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Role of interprofessional teams in emergency general surgery patient outcomes

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A R T I C L E I N F O

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A B S T R A C T

Background: In response to duty hour restrictions, hospitals expanded residency programs and added advanced practice providers. We sought to determine if type of clinical support was associated with emergency general surgery outcomes.
Methods: As part of our 2015 survey of acute care hospitals, we asked hospitals whether residents and advanced practice providers participate in emergency general surgery care. Data from responding hospitals were linked to patient data (≥18 years old admitted with an emergency general surgery diagnosis) from 17 State Inpatient Databases using American Hospital Association identifiers. Analyses compared emergency general surgery patient and hospital characteristics based on type of providers assisting emergency general surgery surgeons (none, only advanced practice providers, only residents, or both). Multivariable analysis determined if presence of advanced practice providers and/or residents was associated with type of management, mortality, or complications.
Results: Eighty-three hospitals and 49,271 unique emergency general surgery admissions were included. Hospitals without residents and advanced practice providers were most likely to manage patients operatively. However, hospitals with residents (alone or with advanced practice providers) had reduced odds of systemic complication compared with hospitals without clinical support (adjusted odds ratio 0.77 [95% confidence interval 0.60–0.98] and adjusted odds ratio 0.77 [95% confidence interval 0.62–0.95], respectively), while hospitals with only residents had the lowest odds of operative complication.
Conclusion: Our findings highlight the positive effect residents (alone or partnering with advanced practice providers) can have on emergency general surgery patient outcomes.

Introduction

As the surgeon workforce becomes strained owing to national shortages and geographic maldistribution of the surgeon workforce, hospitals are increasingly using physician extenders.[1-6] At teaching hospitals, residents have historically provided a great deal of clinical support to practicing surgeons. With duty hour restrictions, even with expansion of residency training positions, more teaching hospitals are turning to advanced practice providers (APPs) to do tasks such as bedside procedures, inpatient consultations, outpatient follow-ups, and initial evaluations.[7] In addition to reducing some of the unnecessary administrative burden of providing care, residents and APPs can also support surgeons clinically.

Studies assessing outcomes based on inclusion of residents or APPs on care teams have found no significant difference in metrics such as length of stay or mortality within critical care, orthopedic surgery, or obstetrics gynecology.[7-10] However, the effects of resident and APPs in the care of emergency general surgery (EGS)

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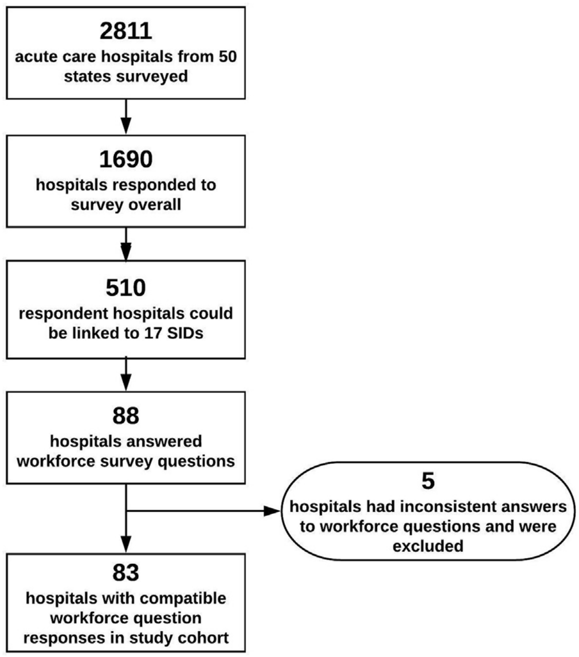

Fig 1. Flow diagram outlining creation of hospital cohort.

