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Preparing the future combat surgeon: a survey of the military general surgery trainee GME experience

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ABSTRACT

Introduction Graduate medical education (GME) lacks a standardized military training program for general surgery residents, and concern exists that they may not be prepared to serve as combat surgeons on training completion. The purpose of this study was to assess military surgery trainee satisfaction with their programs. Our hypothesis was that military residents were not completely confident to care for combat casualties on completion of current GME training.

Methods We surveyed US Army, Navy, and Air Force general surgery residents and fellows between November 2023 and March 2024 to assess their confidence in managing combat injuries. Queried residents further rate their overall satisfaction with surgical training, perceived level of deployment preparedness and curriculum elements which they thought would be most beneficial to their training.

Results The survey yielded an overall 43% response rate (132/305) with a response rate of 42% (61/147) from the Army, 56% (44/79) from the Navy, and 34% (27/79) from the Air Force. Most trainees were trained in military medical treatment facility residency programs (n=91, 68.9%) and nearly half of respondents (n=64, 49%) were senior trainees (postgraduate year (PGY)4, PGY5, and fellows). Among all trainees, only two-thirds (n=88, 67%,) thought they were adequately prepared to deploy and operate on military combat casualties by the end of residency but 114 (86%) were satisfied with the training they received during general surgery residency in adult trauma, 103 (78%) in critical care, and 112 (85%) in acute care surgery. However, more than half were unsatisfied with the training they received in obstetric/gynecologic and urologic emergencies (n=72, 55%; and n=67, 51%, respectively).

Conclusion Although the majority of military surgical residents surveyed are satisfied with their training in adult trauma, critical care, and emergency general surgery, a large number of trainees thought they would not be ready to deploy and manage combat casualties.

Level of evidence Prognostic and epidemiological, Level IV.

WHAT THIS ALREADY KNOWN ON THIS TOPIC

⇒ There is a significant body of literature describing military unique curricula; however, to our knowledge this is the first study of its kind surveying military general surgery trainees about their graduate medical education experience and readiness to be a military surgeon.

WHAT THIS STUDY ADDS

⇒ This study provides the perspective of military general surgery trainees in informing the development of a potential military unique curricula.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study may affect practice or policy by informing a military unique curriculum for military general surgery trainees.

INTRODUCTION

Military surgeons require a specialized set of skills to provide care in austere and resource-limited environments and manage injuries not typically seen in civilian settings, often deploying on single surgeon teams, with limited access or no access to specialists. Graduate medical education (GME) plays a pivotal role in ensuring future Army, Navy, and Air Force surgeons are prepared to support these unique operational requirements. Military surgeons, whether trained in military or civilian Accreditation Council for Graduate Medical Education (ACGME) approved residency programs, often deploy immediately on training completion.[1] Although a significant body of literature examines skill sustainment and deployment readiness for attending surgeons, less research has focused on the role of GME in preparing general surgeons for their military careers.[2 3]

Previous attempts to create and implement a military unique curriculum (MUC) occurred in the 1980s, as then Secretary of Defense Caspar Weinberger directed the Department of Defense (DoD) to examine the military health force, and in turn the role of GME.[4] The DoD later established the Department of Defense Graduate Medical Education Advisory Committee. This committee, led by Edward Brandt from the University of Maryland, recommended in its 1987 Brandt Commission Report that the DoD should implement a distinct military curriculum in GME training programs, taking into account the unique aspects of military medicine.[4 5] The Uniformed Services University of the Health Sciences received this tasking, and, in 1987, published a formal MUC outlining the skills and knowledge pertinent to military physicians in each specialty. Despite these efforts, this curriculum was never implemented.[6 7] Recently, a comprehensive literature review of military GME programs found that, despite individual residency programs incorporating elements of a MUC into

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their training, there has been no standardization of a formal program across services.[8] Moreover, when considering specialty-specific MUC, the review showed that military general surgery was under-represented in terms of describing specialty-specific MUC, especially when compared with family, internal, and occupational medicine.[8] Today, training military surgeons centers around meeting the standards set forth by individual programs, the ACGME, and the American Board of Surgery (ABS) with no formal military requirements.[9 10]

With a lack of standardized military training in general surgery GME programs, there is concern about the preparedness of military GME graduates to serve as combat surgeons on residency completion. To our knowledge, no prior studies have focused primarily on military general surgery trainees and their perceptions of satisfaction and confidence in their abilities to care for military casualties with the training they receive during residency training. The purpose of this project was to assess military surgery GME trainee satisfaction with training programs, overall readiness to deploy, and confidence in managing and treating combat conditions. The survey aimed to gather input from military general surgery trainees to potentially inform the development of a MUC that could be implemented during general surgery residency training. We hypothesized that military surgery residents are not completely confident to care for battlefield casualties based on their current GME training.

