HHS Public Access
Author manuscript
J Trauma Acute Care Surg. Author manuscript; available in PMC 2016 January 01.

Published in final edited form as:
J Trauma Acute Care Surg. 2015 January ; 78(1): 60–68. doi:10.1097/TA.0000000000000492.

Variations in Implementation of Acute Care Surgery: Results from a national survey of university-affiliated hospitals

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Abstract

BACKGROUND—To date, no studies have reported nationwide adoption of Acute Care Surgery (ACS) or identified structural and/or process variations for the care of emergency general surgery (EGS) patients within such models.

METHODS—We surveyed surgeons responsible for EGS coverage at University HealthSystems Consortium hospitals using an 8-page postal/email questionnaire querying respondents on hospital and EGS structure/process measures. Survey responses were analyzed using descriptive statistics, univariate comparisons, and multivariable regression models.

RESULTS—258 of 319 (81%) potential respondents completed surveys. 81 hospitals (31%) had implemented ACS while 134 (52%) had a traditional general surgeon on-call model (GSOC). 38 (15%) hospitals had another model (HYBRID). Larger bed, university-based, teaching hospitals with Level 1 trauma center verification status located in urban areas were more likely to have adopted ACS. In multivariable modeling, hospital type, setting, and trauma center verification predicted ACS implementation. EGS processes of care varied with 28% GSOC having block time vs 67% ACS ($p<0.0001$); 45% GSOC providing ICU care to EGS patients in a surgical/trauma ICU vs 93% ACS ($p<0.0001$); GSOC sharing call among 5.7 (+/− 3.2) surgeons vs 7.9 (+/−2.3) ACS surgeons ($p<0.0001$); and 13% GSOC taking in-house EGS call vs 75% ACS ($p<0.0001$). Among ACS hospitals there were variations in patient cohorting (25% EGS patients alone; 21% EGS+trauma; 17% EGS+elective; 30% EGS+trauma+elective), data collection (26% had prospective EGS registries), and patient handoffs (56% had attending surgeon presence), call responsibilities (averaging 4.8 (+/− 1.3) calls per month with 60% providing extra call stipend and 40% with no post-call clinical duties).

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AUTHORSHIP

HPS drafted the manuscript. HPS, CEC, LDB, GEC, and CIK contributed in the study concept, design, and critical revision of the article. HPS and MDA performed the acquisition of data. MDA , JCM , and HPS performed the analysis and interpretation of data. JCM provided the critical revision of the article.

CONCLUSION—The potential of the ACS on the national crisis in access to EGS care is not fully met. Variations in EGS processes of care among adopters of ACS suggest that standardized criteria for ACS implementation, much like trauma center verification criteria, may be beneficial.

LEVEL OF EVIDENCE—Survey results, Level III

Keywords

Acute Care Surgery; Emergency General Surgery; practice variations; survey research

BACKGROUND

With the aging US population and growing general surgery workforce shortage nationwide, the emergency general surgery (EGS) patient population is increasingly straining our healthcare system.[1-5] In 2011, nearly 2.4 million adults in the United States were admitted to hospitals for non-trauma general surgery emergencies ranging from simple, relatively common diseases such as appendicitis, cholecystitis, and superficial abscesses to complex, potentially life threatening diseases such as necrotizing soft tissue infections, ischemic enteritis, and perforated viscus.[6] First formally proposed in 2005 by leaders in our leading national trauma associations,[7,8] the specialty of Acute Care Surgery (ACS) was put forth to expedite access to care and improve outcomes for patients with these diseases who, up to that point—despite having time-sensitive diseases requiring urgent evaluation by a surgeon and possible operative intervention much like trauma patients—had none of the benefits of organized trauma teams and systems.[9,10]

Since 2005, many hospitals have reported implementing ACS services or have described that such a care model was in place at their institution even before the nomenclature was formalized.[11-22] However, as recently as 2010, 37% of emergency room directors reported inadequate coverage at their hospitals for EGS,[23] with 7% reporting no EGS coverage whatsoever.[2] Currently, the degree to which ACS has been adopted as a strategy to improve quality and timeliness of EGS care in the US is unknown.