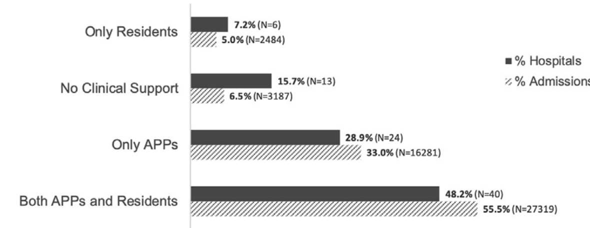

Fig 2. Proportion of hospitals with different types of clinical support for emergency general surgeons and the proportion of 2015 EGS admissions.

patients is not well understood. We sought to determine if residents and APPs, alone or working in teams, were associated with the type of management EGS patients received or reduced rates of complications or mortality. We hypothesized that more clinical support for surgeons would improve patient outcomes after controlling for patient and hospital level characteristics.

Methods

In 2015, we surveyed 2,811 acute care general hospitals across the United States serving adult patients (18+) about the structures and processes in place to provide EGS care. The creation and implementation of the survey has been described previously.[11,12] The survey (Appendix 1) included questions about workforce composition including clinical assistance EGS surgeons receive. Specifically, the presence of residents and or APPs (nurse practitioners and/or physician assistants) was ascertained, as well as how often these clinicians provided assistance. For this retrospective study of our survey, hospitals that did not answer survey questions regarding presence of residents (Question 65) or APPs (Question 63) were excluded, as were those hospitals whose answer regarding presence of residents or APPs was incompatible with their reported frequency of that support. For example, if a hospital reported that residents were not a part of their EGS team, but then reported they always receive daytime clinical support from residents, this hospital would be excluded.

We then sought to link survey responses with both hospital and patient level data. For patient level data, we used 2015 State Inpatient Databases (SID). The SID are developed by the Agency for Healthcare Research and Quality for the Healthcare Cost and Utilization Project.[13] SID are generated from community hospitals (ie, accessible to any community member, nonprison, nonfederal) from billing data for all-payers, providing admission level information including diagnoses, procedures, and patient demographic characteristics. Currently 97% of hospital discharges are represented within SID.[14] For hospital level data we used the 2015 American Hospital Association survey, which reports characteristics such as number of beds, ownership, rurality, medical school affiliation, teaching status, and trauma certification. This survey has a unique American Hospital Association identifier that enabled us to anonymously link hospital survey responses and discharge level data from the 17 SID that allowed linkage in 2015. In total, 510 hospitals who returned our survey were represented within SID with 83 meeting other inclusion/exclusion criteria (Fig 1).

We then created a cohort of EGS patients receiving care from these 83 hospitals. Inclusion criteria included age ≥18 years and an emergency or urgent admission. Inclusion did not require an operation, as type of management was of interest, but did require a primary International Classification of Diseases Ninth or Tenth Revision diagnosis code indicating EGS disease (eg, colorectal emergencies, peritonitis, biliary disease, or small bowel obstruction, see Appendix 2 for a complete list of included diagnoses). This list was based on the 2013 American Association for the Surgery of Trauma panel on the scope of EGS diseases as well as results from our initial pilot study and literature review to encompass those diseases most commonly managed urgently by acute care surgeons or surgeons providing EGS coverage.[15] Patients who were transferred in for EGS care were counted to assess for transfer patterns at the hospital level but were then excluded from patient level analyses, as we would be unable to measure the role of care providers prior to transfer. We used the procedure codes shown in Appendix 3 to identify patients who had an EGS operation to assess if EGS patients were managed operatively or nonoperatively. Outcome variables included operative complications (eg, anastomotic leak, hemorrhage, or reoperation) and systemic complications (eg, pneumonia, acute myocardial infarction, and shock), as shown in Appendix 4, as well as inpatient mortality. After applying these criteria, we identified 49,271 unique EGS admissions.