METHODS

We developed a 15-question survey (online supplemental file 1) to evaluate military general surgery trainee perceived combat injury technical and clinical proficiency and overall training satisfaction with recommendations from a panel of five expert military and civilian trauma surgeons. A literature review of MUC, articles with documented military combat injuries, and a review of prior surveys of military trainees helped inform the survey.[8 11 12] Survey questions assessed confidence in managing conditions typically taught as part of ACGME training in addition to combat-specific injuries. Queried residents were further asked to rate their overall satisfaction with surgical training, rate their perceived level of deployment preparedness, and identify areas they thought would be most valuable to their education.

Trainees provided demographic information that included respondent training year, program type (military or civilian), commissioning source, branch, attended military courses, prior military service, and fellowship status. Three-point Likert-type scales were used for responses that measured confidence in treating combat casualties or satisfaction with training. Respondents were also asked to rank specific training they thought would be most valuable to their education. Prior to sending out the survey, it was critically reviewed by an expert panel of military trauma surgeons.

An online link to the survey was sent to 305 Army, Navy, and Air Force general surgery trainees who were in postgraduate year (PGY) 2 or higher, and all fellows (vascular, colorectal, pediatric, minimally invasive, surgical oncology, plastic reconstructive surgery, and trauma/surgical critical care), between November 2023 and March 2024. The survey was distributed after obtaining email addresses from Army and Navy GME program directors and service specialty leaders or by Air Force specialty leaders directly. Anonymous responses were collected via the Qualtrics survey platform. Responses were monitored for variability that would suggest multiple responses from a single user. Weekly email reminders were sent to trainees to encourage participation during the survey window. Univariate analysis was performed via SPSS V.29 (IBM, Armonk, New York, USA). Results were considered statistically significant with a value of $p<0.05$.

Table 1 Military surgery survey respondent demographics

Respondent characteristics	Respondent, n (%)
Branch of service	
Army	61 (46.2)
Navy	44 (33.3
Air Force	27 (20.5)
Commissioning source	
Health Professions Scholarship Program	86 (65.2)
Uniformed Services University	38 (28.8)
Other	8 (6.0)
Residency type	
Military treatment facility	91 (68.9)
Civilian	41 (31.1)
Trainee year	
PGY2	32 (24.2)
PGY3	36 (27.3)
PGY4	24 (18.2)
PGY5	17 (12.9)
Fellow	23 (17.4)
Trauma/surgical critical care	13 (56.5)
Colorectal	2 (8.7)
Pediatric	3 (13.0)
Vascular	1 (4.0)
Surgical oncology	2 (8.7)
Plastic/reconstructive	1 (4.0)
Prior military service	
Medical	4 (3.0)
Non-medical	10 (7.6)
No	118 (89.4)
Deployment	
Yes	7 (5.3)

PGY, postgraduate year.

RESULTS

Demographics

The survey yielded an overall 43% response rate (132/305) with individual service response rates of 42% (61/147) from the Army, 56% (44/79) from the Navy, and 34% (27/79) from the Air Force. Demographics of the respondents are shown in table 1. Most trainees were commissioned via the Health Profession Scholarship Program (n=86, 65%) and trained in military medical treatment facility (MTF) residency programs (n=91, 69%). Most had no prior military experience (n=118, 89%) and nearly half of respondents (n=64, 49%) were senior trainees (PGY4, PGY5, and fellows).

