<.001**
Underweight	1.72 [1.22–2.43]	**.002**
Functional status		
Independent (Ref)	1.00	
Partially dependent	1.48 [1.18–1.85]	**.001**
Dependent	2.72 [1.52–4.88]	**.001**
Smoking status		
Nonsmoker	1.00	
Smoker	1.28 [1.11–1.46]	**<.001**
ASA class		
1 (Ref)	1.00	
2	3.39 [0.43–26.55]	.244
3	5.29 [0.68–41.14]	.111
4	7.18 [0.92–56.12]	.060
Wound class		
Clean (Ref)	1.00	
Clean contaminated	1.35 [1.02–1.79]	**.034**
Contaminated	1.87 [1.31–2.68]	**.001**
Infected	1.59 [0.82–3.08]	.167
Cancer location		
Right (Ref)	1.00	
Transverse		**.017**
Left	1.21 [0.97–1.50]	.087
Sigmoid	1.04 [0.89–1.21]	.621
Contiguous/NOS	1.19 [1.02–1.39]	**.031**
Operative time	1.04 [0.89–1.21]	**<.001**
Surgical approach		**<.001**
Open (Ref)	1.00	
Minimally invasive	0.58 [0.50–0.67]	**<.001**
PGY		
3 (Ref)	1.00	
4	0.81 [0.65–1.02]	.069
5	0.94 [0.79–1.11]	.462
6+	0.97 [0.74–1.28]	.832
Year		
2004–2009 (Ref)	1.00	
2010–2014	0.85 [0.75–0.97]	**.018**
2015–2019	0.45 [0.38–0.53]	**<.001**

ASA, American Society of Anesthesiologists; *NOS*, not otherwise specified; *PGY*, postgraduate year.
* Ref: Reference category.

environments that facilitate resident autonomy can be designed and executed without compromising clinical quality, safety, and efficiency.

Although there are now increased requirements for our trainees with new technologies and treatments being added to the surgeons' toolkit, compounded with the duty-hour restrictions leading to less operative and clinical training time, there is still a critical need for residents to be prepared for independent practice with the looming surgeon shortage.[5] Although there is appropriate concern from both fellowship and residency program directors, the trainees are unable to be prepared for fellowship or independent practice if not given opportunities for growth and autonomy during residency training. A recent survey found that 25% of graduating residents did not feel prepared for independent practice, reiterating the need for opportunities for independent decision making before entering the workforce.[6] There must be graded autonomy and opportunity for a reasonable degree of independent clinical decision making. The VA health system is fast becoming one of the last places for such to exist. Our article indicates that in a contemporary analysis, resident autonomy and safety and quality are not opposed. Safe training environments that allow for increased autonomy can be implemented without

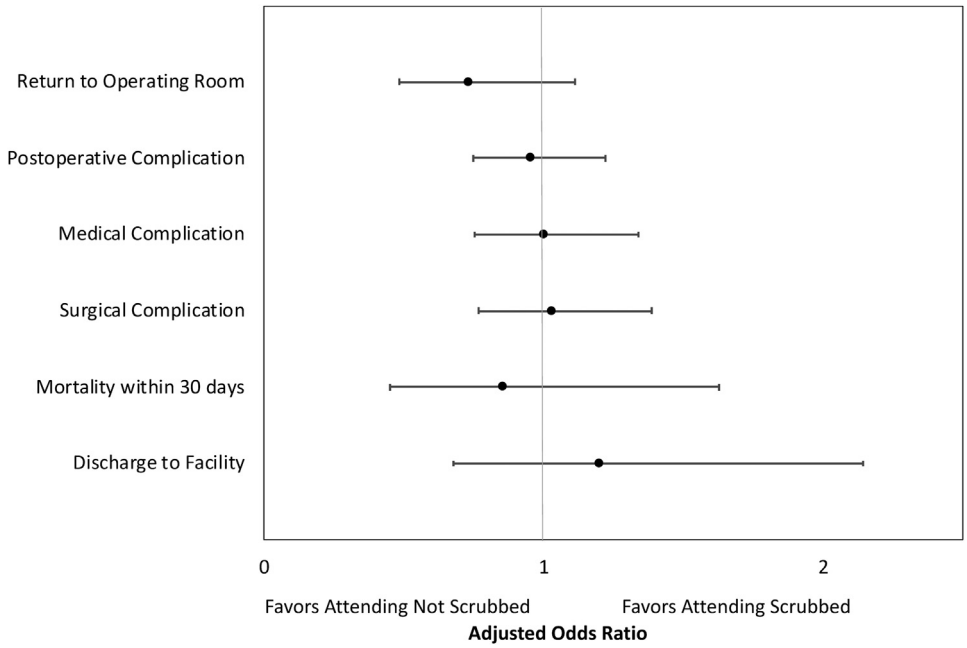

Figure 3. Adjusted odds risk of a given clinical outcome by degree of attending involvement controlling for facility ID.