Patients and hospitals were divided into 4 cohorts based on type of clinical support: no clinical support (only independently practicing surgeons), only residents, only APPs, or both APPs and residents. All analyses compared outcomes across these 4 cohorts with the predictor variable of interest being the type of clinical support provided for EGS care. We compared patient demographic and clinical characteristics, outcomes variables, and hospital characteristics by type of clinical support using χ^2 tests of association, Fisher exact test, Student's *t* test, and Wilcoxon rank-sum test, as appropriate. We then constructed multivariable logistic regression models to determine if type of clinical support impacted odds of operative management, systemic complication, operative complication, or mortality, using each group as the reference. The models were adjusted based on patient and hospital level variables that achieved a P value <.2 in bivariate comparisons to ensure all available variables with some explanatory value were controlled for and to help control for differences in resources between hospitals. These terms were added all at once and retained in the model, regardless of statistical significance. Clustering by hospital was accounted for by using generalized estimating equations. We used the variance inflation factor to assess for collinearity. Analyses were conducted in SAS version 9.5 (SAS Institute, Inc, Cary, NC). The Institutional Review Boards of the Ohio State University College of

Table I
Hospital level characteristics between hospitals with different workforce compositions for emergency general surgery ($N = 83$)

Clinical support for EGS attendings	None $n = 13$ (15.7%)	Only APP $n = 24$ (28.9%)	Only residents $n = 6$ (7.2%)	Both APPs and residents $n = 40$ (48.2%)	*P* value
EGS surgical workforce size median [IQR] – missing for 2 hospitals					.03
Number of independent surgeons	4 [2–7]	7 [5.5–8]	7 [7–10]	9 [7.5–11.5]	
Critical care specialists available 24/7					.0038
Yes	9 (69.2%)	19 (79.2%)	6 (100%)	40 (100%)	
No	4 (30.8%)	5 (20.8%)	-	-	
Ownership *n* (%)					.06
Nongovernmental	11 (84.6%)	23 (95.8%)	5 (83.3%)	29 (72.5%)	
Governmental	1 (7.7%)	1 (4.2%)	1 (16.7%)	11 (27.5%)	
Investor-owned	1 (7.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Location *n* (%)					.009
Urban	8 (61.5%)	20 (83.3%)	5 (83.3%)	39 (97.5%)	
Rural	5 (38.5%)	4 (16.7%)	1 (16.7%)	1 (2.5%)	
Bed size *n* (%)					<.0001
≥500 beds	0 (0.0%)	8 (33.3%)	1 (16.7%)	22 (55.0%)	
400–499 beds	0 (0.0%)	2 (8.3%)	1 (16.7%)	7 (17.5%)	
300–399 beds	0 (0.0%)	4 (16.7%)	1 (16.7%)	5 (12.5%)	
200–299 beds	2 (15.4%)	5 (20.8%)	2 (33.3%)	2 (5.0%)	
<200 beds	11 (84.6%)	5 (20.8%)	1 (16.7%)	4 (10.0%)	
Registered nurse FTE median [IQR]					<.0001
Number of FTE RN	163 [104–330]	689.5 [351–1,080]	686.5 [513–820]	1,637 [763–2,268]	
Teaching status *n* (%)					<.0001
Major	0 (0.0%)	0 (0.0%)	2 (33.3%)	26 (65.0%)	
Minor	3 (23.1%)	13 (54.2%)	4 (66.7%)	12 (30.0%)	
Nonteaching	10 (76.9%)	11 (45.8%)	0 (0.0%)	2 (5.0%)	
Med school affiliation *n* (%)					<.0001
Yes	1 (7.7%)	11 (45.8%)	5 (83.3%)	37 (92.5%)	
No	12 (92.3%)	13 (54.2%)	1 (16.7%)	3 (7.5%)	
Trauma center verification *n* (%) – missing for 1 hospital					.0052
Yes	7 (53.9%)	21 (91.3%)	6 (100.0%)	36 (90.0%)	
No	6 (46.2%)	2 (8.7%)	0 (0.0%)	4 (10.0%)	
Proportion of EGS patients trasnferred					<.0001
Transferred in	1.5%	3.7%	6.7%	16.2%	
Transferred out	11.1%	10.4%	10.2%	10.6%	

IQR, interquartile range; *RN*, registered nurse.