Overall confidence

Among all trainees, 88 (67%) thought adequately prepared to deploy and operate on military combat casualties by the end of residency (table 2). Thirty-seven (28%) endorsed some confidence and seven (5%) felt no confidence to deploy immediately on graduation from surgery residency. When comparing senior residents (PGY4 and PGY5) and fellows, 27 (66%) and 17 (74%), respectively, felt confident with no statistically significant difference between their perceived confidence (p=0.467). Among respondents currently in a general surgery training program

Table 2 Military trainee overall perceived confidence to operate on combat casualties at the completion of training and satisfaction with areas of combat related surgical training

Perceived confidence	Confident (n, %)	Some confidence (n, %)	Not confident (n, %)	P value
Trainee year				
PGY2	23 (71.9)	8 (25.0)	1 (3.1)	p=0.467
PGY3	21 (58.3)	13 (36.1)	2 (5.6)	
PGY4	16 (66.7)	7 (29.2)	1 (4.2)	
PGY5	11 (64.7)	6 (35.3)	0 (0.0)	
Fellow	17 (79.3)	3 (13.0)	3 (13.0)	
All trainees	88 (66.7)	37 (28.0)	7 (5.3)	
Residency type (PGY2 to PGY5)				
MTF	47 (59.5)	30 (38.0)	2 (2.5)	p=0.036
Civilian	24 (80.0)	4 (13.3)	2 (6.7)	
Satisfaction with training type	Satisfied (n, %)	Neither satisfied nor unsatisfied (n, %)	Unsatisfied (n, %)	
Training type				
Adult trauma	114 (86.4)	10 (7.6)	8 (6.1)	
Vascular	81 (61.4)	26 (19.7)	25 (18.9)	
Burn	88 (66.7)	28 (21.2)	16 (12.1)	
Critical care	103 (78.0)	13 (9.8)	16 (12.1)	
Acute care surgery	112 (84.8)	14 (10.6)	6 (4.5)	
Pediatric trauma	42 (31.8)	49 (37.1)	41 (31.1)	
Gynecologic/obstetric emergencies	8 (6.1)	52 (39.4)	72 (54.5)	
Urologic emergencies	7 (5.3)	58 (43.9)	67 (50.8)	

MTF, medical treatment facility; PGY, postgraduate year.

(PGY2 to PGY5), those training in a civilian residency program felt significantly more confident in their future readiness to deploy and operate on combat casualties compared with those training in a MTF-based military residency program (p=0.036).

Satisfaction with training

Among all trainees, most (114, 86%) were satisfied with the training they received during general surgery residency in adult trauma, 103 (78%) in critical care, and 112 (85%) in acute care surgery (table 2). More than half were unsatisfied with the training they received in gynecologic/obstetric and urologic emergencies (n=72, 55%; and n=67, 51%, respectively).

Confidence in managing specific combat conditions and injuries

Trainees were also asked to rate their confidence in managing specific conditions and injuries commonly seen in combat. Senior residents (PGY4 to PGY5) were most confident with exploratory laparotomy, managing abdominal trauma and hemorrhagic shock, wound debridement, and hollow viscus repair. Residents were least confident in treating vena cava, pancreatic, complex liver, or portal vein injuries. Furthermore, we found a wide degree of variance in comfort levels with managing other combat-specific injury patterns (table 3). Fellows expressed significantly more confidence than senior residents in managing pelvic fractures (p=0.026), and complex liver (p=0.003), pancreatic (p=0.013), portal vein (p=0.023), vena cava (p=0.012) injuries, and conducting a neck exploration (p=0.040).

Training courses attended

Trainees completed a number of surgical skills courses (table 4). Thirty-one (76%) senior residents reported completing either ATOM (Advanced Trauma Operative Management), ASSET (Advanced Surgical Skills for Exposure in Trauma), or BEST (Basic Endovascular Skills for Trauma) courses. When compared with senior residents who had not taken these courses, residents who completed them were more confident in repairing gastric (p=0.036), liver and portal vein (p=0.022), vena cava (p=0.004), and carotid artery (p=0.032) injuries (table 4). Additionally, they were more confident with neck explorations (p=0.001), temporary vascular shunting (p<0.001), and completing definitive vascular repairs (primary repair or graft) (p=0.006).