Table IV
Propensity match based on attending involvement demonstrating rates of select postoperative outcomes

Outcomes	Attending not scrubbed, n (%)	Attending scrubbed, n (%)	*P* value	SMD
n	457	457		
Operative time in h*	3.02 (1.21)	3.04 (1.26)	.803	2%
Return to operating room within 30 d	26 (6)	38 (8)	.154	10%
Postoperative complication	101 (22)	116 (25)	.276	8%
Medical complication	63 (14)	64 (14)	>.99	1%
Surgical complication	61 (13)	69 (15)	.507	5%
Mortality within 30 d	11 (2)	12 (3)	>.99	1%
Length of stay in d*	8.13 (6.34)	8.82 (7.31)	.126	10%
Discharge to facility	16 (4)	16 (4)	>.99	<1%

SMD, standardized mean difference.
* Mean (standard deviation).

compromising efficiency. This message needs to be brought forward by academic leaders.

One point warrants further discussion. Prolonged operative time is frequently given as a reason to limit resident autonomy in the operating room. Operative time directly relates to facility costs, and any increase in operative time results in financial burden for the hospital and providers.[7,8] Increased operative time has also been associated with compromised clinical outcomes in colon and rectal surgeries.[9] Our analysis found no difference in length of time required for partial colectomy when performed with increased resident autonomy. Kulaylat et al previously demonstrated that resident involvement in a colon resection does not prolong operative time.[10] Our study was able to take the next step and demonstrate that residents could operate independently without prolonging operative times.

There have been a small number of prior studies that have demonstrated that resident involvement in an operation does not compromise patient outcomes.[10,11] A recent American College of Surgeons National Surgical Quality Improvement Program analysis found that less than 1% of appendectomy, cholecystectomy, and inguinal hernia procedures were performed without an attending scrubbed into the operation.[12] Their adjusted analysis demonstrated no increased complications when the resident was operating independently. We attempt to take the next logical step in asking whether resident autonomy is associated with clinical outcome. Through building on this work and updating the work of Khuri et al, we focused on a specific operation in general surgery to assess whether the mortality and morbidity rates have changed over time and with resident autonomy.[4]

There are several limitations in our study that warrant recognition. The study is a retrospective review of prospectively accruing national-level data. By nature, it is subject to omitted variable and selection bias. We attempted to control for case complexity using patient and case factors but cannot fully assess the technical complexity of the cases reviewed. Due to database limitations, we are unable to identify which cases were initially performed by the resident but necessitated direct attending involvement during the operation. We were also unable to obtain information related to oncologic outcomes including lymph node yield, pathologic margin status, and cancer recurrence. Our study population contains 457 cases completed autonomously. Because this is a retrospective study, this number cannot be modified, but we believe this number is high enough to ensure that our conclusions are valid. There is undoubtedly significant selection bias in our study. We are unable to adjust for the technical skills and knowledge of the residents or for variation in attending comfort with the assumption of risk or

confidence with a resident skill set. Finally, we only selected colectomies performed for primary neoplasm. This may narrow the generalizability of our studies given the multitude of indications for a colon resection. Despite these limitations, we believe that there is significant information presented regarding the role of residents at VA facilities and their operative outcomes.

In conclusion, recognizing the limitations inherent in the data set, we report the largest national evaluation to date of the association between resident autonomy and clinical outcome in a population of patients undergoing partial colectomy. We find that a small percentage of the colectomies performed at VA facilities are done independently by residents. The residents who are provided with increased autonomy, as evidenced by completing an operation without the direct attending involvement, are able to complete the procedures with similar operative times and clinical outcomes that are equivalent to those for cases performed with greater degrees of resident involvement. These findings support the contention that educational environments that afford appropriate degrees of resident autonomy can be implemented without compromising operational efficiency and clinical outcome.

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Conflict of interest/Disclosure

The opinions represented do not represent those of the Veterans Health Administration or the United States government. The authors have no personal or financial relationships, conflicts of interest, or affiliations to declare.