Furthermore, while single-center retrospective studies have demonstrated the benefits of ACS at their individual hospitals (e.g., shorter lengths of stay, expedited time to the operating room, increased revenue, higher job satisfaction),[11-22] none of these reports clearly described the structures and processes implemented for emergency general surgery (EGS) patients as part of their ACS model. Our qualitative study representing 18 teaching hospitals from different geographic and practice settings where an ACS model had been implemented found many variations in care delivery (e.g., patient cohorting, continuity clinics), workforce (e.g., critical care certification), resource allocation (e.g., dedicated EGS OR, in-house call), communication (e.g., face-to-face morning report), and data collection (e.g., registries).[24,25] These variations in our sample suggest that ACS is being variably implemented on a national scale. Therefore, it is impossible to tell if the benefits of ACS described at single centers that may have unique approaches to ACS would be generalizable across US hospitals.

ACS was originally described as a new specialty combining trauma, surgical critical care, and emergency general surgery; however, today, nearly a decade after it was first proposed, there are no agreed upon guidelines for the implementation of ACS. To date, no studies have reported nationwide adoption of ACS or identified structural and/or process variations for the care of EGS patients within such models. We undertook a national survey to determine the degree to which ACS has been adopted at US teaching hospitals and describe differences in ACS practice patterns across institutions.

METHODS

We conducted a survey of University Health Systems Consortium Hospitals (UHC). UHC is an administrative data gathering collaborative, with participation from 90% of all US academic centers and over 200 of their affiliated hospitals, focusing on optimization of cost and quality of care.[26] Using exploratory data acquired from a qualitative study interviewing surgeons responsible for acute care surgery at 18 teaching hospitals,[25] we developed and tested a survey instrument in an iterative fashion. Six test respondents who took EGS call at their hospital, whether or not the hospital had adopted ACS, were sampled in 3 phases to assess construct validity of questionnaire items and determine ease of completion. To eliminate bias, testers had not participated in our interviews and were not in leadership positions to be targeted for the final survey. Based on our interview data, pilot testing of preliminary questionnaires, and our review of the existing data on which aspects of ACS models might improve quality of care (e.g., workforce, in-house call, critical care certification, patient cohorting, operating room availability),[11-22] an 8-page final questionnaire, eliciting both opinions and resources allocated for EGS care at targeted hospitals, was developed (see supplemental digital content 1).

Given the variability in defining the components of “acute care surgery” as identified in our qualitative research and pilot testing, we did not supply respondents with an a priori definition of “acute care surgery.” Rather, we labeled as having implemented some form of ACS those who reported a “dedicated team” structure for delivering care to EGS patients as opposed to a “general surgeon on call model” (GSOC). Finally, those respondents indicating partial use of a dedicated team combined with GSOC were labeled HYBRID. More detailed subsequent queries on the survey then sought to clarify how ACS was defined at the institutional level.

The survey was implemented using a hybrid postal and email methodology. Our goal was to identify respondents who would be able to respond to queries regarding the structures and processes for EGS care at their hospital. Therefore, we targeted one surgeon from each hospital known to be the head of acute care surgery, trauma and critical care, emergency general surgery, surgical hospitalists, or surgery (depending on hospital) by their published title on hospital marketing materials (e.g., website, brochure), through the hospital operator, or through the rolls of national specialty organizations (e.g., American College of Surgeons, American Association for the Surgery of Trauma, Eastern Association for the Surgery of Trauma). For each surgeon targeted, the next most senior surgeon was also selected for a back-up list of potential respondents. Supplemental digital content 2 breaks down the respondent roles. Potential respondents were mailed a survey package with an introductory

letter explaining the purpose of the survey and the goal of anonymously linking responses to outcomes data, a paper copy of the survey with a postage paid envelope, and a small incentive (laser pointer pen) to thank participants for their time. Subsequent reminders were sent up to 3 times in the ensuing 7 weeks with the opportunity for electronic survey response as well. After the first 7 week round of survey implementation, we used the same method to contact alternate respondents at hospitals whose primary potential respondents had not responded. Survey response was accepted in lieu of written informed consent. The survey was implemented from June-September 2013.

Survey data were compiled and analyzed using descriptive statistics and univariate comparisons. Associations between implementation of ACS and (HYBRID) or (GSOC) were measured using Chi squared tests of association to compare categorical variables, t tests for normally distributed continuous variables, and Wilcoxon rank sum tests for non-normally distributed continuous variables. Predictors of ACS implementation were determined using a multiple logistic regression where adoption of ACS was the outcome of interest and relatively static hospital characteristics such as practice setting (university-based, community-based, governmental), rurality (urban, rural, suburban), teaching status (NB: though we surveyed only UHC participants not all university affiliated hospitals have teaching roles), trauma center verification, and inpatient bed capacity. Since HYBRID hospitals potentially had structure and process measures reflecting both GSOC and ACS and therefore might drive results towards the null (i.e., no differences between ACS and GSOC) we performed all analyses separately for ACS vs. GSOC and for ACS vs. GSOC or HYBRID.