Most valuable academic and elective opportunities

Trainees were also given the opportunity to rank academic and elective opportunities that they thought would be most valuable to their general surgery training if there were a MUC. Overwhelmingly, trainees found having attendings with combat experience and having a designated military mentor were the most valuable academically (69% and 43%, respectively). For elective opportunities, trainees ranked annual skills courses (ASSET or ATOM) as being most valuable (n=102, 79%), followed by having an international (n=58, 45%) or rural elective (n=49, 38%) (table 5).

DISCUSSION

This study is the first to hear from military general surgery trainees directly and analyze how they view their readiness to serve as combat surgeons and identify areas of training improvement. Overall, general surgery trainees are satisfied with the training they receive in adult trauma and acute care surgery, critical components of combat care. However, a third still did not feel confident they would be ready to deploy on completion of residency training. Interestingly, trainees at civilian hospitals felt more confident to serve as combat surgeons after residency than those at training at military centers.

Given the current relative interwar period characterized by a limited casualty burden compared with the previous 20 years of war in Iraq and Afghanistan, it is imperative to maintain a ready

Table 3 Military surgery trainee confidence in combat surgery procedures and injuries, with confidence of senior residents compared with fellows

	PGY2 to PGY3 (n, %)	PGY4 to PGY5 (n, %)	Fellow (n, %)	P value
Injuries				0.545
Blunt abdominal trauma	38 (55.9)	39 (95.1)	21 (91.3)	
Hemorrhagic shock	46 (67.6)	39 (95.1)	21 (91.3)	0.545
Penetrating abdominal trauma	32 (47.1)	38 (92.7)	21 (91.3)	0.844
Extremity compartment syndrome	28 (41.2)	32 (78.0)	20 (87.0)	0.381
Non-hemorrhagic shock	31 (45.6)	29 (70.7)	19 (82.6)	0.292
Extremity vascular injury	15 (22)	25 (61)	13 (57)	0.674
Burn TBSA >20%	27 (39.7)	24 (58.5)	16 (69.7)	0.382
Penetrating thoracic trauma	13 (19.1)	21 (51.2)	15 (65.2)	0.279
Pelvic fracture	12 (17.6)	19 (46.3)	17 (73.9)	0.026*
Duodenal injury	5 (7.4)	13 (31.7)	12 (52.2)	0.160
Penetrating neck wounds	8 (11.8)	14 (34.1)	14 (60.9)	0.088
Complex liver injury	4 (5.9)	7 (17.1)	13 (56.5)	0.003*
Pancreatic injury	5 (7.4)	7 (17.1)	11 (47.8)	0.013*
Procedures				
Fracture washout	26 (38.2)	27 (65.9)	19 (82.6)	0.357
Wound debridement	61 (89.7)	40 (97.6)	23 (100.0)	0.450
Fasciotomy	32 (47.1)	36 (87.8)	23 (100.0)	0.081
Exploratory laparotomy	35 (51.5)	39 (95.1)	22 (95.7)	0.923
Bowel repair	25 (36.8)	38 (92.7)	21 (91.3)	0.369
Gastric repair	16 (23.5)	38 (92.7)	22 (95.7)	0.176
Liver/portal vein repair	3 (4.4)	6 (14.6)	10 (43.5)	0.023*
Vena cava repair	1 (1.5)	8 (19.5)	12 (52.2)	0.012*
Carotid artery repair	3 (4.4)	14 (34.1)	12 (52.2)	0.251
Extremity amputation	26 (38.2)	31 (75.6)	20 (87.0)	0.384
Thoracotomy	17 (25.0)	31 (75.6)	20 (87.0)	0.491
Neck exploration	4 (5.9)	15 (36.6)	16 (69.6)	0.040*
Temporary vascular shunt	6 (8.8)	20 (48.8)	18 (78.3)	0.070
Definitive vascular repair	3 (4.4)	16 (39.0)	9 (39.1)	0.092
Ventilator management	38 (55.9)	27 (65.9)	18 (78.3)	0.415
Burn management >24 hours	31 (45.6)	24 (58.5)	16 (69.6)	0.239

*Statistically significant p<0.05.
PGY, postgraduate year.

military medical force capable of caring for combat casualties during the next conflict. As military surgeons often deploy soon after completing residency training, the fact that a third of senior military residents surveyed are not confident in their readiness to deploy is a concerning finding and suggests the need for a standardized MUC during GME training. History has demonstrated that medical advances made during battlefield experience are quickly lost during interwar periods and negatively impacts the survival of the first casualties of the next war. This phenomenon known as either the "Walker Dip" or peacetime effect is well described.[13 14] A MUC during general surgery training may help to blunt the effect of the Walker Dip on future combat casualty care, ensuring that the next generation of combat surgeons have the knowledge, skills, and abilities necessary to save lives on the battlefield at the start of the next war.