Medicine and the University of Massachusetts Medical School reviewed and approved this research.

Results

Of 83 hospitals, 15.7% ($n = 13$) had no clinical support and cared for 6.5% EGS patients ($n = 3{,}187$), 28.9% ($n = 24$) had APPs only and cared for 33.0% EGS patients ($n = 16{,}281$), 7.2% ($n = 6$) had residents only and cared for 5.0% EGS patients ($n = 2{,}484$), and 48.2% ($n = 40$) of hospitals had both residents and APPs and cared for 55.5% EGS patients ($n = 27{,}319$). This can be seen in Fig 2.

Hospital profiles are shown in Table I. Hospitals without residents and APPs had the smallest surgeon workforce size with a median of 4 surgeons, while hospitals with APPs and residents on the team were the largest at a median of 9 surgeons. In contrast to hospitals with both types of clinical support, hospitals without residents and APPs had the highest proportion of hospitals that were rural (38.5%), had fewer than 200 beds (84.6%), lacked trauma certification (46.2%), were nonteaching (76.9%), and were not affiliated with a medical school (92.3%). While hospitals with only residents and only APPs had the same proportion of rural hospitals (16.7%), hospitals with only APPs were more likely to be nonteaching, lack a medical school affiliation, and lack trauma certification compared with hospitals with only residents.

Patient demographic and clinical and outcome variables based on type of clinical support are shown in Table II. While patients across groups were white and older, a higher proportion of EGS patients at hospitals without residents (surgeons alone or surgeons with APPs only) were older (>64; ~42%) and nonHispanic white (~77–79%) compared towithhospitals with residents only or residents and APPs. Hospitals with APPs only were most likely to have patients with 3 or more comorbidities (39%) compared with the other 3 types of coverage. Hospitals without clinical support had the highest proportion of both Medicare (46%) and self-pay (7%). Patients at surgeon-only hospitals also had a higher likelihood of operation (36%) than the other 3 types of coverage. Most patients across all sites did not have complications, though hospitals with only residents had the highest proportion of patients without operative complication (86%) and systemic complication (78%). Median length of stay was 3 days with a range of 2 to 6 across all types of coverage hospitals. Inpatient mortality was highest at hospitals with APPs (1.8%).

For operative management, once patient and hospital factors were adjusted for, all hospitals with clinical support had lower odds of operative management compared with hospitals without residents or APPs: only APPs adjusted odds ratio (aOR) 0.70 (95% confidence interval [CI] 0.51–0.95), only residents aOR 0.64 (95% CI 0.44–0.92), and both residents and APPs aOR 0.72 (95% CI 0.52–0.98). Figure 3 shows the results of the regression analysis for the outcome metrics with each type of clinical support as referent shown. Hospitals with residents only had lower adjusted odds of operative complication compared with the other 3 groups, while hospitals with both residents and APPs also had lower odds of operative complication compared with hospitals with only APPs. Hospitals with residents (alone or with APPs) had lower adjusted odds of major systemic complication compared with hospitals without residents or APPs (aOR 0.77 [95% CI 0.60–0.98] and aOR 0.77 [95% CI 0.62–0.95], respectively). There were no significant differences in mortality after adjusting for patient and hospital level characteristics.

Table II
Clinical characteristics and outcomes for patients admitted with an emergency general surgery diagnosis to 83 US hospitals in 2015 with different workforce compositions ($N = 49{,}271$ Admissions)