The survey was deemed exempt by our institutional review board. Survey data were stored in a REDCap database and analyzed using SAS 9.2 (SAS Corp, Cary, NC).

RESULTS

258 of 319 potential respondents completed surveys (81% response rate). 81 hospitals (31%) had implemented ACS while 134 (52%) had a traditional general surgeon on-call model (GSOC); 38 (15%) hospitals had another model that was either a combination of both a dedicated ACS team and a traditional model or was in the process of transitioning to a dedicated ACS team (HYBRID). Among these 38 hospitals, the estimated proportion of ACS model vs GSOC was as follows: < 25% ACS and >75% GSOC, 2 (5.3%) ; ~25% ACS and ~75% GSOC, 4 (11%) ; ~50% ACS and ~50% GSOC, 12 (32%) ; ~75% ACS and ~25% GSOC, 11 (29%); >75% ACS and < 25% GSOC, 5 (13%); missing response, 4 (11%). (data not shown)

Table 1 shows hospitals' care models compared by their reported characteristics. In both comparisons (ACS vs. GSOC; ACS vs. GSOC or HYBRID), larger bed, university-based, teaching hospitals with Level 1 trauma center verification status located in urban areas were more likely to have adopted ACS models. As shown in table 2, in multivariable modeling comparing ACS vs. GSOC or HYBRID community-based setting (76% lower odds compared to university-based), suburban location (76% lower odds compared to urban), and trauma center verification where verification by state agencies or the American College of

Surgeons was not specified (level 2 89% lower odds than level 1; non-designated 97% lower odds than level 1) were less likely to be associated with implementation of ACS. When comparing ACS vs. GSOC, excluding programs with some components of each, community-based setting (87% lower odds compared to university-based) and trauma center verification (level 2 88% lower odds than level 1; level 3 94% lower odds than level 1; non-designated 98% lower odds than level 1) were less likely to be predictors of ACS implementation. In both models, the strongest association was between trauma center verification and ACS implementation.

Table 3 shows variations in EGS processes of care by care model. ACS models were more likely to have dedicated EGS OR time compared to both GSOC and HYBRID; however, 33% of ACS models still had none. ACS models were more likely to provide ICU care for critically ill EGS patients in a surgical specialty ICU (surgical or trauma). ACS models were also more likely to have EGS patients transferred from other hospitals and maintain a prospective EGS registry than GSOC models. There were also workforce and call differences with GSOC having fewer surgeons in the call pool where surgeons under a GSOC model took more calls per month compared to those in an ACS model. For these calls, GSOC was also less likely to require in-house coverage and free surgeons of clinical responsibilities post-call.

As demonstrated by p-values for comparisons of only ACS to HYBRID programs (Table 3), HYBRID models were more similar to ACS in their EGS structures and processes than GSOC models, specifically in terms of EGS OR time, percentage of EGS transfer patients, prospective EGS registry, morning report, subspecialty certification, and call stipends. However, HYBRID models continued to differ from ACS models in terms of critical care coverage, size of surgeon call pool, number of calls per month, requirement for in-house call, and limitation of clinical duties post-call.

As shown in Table 4, while the only structure and process measure statistically different between ACS and HYBRID models was in team personnel with ACS more likely to have physician extenders and resident coverage compared to HYBRID models, we noticed hints of variations in patient cohorting, practice of routinely transferring patients to a subspecialty (i.e., after stabilizing the patient's emergency condition), and hand off practices.

DISCUSSION

In our national survey, we found that nearly half of the university-affiliated hospitals in the US have adopted or are in the process of adopting ACS. However, even among these hospitals that have made an overt resource and/or infrastructure commitment to the care of EGS patients, there are considerable variations in the exact structures and processes implemented for EGS which brings up a number of concerns regarding the potential of ACS as a healthcare delivery model.