Another concerning finding is that military residents training in civilian GME programs were more confident in their readiness to deploy than those trainees in MTF-based residency programs. Although the reason for this is unknown, there are a couple of speculative options worth mentioning. This may be reflective of the perception of training and volume seen at their home institutions, with trainees at civilian institutions feeling more confident due to a perception of receiving adequate volume and exposure to high-acuity patients than those at MTF-based residency programs. Although this was unable to be truly elucidated from the current study, the lack of combat-related trauma exposure has previously been documented as a weakness of GME training at military treatment facilities.[15] Furthermore, a recent analysis of military surgical residents in MTF-based GME programs by Choi and colleagues found that although most trainees were satisfied with their GME training, more than two-thirds of residents surveyed did not plan to stay in the military beyond their current service obligation. The main reason for this is declining patient volume at their home MTF.[16] Another speculative reason for the increased perception of readiness to deploy from those training at civilian institutions may be a lack of insight regarding the demands of and skills necessary to be a combat surgeon as a result of fewer military faculty and fewer military patients.[17 18]

Although we ultimately found this difference in perceived confidence between civilian and military training programs intriguing, more studies are necessary to directly compare readiness between military and civilian programs. This study's scope was broader and was not designed to adequately capture the differences, given the fewer number of senior resident respondents from civilian programs. Some partnerships with civilian residencies are newer, and do not yet have senior residents. We think additional studies are necessary comparing outcomes of residents who trained in military verses civilian programs.

Table 4 Number of trainees completing skills courses and comparison of senior residents and fellows who completed surgical skills courses perceived confidence at managing combat injuries and with combat skills

Trainee participation in skill courses	PGY2 (n, %)	PGY3 (n, %)	PGY4 (n, %)	PGY5 (n, %)	Fellow (n, %)
Course					
None	11 (344)	9 (25.0)	6 (25.0)	0 (0.0)	0 (0.0)
ATOM	0 (0.0)	0 (0.0)	1 (4.2)	0 (0.0)	3 (13.0)
ASSET	1 (3.1)	7 (19.4)	9 (37.5)	3 (17.6)	15 (65.2)
ASSET +	1 (3.1)	3 (8.3)	3 (12.5)	7 (41.2)	12 (52.2)
BEST	1 (3.1)	4 (11.1)	2 (8.3)	1 (5.9)	8 (34.8)
ABLS	4 (12.5)	2 (5.6)	0 (0.0)	3 (17.6)	6 (26.1)
C4	13 (40.6)	12 (33.3)	9 (37.5)	5 (29.4)	14 (60.9)
TCCC	12 (37.5)	18 (50.0)	12 (50.0)	11 (64.7)	11 (47.8)
Flight surgeon	2 (6.3)	4 (11.1)	3 (12.5)	0 (0.0)	3 (13.0)
Dive medicine	0 (0.0)	5 (13.0)	0 (0.0)	0 (0.0)	0 (0.0)
Tropical medicine	0 (0.0)	2 (5.6)	0 (0.0)	1 (5.9)	0 (0.0)
Mountain medicine	1 (3.1)	3 (8.3)	1 (4.2)	0 (0.0)	0 (0.0)
Bushmaster	7 (21.9)	11 (30.6)	6 (25.0)	9 (52.9)	2 (8.7)
Other	2 (6.3)	5 (13.9)	0 (0.0)	0 (0.0)	1 (4.3)
Differences in confidence based on course completion	**ATOM, ASSET, ASSET +, BEST (n, %)**		**No ATOM, ASSET, ASSET +, BEST (n, %)**		**P value**
Injury					
Non-hemorrhagic shock	30 (76.9)		18 (72.0)		0.657
Penetrating thoracic trauma	25 (64.1)		11 (44.0)		0.114
Penetrating neck wound	22 (56.4)		6 (24.0)		0.011
Burn TBSA >20%	28 (71.8)		12 (48.0)		0.055
Blunt abdominal trauma	37 (94.9)		23 (92.0)		0.643
Penetrating abdominal trauma	36 (92.3)		23 (92.0)		0.964
Complex liver injury	14 (35.9)		6 (24.0)		0.433
Duodenal injury	18 (46.2)		7 (28.0)		0.198
Pancreatic injury	14 (35.9)		4 (16.0)		0.024
Pelvic fracture	21 (53.8)		15 (60.0)		0.674
Extremity vascular injury	25 (64.1)		13 (52.0)		0.395
Extremity compartment syndrome	34 (87.2)		18 (72.0)		0.129
Procedure					
Fracture washout	27 (69.2)		19 (76.0)		0.789
Incision and debridement of open wounds	38 (97.4)		25 (100.0)		0.42
Fasciotomy	38 (97.4)		21 (84.0)		0.051
Exploratory laparotomy	38 (97.4)		23 (92.0)		0.315
Bowel repair	36 (92.3)		23 (92.0)		0.388
Gastric repair	39 (100.0)		21 (84.0)		0.036*
Liver and portal vein repair	14 (35.9)		2 (8.0)		0.022*
Vena cava repair	18 (46.2)		2 (8.0)		0.004*
Carotid artery repair	19 (48.7)		7 (28.0)		0.032*
Extremity amputation	31 (79.7)		20 (80.0)		0.479
Thoracotomy	33 (84.6)		18 (72.0)		0.291
Neck exploration	25 (64.1)		6 (24.0)		0.001*
Temporary vascular shunting	30 (76.9)		8 (32.0)		<0.001*
Definitive vascular repair with graft	18 (46.2)		7 (28.0)		0.006*
Ventilator management	29 (74.4)		16 (64.0)		0.674
Management of severe burn	26 (66.7)		14 (56.0)		0.617