Clinical support for EGS attendings	None $n = 3{,}187$ (6.5)	Only APPs $n = 16{,}281$ (33.0%)	Only residents $n = 2{,}484$ (5.0%)	Both APPs and residents $n = 27{,}319$ (55.5%)	*P* value
Demographics and clinical characteristics *n* (%)					
Age *n* (%)					<.0001
18–34 y old	360 (11.3%)	1,817 (11.2%)	343 (13.8%)	3,475 (12.7%)	
35–49 y old	636 (20.0%)	2,865 (17.6%)	452 (18.2%)	5,758 (21.2%)	
50–64 y old	846 (26.6%)	4,755 (29.2%)	744 (30.0%)	8,553 (31.3%)	
>64 y old	1,345 (42.2%)	6,844 (42.0%)	945 (38.0%)	9,533 (34.9%)	
Sex *n* (%) – missing for 113					<.0001
Female	1,684 (52.9%)	8,782 (54.3%)	1,212 (48.8%)	14,100 (51.6%)	
Male	1,501 (47.1%)	7,394 (45.7%)	1,272 (51.2%)	13,213 (48.4%)	
Race *n* (%) - missing for 5,290					<.0001
Non-Hispanic white	2,394 (79.3%)	11,754 (77.2%)	1,614 (65.5%)	14,970 (64.3%)	
Black	157 (5.2%)	1,855 (12.2%)	398 (16.1%)	4,788 (20.6%)	
Hispanic	318 (10.5%)	1,005 (6.6%)	328 (13.3%)	2,554 (11.0%)	
North American Native	–	125 (0.8%)	17 (0.7%)	100 (0.4%)	
Asian/Pacific Islander	13 (0.4%)	318 (2.1%)	97 (3.9%)	425 (1.8%)	
Other	129 (4.3%)	170 (1.1%)	12 (0.4%)	431 (1.9%)	
Elixhauser index *n* (%)					<.0001
0 comorbidities	666 (20.9%)	2,996 (18.4%)	526 (21.2%)	5,342 (19.6%)	
1 comorbidity	761 (23.9%)	3,598 (22.1%)	592 (23.8%)	6,229 (22.8%)	
2 comorbidities	649 (20.4%)	3,413 (21.0%)	493 (19.9%)	5,468 (20.0)	
3+ comorbidities	1,111 (34.9%)	6,274 (38.5%)	873 (35.1%)	10,280 (37.6%)	
Insurance *n* (%) – missing for 12					<.0001
Medicare	1,451 (45.5%)	6,503 (40.0%)	1,002 (40.3%)	10,436 (38.2%)	
Medicaid	446 (14.0%)	2,277 (14.0%)	580 (23.4%)	4,833 (17.7%)	
Private	1,001 (31.4%)	6,024 (37.0%)	140 (5.6%)	1,609 (5.9%)	
Self-pay	222 (7.0%)	940 (5.8%)	140 (5.6%)	1,609 (5.9%)	
Other*	67 (2.1%)	132 (3.3%)	63 (2.5%)	906 (3.3%)	
Diagnosis *n* (%)					<.0001
Necrotizing soft tissue infection	–	28 (0.2%)	13 (0.5%)	113 (0.4%)	
Small bowel obstruction	623 (19.6%)	3,245 (19.9%)	444 (17.9%)	5,429 (19.9%)	
Appendicitis	296 (9.3%)	1,241 (7.6%)	205 (8.3%)	2,176 (8.0%)	
Biliary disease	529 (16.6%)	2,580 (15.9%)	378 (15.2%)	4,220 (15.5%)	
Pancreatitis	569 (17.9%)	2,948 (18.1%)	431 (17.4%)	4,963 (18.2%)	
Upper gastrointestinal emergencies	401 (12.6%)	2,307 (14.2%)	363 (14.6%)	3,668 (13.4%)	
Colorectal emergencies	742 (23.3%)	3,824 (23.5%)	628 (25.3%)	6,472 (23.7%)	
Other abdominal diagnosis	21 (0.7%)	108 (0.7%)	22 (0.9%)	278 (1.0%)	
Outcomes					
Underwent 1 or more EGS operation *n* (%)					<.0001
Yes	1,161 (36.4%)	5,147 (31.6%)	716 (28.8%)	7,974 (29.2%)	
No	2,026 (63.6%)	11,134 (68.4%)	1,768 (71.2%)	19,345 (70.8%)	
Major operative complications† *n* (%)					.009
None	948 (81.7%)	4,089 (79.4%)	617 (86.2%)	6,442 (80.8%)	
1	170 (14.6%)	843 (16.4%)	79 (11.0%)	1,214 (15.2%)	
2	35 (3.0%)	180 (3.5%)	17 (2.4%)	251 (3.2%)	
3 or more	–	35 (0.7%)	-	67 (0.8%)	
Major systemic complications *n* (%)					.001
None	2,446 (76.8%)	12,236 (75.2%)	1,937 (78.0%)	20,914 (76.6%)	
1	653 (20.5%)	3,437 (21.1%)	478 (19.2%)	5,515 (20.2%)	
2	82 (2.6%)	536 (3.3%)	65 (2.6%)	785 (2.9%)	
3 or more	–	72 (0.4%)	–	105 (0.4%)	
Total hospital length of stay‡ median [IQR]	3 [2–5]	3 [2–5]	3 [2–5]	3 [2–6]	<.0001
Inpatient mortality *n* (%) - missing for 20	27 (0.9%)	292 (1.8%)	25 (1.0%)	389 (1.4%)	<.0001