ACS, as visualized by the leading surgeons who first formally applied this term to the comprehensive delivery of trauma, EGS, and surgical critical care in 2005, was put forth as a new care delivery model for EGS that would improve productivity in an overburdened

healthcare system, optimize outcomes, and increase cost-effectiveness without adversely affecting quality of care for trauma patients. In effect, ACS was a re-application to EGS patients of the Donabedian model (structure → process → outcomes) of quality improvement that had been successfully applied in the previous four decades to trauma patients. Without ACS, EGS patients were at risk of being abandoned in our nation's emergency rooms.[27-29] EGS care, historically provided by the local general surgeon on-call, would be repackaged into an organized team structure that would bring together the surgeons, resources, and infrastructure to implement the processes necessary to provide round-the-clock care for general surgery emergencies and measure outcomes for continuous quality improvement. Although our survey alone cannot measure the effect of the EGS structures and processes we measured on outcomes at the hospitals we surveyed, given the initial reports describing the vision for successful ACS models and subsequent data on the benefits of ACS at single centers,[11-22] our findings of variations in EGS structures and processes from center to center suggest barriers to ACS implementation and lack of agreed upon criteria to achieve the theorized benefits of ACS.

Such practice variations suggest that the quality improvement hoped for from ACS across hospitals may not be achieved (the Donabedian approach will fail) until accepted guidelines such as those for trauma center verification are developed for ACS.[30] Furthermore, our findings that certain types of hospitals are more likely to implement ACS suggest that in modern practice not all hospitals will be able to harness the same structures and processes for EGS; thus, a tiered system may be necessary for ACS as is in place for trauma centers. We found that no hospitals with fewer than 100 beds had implemented ACS, with only 5 describing their approach to EGS as some type of combination between ACS and GSOC. And, while a model of ACS termed ‘hospitalism’ has been described at community hospitals,[31] the prevalence of ACS at community-based hospitals in our sample was still far lower than at university-based hospitals. Based on our findings, we hypothesize that some of the barriers to implementing ACS may be securing OR block time for EGS, hiring mid-level practitioners, ensuring adequate resident coverage, and supporting a large enough cohort of surgeons to take call.

Given our finding of the strong association between trauma center verification level and implementation of ACS, it is possible that the future may involve a joint verification not just for trauma but also for EGS, thus building upon a known and proven system, rather than creating an entirely new one.[9,10] And, within this system, hospitals will have varying abilities to harness EGS resources. Depending on size, location, and practice setting, it may make sense from a quality and cost perspective to regionalize the care of EGS patients to centers with routine availability of dedicated EGS structures and processes.[32-34] In fact, that the proportion of EGS patients presenting in transfer was higher in ACS models, suggests that this phenomenon may already be occurring to a certain extent.

However, it is worrisome that so few centers with ACS have embraced concepts otherwise proven to improve quality. For example, despite the data on the importance of face-to-face signouts,[35,36] attending surgeon presence was sparse among ACS programs even though the vast majority of ACS and hybrid programs had face-to-face signouts. Still, there are some programs that have found innovative ways to ensure appropriate handovers within newly

emerging ACS teams.[24] Similarly, while trauma quality improvement hinges upon comprehensive, prospective data collection, and the feasibility of such registries has been documented,[34,37] only a quarter of our fully implemented ACS programs had a registry.

Still, compared to the traditional GSOC model, it seems that implementation of ACS may impart some of the presumed benefits of the model of care. Reports suggest that 13-50% of EGS patients require intensive care.[12,15,38] Our results show that ACS and models transitioning to ACS are more likely to have critical care certified surgeons caring for EGS patients. Presumably, this added expertise, especially in light of rapid advances of critical care in recent decades, will ensure application of the most cutting edge critical care support of EGS patients and adherence to critical care guidelines that surgeons without such expertise may lack. Reports also indicate that up to 70% of EGS patients require an operation,[38] but only half of these operations are performed at night.[11,12,39] Although many of our respondents reported no EGS block time for semi-urgent EGS cases, those with a fully or partially implemented ACS model were far more likely to have any designated block time. For patients who do not need immediate surgery, accessible ORs during regular hospital hours presumably reduces wait times for semi-urgent procedures. Unfortunately, our survey did not query whether GSOC models have face-to-face handoffs but these are historically uncommon among this model of care. Thus, despite the variability that we found regarding who attends handoffs, the fact that >80% of ACS or HYBRID models had handoffs suggests that transfer of key patient care information may be improved compared to models without such communication tools.[35,36] Similarly, while the majority of hospitals in our sample lacked prospective EGS registries, ACS and HYBRID models were more likely to be making such an effort at data-driven continuous quality improvement according to our results.