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Discussion

Celsa Tonelli, Isabela Lorenzo, Corinne Bunn, Sujay Kulshrestha, Zaid M. Abdelsatter, Marshall S. Baker, Frederick A. Luchette

Presentation given by Celsa Tonelli, DO

Dr John D. Mellinger (Southern Illinois University): I would like to compliment you on looking at national-level data and high-volume data from multiple centers to try to address this issue of autonomy. The findings are a real significance and worth weighing in. Recognizing the limitations and challenges of working with the database and the limits that big databases put on us in terms of all the things we'd like to know but can't necessarily explore, I'd like to ask you 3 questions.

One is, you mention in your manuscript that there was some elimination of cases because of missing data. For many of us that don't work regularly with the VASQIP database, could you just comment, is this a sampling type database or a comprehensive one? Is it like NSQIP where a certain percentage of cases are taken out of the total population, or is every case entered? And could you comment on how many cases were eliminated because things were incomplete in the database, just so we have a sense of the integrity of the database itself.

I also noticed in your manuscript that the way the participation of the attending was gauged was by a circulating nurse who recorded that in the system. Could you comment on whether those circulating nurses recorded that at a certain time in the case. In other words, could things have changed, and we wouldn't know about it? Is that standardized, and is there any kind of frame of reference training given to the circulating nurses in the VA system so that we know there's some standardization for how that is categorized, or is it pretty much at the discretion of the nurse and the facility?

And then, finally, since your study population was cancer patients, it's interesting when you look at, for example, simple data, which is another widespread, not quite national, but certainly geographically represents national data. Colectomy is the common core procedure that residents seem to have the least autonomy of the 5 most common procedures performed by the time they finish. The really big outcome isn't just whether they got out of the hospital, but how they did oncologically. Do you have data here about lymph node counts and long-term oncologic outcomes given the duration of the study and the inner log that you can help us know where the residents achieving a similar oncologic product to what they achieved technically?

Thank you very much for the privilege of discussing.

Dr Tonelli: The first question was about missing data. The way the VASQIP database works is similar to NSQIP, which was designed based on VASQIP. There's a VASQIP nurse, and there are required procedures of which every case is documented, and then the remaining procedures completed at the VA are selected on a case-by-case basis by the local VASQIP nurse, so not every case was covered. We can't say every single colectomy is logged here, but in light of that, there was a significant portion. And most of our cutting down was first based on identifying only neoplasm cases, which we did based on ICD-9 and 10 codes, and that's also how we identified which portion of the colon was resected. And then from there, the majority of the—I think there was about 25,000

colectomies that we started from, and so we narrowed down from there. The other big exclusion criteria was cases that had no resident or a PGY-1 or 2 was the highest resident level. Our thinking for excluding these cases was that a PGY-2 is not going to do a colectomy on their own. We thought that they weren't going to have significant autonomy at that level.

As far as the logging of the attending involvement, the VASQIP nurse is responsible for educating our circulating nurses on these variables, including the attending involvement. The reason we selected the scrubbed or not scrubbed is because we thought it was a very clear delineation, either the attending was directly touching and was sterile or they weren't. As you saw, 1 of the variables is the resident as primary surgeon, but we thought that was very subject to interpretation. So, we went with kind of a harder cutoff there.

As far as the oncologic outcomes, that's a great next step. The VASQIP database does not have information on that. There are adjunct VA databases that do.

Dr Scott Steele (Cleveland, Ohio): And maybe this is more of a comment than a question. But we get a lot of these papers submitted, and the devil was obviously in the details. My concern with these is that it's always assumed that autonomy or attending participation is a negative influence, like how dare—it just comes across very negative. And I would tell you that, you had a third-year population that was laparoscopic, and we do know that there are a lot of attendings that can be scrubbed in and don't do anything, and others are different. Were you able to see that the ones that weren't scrubbed in, it's a lot easier to point to a monitor and be able to say, you know, no, go here, than it is during an open operation? So, were you able to look at that? And I would encourage you, that if you're up to look at this outside of a database to do it in a fashion where you actually construct a set that really looks at attending participation, because I can tell you when I did the fellowship, I wanted the attendings there. I wanted them to teach me, and part of residency is to be taught to do it. And then maybe again, maybe the reason the colectomy, as Dr Mellinger said, that maybe just colorectal surgeons are a little bit more heavy-handed and heavily involved. That's why that was the least amount of resident participation, but I would highly encourage you to do that in a prospective study.

Dr Tonelli: I have spoken to some people at my institution about finding a way to do something like this in the future. Personally, I'm still very early in my training, and I don't see an attending being there as a negative. I value that input, and I am excited to learn more. (Applause)