Per data distributor rules cell sizes ≤10 cannot be reported.
IQR, interquartile range.
* Other includes no charge, other, and unknown.
† For patients who underwent an operation of interest during admission ($n = 14{,}998$)
‡ For patients discharged alive ($n = 48{,}538$)

Discussion

Our study of the role of clinical support in the care of EGS patients at 83 hospitals in 17 states found significant differences in management and complication rates based on team structure, while mortality did not differ once patient and hospital factors were controlled for. Hospitals without clinical support were most likely to use operative management for EGS diseases; however, operative complications were lowest at hospitals where surgeons provide care for EGS patients with resident assistance only. Systemic complications were higher at hospitals where surgeons provide care for EGS patients without clinical assistance from residents. These findings highlight the positive impact that residents may have on EGS patient outcomes and have potential implications for the structuring of EGS care.

EGS patients cared for at hospitals without residents or APPs were more likely to be managed operatively, even after controlling for other patient and hospital level factors. This may reflect the presence of extra team members to observe patients and perform serial exams. An ability to perform serial exams may enable surgeons to allow a period of watchful waiting and avoid surgical

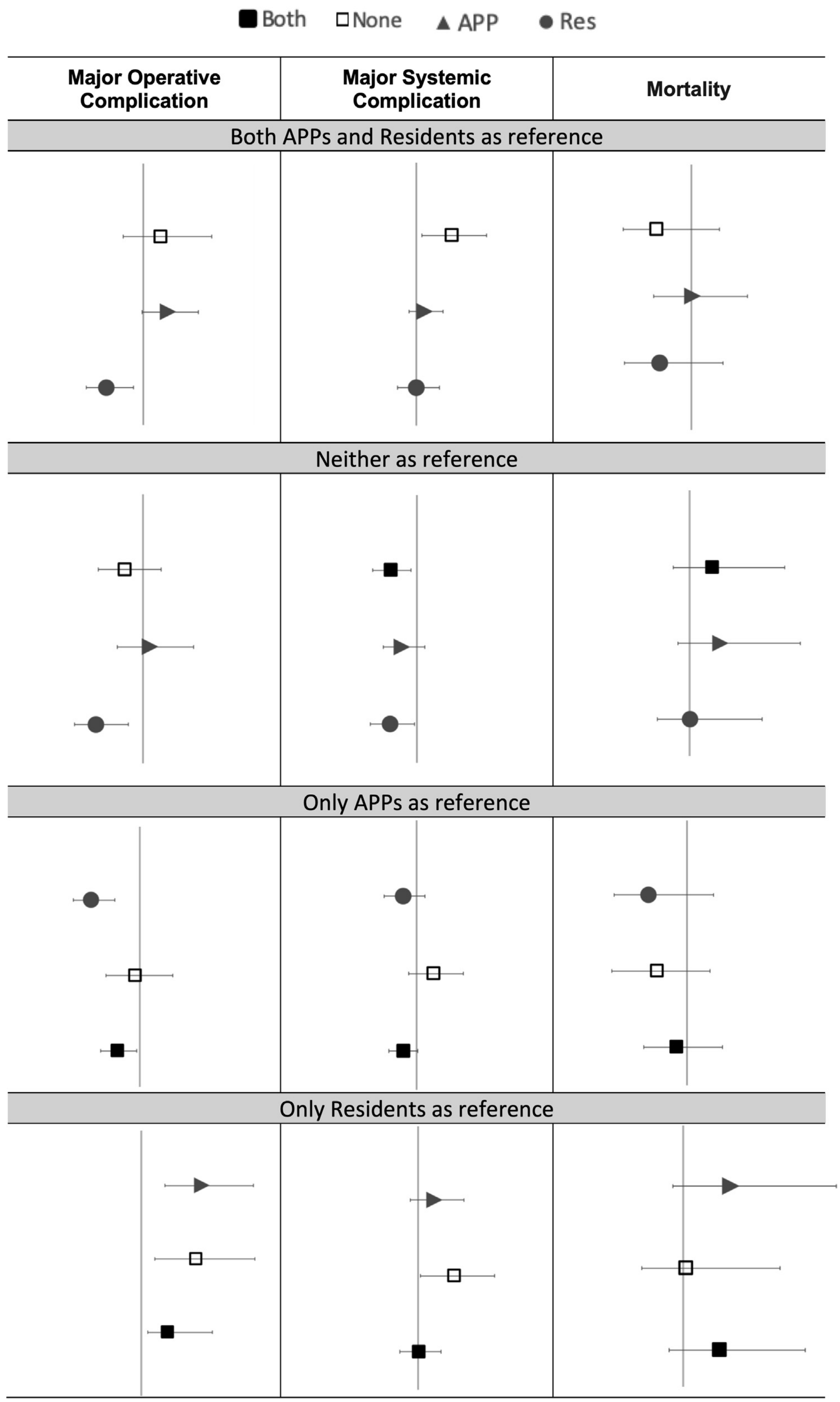

Fig 3. Adjusted odds of mortality and complication based on type of clinical support emergency general surgeons receive.

intervention, while ensuring clinical deterioration is promptly detected.