While we had an exceptionally high response rate for a physician survey, there are some limitations to our findings. First, our sample was derived entirely from a voluntary quality improvement consortium limited to university-affiliated hospitals; thus, our results may not be generalizable to hospitals without quality consortium involvement or direct university affiliation. However, given that this care model was first proposed within the trenches of large teaching hospitals, we felt that ours was a good initial approach to a national understanding of the current penetration and associated practice patterns of ACS in the US today. We also sampled a single respondent from each institution, choosing a senior surgeon responsible for EGS coverage. It is possible that others from the same institution but in a different role may have answered surgery questions differently. However, to the extent that the queries presented here are factual reports of what structures and processes do or do not exist for the care of EGS patients at each hospital (rather than any given respondent's opinion) we feel that this sort of bias is limited. Finally, despite our qualitative development of the survey and extensive pilot testing, as with all surveys, our results may be subject to construct bias. However, as described in our survey development methods, we feel we have minimized these as well.

Despite these limitations, to our knowledge this is the first national survey describing the degree to which ACS has been implemented in the US and associated variations. Our findings add to the national discussion at a time when access to timely and high quality care

for general surgery emergencies remains an issue given reported trends in the general surgery workforce.[5,23,40-42] If the tradition of broad based general surgeons whose practice included some emergency care can no longer meet our patients' needs, ACS may be a solution based on local needs including annual volume of EGS patients, ratio of practicing general surgeons to population and proximity of a tertiary care hospital. However, variations in ACS practice patterns are concerning from a quality perspective, and guidelines for the triage, referral, and provision of EGS care may be warranted as the implementation of ACS as a care delivery model continues to spread.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Conflicts of Interest and Source of Funding: Heena P. Santry receives partial salary support from a grant from the National Institute of Health (UL1RR031982, 1KL2RR031981-01 (02), 8KL2TR000160-03)

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Table 1

Comparison of Hospital Characteristics by Patient Care Model*

	Acute Care Surgery Model (N=81)	General Surgeon On-Call Model (N=134)	Hybrid Model† (N=38)	p-value‡ (ACS vs GSOC & HYBRID)	p-value‡ (ACS vs GSOC)
Setting N(%)				<.0001	<.0001
University-based	55 (68)	18 (13)	23 (61)		
Community-based	6 (7.4)	96 (72)	9 (24)		
State/County/City/Public	16 (20)	8 (6)	2 (5.2)		
Other	2 (2.5)	2 (1.5)	1 (2.6)		
Location N(%)				<.0001	<.0001
Urban	65 (80)	35 (26)	19 (50)		
Suburban	7 (8.6)	52 (39)	10 (26)		
Rural	7 (8.6)	37 (28)	6 (16)		
Teaching Status N(%)				<.0001	<.0001
Teaching	78 (97)	68 (51)	31 (82)		
Non-teaching	1 (1.2)	56 (42)	4 (11)		
Trauma Center Verification N(%)				<.0001	<.0001
Level 1	71 (88)	14 (10)	21 (55)		
Level 2	2 (2.5)	15 (11)	5 (13)		
Level 3	2 (2.5)	20 (15)	1 (2.6)		
Not a designated trauma center	3 (3.7)	75 (56)	7 (18)		
Inpatient Bed Capacity N(%)				<.0001	<.0001
>500	46 (57)	14 (10)	16 (42)		
401-500	12 (15)	8 (6)	4 (11)		
301-400	12 (15)	17 (13)	6 (16)		
201-300	5 (6.2)	24 (18)	4 (11)		
101-200	4 (5)	25 (19)	0		
< 100	0	36 (27)	5 (13)		

*For each ‘row category’ there are different number of missing observations thus column %s do not add up to 100%

†Hybrid models have some components of a dedicated team for emergency general surgery (ACS) and some components of a traditional general surgeon on call model (GSOC)