*Statistically significant p<0.05.
ABLS, advanced burn life support; ASSET, Advanced Surgical Skills for Exposure in Trauma; ATOM, Advanced Trauma Operative Management; BEST, Basic Endovascular Skills for Trauma; C4, combat casualty care course; PGY, postgraduate year; TCCC, tactical combat casualty care course.

Although a third of senior military residents expressed decreased perceived levels of confidence in treating combat injuries, fellowship training appeared to increase confidence levels in managing those complex injuries—especially those including the pelvis, liver, pancreas, liver/portal vein, vena cava, and neck. Fellowship training may increase confidence levels among military surgeons, yet fellowship training opportunities are limited within the military and based on antiquated quotas of specialty requirements across the services that have not been wholistically analyzed across the military health system in the context of current and future needs in decades.

As a result, opportunities such as the development of a MUC may exist to facilitate additional skill improvement during residency training.[19] Trainees (both in military and civilian programs) may be satisfied with their trauma training, which primarily occurs at civilian hospitals, but given their lack of

Table 5 Military general surgery trainee ranking of MUC elements seen as most valuable to training

MUC element	Ranked #1 or #2 (n, %)
Academic opportunities	
Assigned military mentor	55 (42.6)
Military faculty with combat experience	89 (69.0)
Military journal club	18 (14.0)
Joint Trauma System clinical practice guidelines review	23 (17.8)
Military-specific Surgical Council on Resident Education curriculum	16 (12.4)
Expert lectures	43 (33.3)
Military-specific research	4 (3.1)
American College of Surgeons military clinical readiness curriculum	29 (22.5)
Elective opportunities	
International elective	58 (45.0)
Annual surgical skills course	102 (79.1)
Rural elective	49 (38.0)
Orthopedic subspecialty training	36 (27.1)
Urology subspecialty training	25 (19.4)
Face subspecialty training	9 (7.0)

*Statistically significant p<0.05.
MUC, military unique curriculum.