Patients cared for at hospitals with only residents assisting EGS surgeons had the lowest odds of operative complication. Previous research examining resident involvement in the operating room has found mixed results regarding operative complications. Consistent with our findings, an Australian emergency surgery study found that operative complication rates were lower with resident involvement.[16] Further, lower rates of perioperative bleeding complications have been found for thyroid procedures.[17]

However, higher rates of surgical site infections for ventral hernia repairs and anastomotic leak for bariatric procedures have also been noted.[8,17-21] This might be owing to the fact that bleeding is an immediate perioperative complication and having the extra set of eyes of the resident may indeed be protective. On the other hand, subtle errors in intraoperative technique that can occur despite the closest supervision of the attending surgeon (eg, the anastomosis is only created once and likelihood of failure cannot be visualized at that time) result in complications like wound infection and anastomotic leak that occur days after surgery. While this may explain some of the benefit of having a team with residents, we also found that hospitals with residents only had lower odds of complications compared with hospitals with both residents and APPs. This points to an alternative dynamic that may be occurring. Previous research has found that APPs may allow residents to have more time in the operating room.[22] Thus, residents at hospitals without APPs presumably spend more time on the floor and less time in the operating room compared with residents at hospitals with both residents and APPs. This potentially decreased involvement might explain lower complications compared with hospitals with both APPs and residents. This suggests the need for further research into ways to create the highest yield and safest intraoperative training opportunities, as it seems that simply freeing up residents from floor work to spend more time in the operating room is of questionable benefit (or harm) to patients, at least in the short-term.