‡Pearson Chi^2 Test of Association for mutually exclusive responses

Table 2

Predictors of ACS Model Implementation by Hospital Characteristics

	Odds Ratio (95% CI) for Implementation of Acute Care Surgery vs. General Surgeon On-call or Hybrid Model[*] (N=253)	**Odds Ratio (95% CI) for Implementation of Acute Care Surgery vs. General Surgeon On-call Model (N=215)**
Setting		
University-based	Ref	Ref
Community-based	0.24 (0.06, 0.99)	0.13 (0.03, 0.63)
State/County/City/Public	1.91 (0.55, 6.61)	1.22 (0.28, 5.39)
Other	4.18 (0.09, 189.37)	--[†]
Location		
Urban	Ref	Ref
Suburban	0.24 (0.08, 0.76)	0.32 (0.07, 1.52)
Rural	0.53 (0.16, 1.81)	0.46 (0.1, 2.08)
Teaching Status		
Teaching	Ref	Ref
Non-teaching	0.41 (0.03, 5.43)	0.34 (0.02, 4.97)
Trauma Center Verification		
Level 1	Ref	Ref
Level 2	0.11 (0.02, 0.59)	0.12 (0.02, 0.8)
Level 3	0.09 (0.01, 1.45)	0.06 (0, 0.94)
Not a designated trauma center	0.03 (0, 0.21)	0.02 (0, 0.13)
Inpatient Bed Capacity		
>500	Ref	Ref
401-500	0.59 (0.18, 1.92)	0.32 (0.07, 1.44)
301-400	0.5 (0.16, 1.54)	0.44 (0.09, 2.06)
201-300	0.52 (0.11, 2.52)	0.42 (0.06, 2.98)
101-200	13.07 (0.97, 176.82)	9.85 (0.74, 131.73)
< 100	--[†]	--[†]

[*] Hybrid models have some components of a dedicated team for emergency general surgery (ACS) and some components of a traditional general surgeon on call model (GSOC).

[†] Too few outcomes to calculate odds ratio.

Table 3

Comparison of Emergency General Surgery (EGS) Structures and Processes by Care Model[*]

	Acute Care Surgery Model (N=81)	General Surgeon On-Call Model (N=134)	Hybrid Model[†] (N=38)	p-value[‡] (ACS vs GSOC or HYBRID)	p-value[‡] (ACS vs GSOC)	p-value[‡] (ACS vs HYBRID)
Dedicated EGS Operating Room Block Time N(%)				<.0001	<.0001	0.0874
None	27 (33)	97 (72)	22 (58)			
One day per week	3 (3.7)	1 (0.7)	0			
Two days per week	7 (8.6)	2 (1.5)	0			
Three days per week	2 (2.5)	2 (1.5)	1 (2.6)			
Four days per week	2 (2.5)	0	0			
Five days per week	17 (21)	13 (10)	9 (24)			
> 5 days per week	22 (27)	18 (13)	6 (16)			
Hospital's Critical Care Model N(%)				<.0001	<.0001	0.0024
Surgical ICU	64 (79)	42 (31)	28 (74)			
Combined MedSurg ICU	4 (5)	74 (55)	8 (21)			
Trauma ICU	11 (14)	2 (1.5)	0			
Other	2 (2.5)	15 (11)	2 (5.2)			
Proportion of EGS patients transferred from another hospital N(%)				<.0001	<.0001	0.3800
< 1%	10 (12)	59 (44)	8 (21)			
1-20%	37 (46)	56 (42)	20 (53)			
21-40%	23 (28)	16 (12)	6 (16)			
41-60%	11 (14)	1 (0.7)	1 (2.6)			
61-80%	0	1 (0.7)	2 (5.2)			
>80%	0	0	1 (2.6)			
Quality Improvement N(%)						
Prospective Emergency General Surgery Registry	21 (26)	14 (10)	7 (18)	0.013	0.0031	0.4881
Morning Report[§] N(%)	70 (86)	--[ж]	32 (84)	--[ж]	--[ж]	0.6994
Workforce						
# surgeons in call pool						
Mean (SD)	7.9 (2.3)	5.74 (3.2)	6.01 (2.5)	<.0001	<.0001	0.0002
Median (IQR)	8 (6,9.5)	5 (4,7)	6.5 (4.5,8)	<.0001	<.0001	0.0131
Surgeons with any additional subspecialty training N(%)	80 (99)	92 (67)	33 (87)	<.0001	<.0001	0.2160
Surgical Critical Care N(%)	72 (89)	36 (27)	20 (53)	<.0001	<.0001	0.0348
Trauma Surgery N(%)	51 (63)	0	14 (37)	--[ж]	--[ж]	0.0034
Burn N(%)	5 (6.2)	0	0	--[ж]	--[ж]	--[ж]
Acute Care Surgery N(%)	20 (25)	0	4 (10.5)	--[ж]	--[ж]	0.0726

	Acute Care Surgery Model (N=81)	General Surgeon On-Call Model (N=134)	Hybrid Model† (N=38)	p-value‡ (ACS vs GSOC or HYBRID)	p-value‡ (ACS vs GSOC)	p-value‡ (ACS vs HYBRID)
Minimally invasive N(%)	16 (19.7)	57 (42.5)	25 (66)	<.0001	<.0001	<.0001
Other§ N(%)	25 (31)	118 (88)	25 (66)	0.0002	0.0012	<.0001
Call Burden						
In-house Call Required N(%)	61 (75)	18 (13)	13 (34)	<.0001	<.0001	<.0001
No clinical responsibilities post-call N(%)	32 (40)	4 (3)	5 (13)	<.0001	<.0001	0.0045
Typical nights/month on call						
Mean (SD)	4.8 (1.3)	7.6 (6.0)	6.2 (5.0)	<.0001	<.0001	0.0226
Median (IQR)	5 (4,5)	6 (4,10)	5 (3.5,7.5)	<.0001	<.0001	0.9756

[*] For each ‘row category’ there are different number of missing observations thus column %s do not add up to 100%

[†] Hybrid models have some components of a dedicated team for emergency general surgery (ACS) and some components of a traditional general surgeon on call model (GSOC)

[‡] Pearson Chi2 Test of Association for mutually exclusive responses for a single category of variable represented in gray row or Pearson Chi2 Test of Association for each possibility for variables with more than one response (i.e. ‘check all that apply’), Student's T-test for comparison of Means or Mann-Whitney U-test for comparison of medians

[§] Includes Surgical Oncology, Colorectal Surgery, Breast Surgery, Bariatric Surgery, Thoracic Surgery, Vascular Surgery, Transplant Surgery, and “Other”

[ℋ] Too few outcomes to calculate odds ratio

Table 4

Organization of Emergency General Surgery (EGS) Services Among Care Models with Full or Partial Implementation of Acute Care Surgery (ACS)*

	ACS team (N=81)	Hybrid (N=38)	p-value* (ACS vs Hybrid)
Team Personnel			
Physician Extenders (e.g., NP, PA) N(%)	62 (77)	21 (55)	0.0185
Surgical Chief (PGY-5) Resident N(%)	49 (61)	14 (37)	0.0160
Surgical Senior (PGY-4) Resident N(%)	49 (61)	13 (34)	0.0075
Surgical Midlevel (PGY-3) Resident N(%)	41 (51)	16 (42)	0.3862
Surgical Junior (PGY-2) Resident N(%)	53 (65)	13 (34)	0.0014
Surgical Intern (PGY-1) N(%)	68 (84)	24 (63)	0.0116
Other N(%)	16 (20)	3 (7.9)	0.2890
Patient Cohorting N(%)			0.8115
EGS patients alone	20 (25)	7 (18)	
EGS patients with trauma patients	17 (21)	7 (18)	
EGS patients with elective general surgery patients	14 (17)	9 (24)	
EGS patients with trauma and elective surgery patients	24 (30)	12 (32)	
Other/Missing	5 (7.4)	3 (7.9)	
Routine Transfer of Care to Subspecialty Services N(%)			0.077
Yes	20 (25)	15 (39)	
Face-to-face patient hand-offs (e.g., morning report, sign out rounds) N(%)			0.6994
Yes	70 (86)	32 (84)	
Personnel Present at Hand-offs			
Overnight residents N(%)	59 (73)	22 (58)	0.1030
Overnight attending N(%)	39 (48)	14 (37)	0.2473
Off-service attendings N(%)	8 (10)	7 (18)	0.2379
Other (overnight team members) N(%)	7 (8.6)	2 (5.3)	0.7169
Daytime residents N(%)	65 (80)	24 (63)	0.0453
Daytime attending N(%)	49 (61)	20 (53)	0.4179
Physician Extenders (e.g., NP, PA) N(%)	45 (56)	13 (34)	0.03
Other (daytime team members) N(%)	12 (15)	1 (2.6)	0.06

† Hybrid models have some components of a dedicated team for emergency general surgery (ACS) and some components of a traditional general surgeon on call model (GSOC)

*For each ‘row category’ there are different number of missing observations thus column %s do not add up to 100%

‡Pearson Chi2 Test of Association for mutually exclusive responses for a single category of variable represented in gray row or Pearson Chi2 Test of Association for each possibility for variables with more than one response (i.e. ‘check all that apply’)