In our study, systemic complications included disease processes such as pneumonia, pulmonary embolism, and central line-associated bloodstream infection. These are diseases that are largely preventable with routine bedside practices and monitoring. This observation may explain the reduced odds of systemic complications seen at hospitals with residents (either alone or in partnership with APPs) compared with hospitals with neither residents nor APPs because residents may spend more time at the hospital and bedside than surgeons who have completed training. One can surmise that they might provide benefit by ensuring appropriate venous thromboembolism prophylaxis, pulmonary toileting, and removal of unnecessary central venous catheters on daily rounds. Many of these processes are evidence-based and routinely incorporated into bedside care algorithms. We were surprised to find that the addition of APPs specifically was not found to decrease odds of systemic complication as the addition of acute care nurse practitioners to a Surgical Intensive Care Unit has been found to increase adherence to guidelines such as deep vein thrombosis prevention, while a trauma service found decreased rates of pneumonia and deep vein thrombosis after expansion of their nurse practioner workforce.[14,23]

For team structure, we found that the majority of EGS patients and a plurality of EGS hospitals have both residents and APPs working together; however, outcomes were not superior with these teams. Previous studies have reported other benefits of APPs and residents working together on teams including a positive effect on resident experience including reduced workload, enhanced patient care, and educational benefits.[22,24-25] While operative complications were lowest for hospitals with only residents, hospitals with both APPs and residents together or only residents performed better than hospitals without clinical support at preventing systemic complications. It is not clear why hospitals with both APPs and residents were not able to realize benefits and deserves more study. Given the other notable benefits of interprofessional teams with APPs and residents and that upwards of 65% of EGS patients are managed entirely on the floor without any operation, it seems critical to strengthen these models for the continued care of EGS patients as the aging US population continues to strain our national EGS workforce. Notably, there is potential for disagreement between residents and APPs regarding chain of command and APPs equivalent role and contribution. Specifically, residents reported that APPs were equivalent to postgraduate year 2 residents, while APPs viewed themselves as most similar to fellows.[25] Similarly, Buch et al found that APPs were significantly more likely to report that they had a role in residents' clinical education (75% vs 39% from residents).[26] Thus, as such models of APP and resident combined teams are developed and disseminated, it will be critical to include robust interprofessional education and guidelines such that these teams can thrive bringing professional satisfaction to APPs and maintain robust surgical training for residents in all domains of patient care. Indeed, the Association of American Medical Colleges has advocated for the adoption of core competencies for interprofessional collaboration to enhance this key area.[27]

Our findings must be interpreted in the context of a number of limitations. First are the limitations among administrative data sources, such as SIDs. The SIDs are robust and validated publicly available data; however, they lack clinical details and are limited to index hospitalization outcomes. Second, our survey responses may have been subjected to selection bias owing to overall response rate to the clinical support questions being low and to social desirability bias with the respondent providing responses they believed would please the researcher. In comparison the risk of recall bias was likely low given that we asked for real-time information on how EGS care was being provided at the time of completing the survey. In addition, our results may not be fully generalizable to the wider US population as we were only able to include responses from hospitals in the 17 states that allowed data linkage. Finally, while we had overall data on the makeup of the EGS team, we did not have patient level information regarding which specific team members, if any, helped manage the patient leading to a possible selection bias at the patient level.

In conclusion, in this study, we present the largest cohort to our knowledge of patients whose outcomes are being assessed relative to the presence of APP or resident clinical assistance for surgeons (over 49,000 discharges vs <16,000). Our findings highlight the positive effect residents (either alone or in partnership with APPs) seem to have on EGS patient outcomes compared with hospitals without residents nor APPs. Given the prevalence of hospitals with both residents and APPs and the potential for improved outcomes from this collaboration, more needs to be studied to understand why this potential benefit was not realized for EGS patients.

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Conflict of interest/Disclosure

The authors do not have conflicts of interest to disclose. Dr Heena Santry, Dr Victor Heh, and Holly Baselice had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.surg.2020.04.046.

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