confidence in treating more complex injuries, these trauma skills learned in civilian hospitals may not necessarily be transferable to treating battlefield casualties. For example, Clinical Practice Guideline from the Joint Trauma System describes some of the skills required for a combat surgeon that may not be obtained from civilian training. This includes accepting a different clinical mindset whereby "medical decisions are made in the context of the following variables: time and distance to the next role of care, capability of the next role of care, availability of blood products, sterility, anticipation of further casualties, evacuation capability, security, mobility, and patient holding capacity".[20] Unlike well-resourced academic and military hospitals where residents train, they may not be prepared for austere environments where there may be no senior partner available to assist (or any partner), no CT scanner, no experienced surgical assistant, and limited blood, medications, and supplies. Using such pre-existing programs as the Joint Trauma System weekly conference could be an opportunity to provide additional lectures and integrate a resident-specific program on a weekly or monthly basis that covers non-operative requirements of military medicine including principles of medical evacuation, triage or response to chemical or biological weapons. This would also enable trainees to engage with military faculty who had significant combat or operational experience for residents in both civilian and military training programs. Additionally, these are skills that could be obtained by encouraging trainees to attend military courses during their research year.

The data showing a lack of satisfaction in obstetric/gynecologic and urologic surgical emergencies is not surprising since these specialties are not routinely taught in current general surgery residency programs. However specific training in these areas is needed for military surgery residents since these injuries related to these systems are seen on the battlefield.[21] Furthermore, general surgeons are often called on to manage emergency obstetric, gynecologic and urologic surgical emergencies when forward deployed, particularly solo Navy surgeons deployed on US warships.[1 22 23] Although general surgery residents are not required by ACGME or ABS to participate in obstetrics/gynecology or urology patients, having specific requirements may be an opportunity to obtain training in these areas. Given the availability of elective rotations in most training programs, residents could possibly be exposed to these patients on a community surgery rotation, for example, where there are often still practicing urologists and obstetricians/gynecologists.

Additionally, specific areas that may improve trainee readiness involve participation in surgical skills courses. Although the majority of senior residents and fellows had completed at least one of these courses, there were still a large number who had not; only 46% of PGY4s and PGY5s, for example, had not completed ASSET. Senior residents and fellows who had completed these courses were significantly more confident treating gastric, liver, portal vein, vena cava, and carotid artery injuries, in addition to performing neck explorations, temporary vascular shunting, and definitive vascular repairs. These skills courses have been previously validated among military and general surgeons as a mechanism to improve trauma surgery readiness—pertinent to the needs of a new general surgery trainee.[24–26] Trainees also recognized the value of a skills-specific course, ranking having access to an annual skills course as being most valuable to developing their technical skills in a potential MUC. Academically, they identified having military faculty with combat experience or military mentors as most beneficial to their training. Training in military hospitals or robust military-civilian partnerships that expose trainees to the nuances of military medicine throughout the duration of their training may also improve deployment readiness on training completion.[17–19] Additional funding and requirements for military general surgery residents to participate in these courses on a yearly basis would potentially improve their technical training during residency.

This survey provides valuable insight into the perceived readiness of military surgery trainees to serve as combat surgeons and identifies areas where a MUC may be beneficial. However, this study is not without limitations. Whereas a 43% response rate is fairly robust, the opinions of more than half of general surgery trainees are unaccounted for. This may be secondary to a degree of survey fatigue from the constant demand for their opinions on different matters.[27] A second limitation of this study is access to trainees. Email addresses were collected from service general surgery consultants and program directors. Given the number of trainees and specialties, some trainees may not have been accounted for due to not having accurate contact information despite our best efforts.

Another factor in this study is the "Dunning-Kruger Effect", whereby less competent individuals tend to overestimate their abilities whereas more competent individuals express less relative confidence.[28 29] We recognize that this factor probably influenced this survey since it involves trainees and junior physicians, who have not completed the requirements to become a board-certified surgeon or practice independently. Additionally, most of them have never experienced surgical combat casualty care and may not fully understand the expectations placed on them as military officers or surgeons. Trainees may have limited insight into their own abilities, for better or for worse.

A further limitation of this study is that it did not explicitly address differences in training in military or civilian residency programs. It is important to note that the majority of military GME now occurs in civilian programs via outside rotations, because of the loss of inpatients at the MTFs. We think additional studies are necessary comparing outcomes of residents who trained in military programs with a significant portion of

the training obtained via rotations in civilian hospitals versus residents trained in entirely civilian residency programs.

Despite these limitations, this survey provides valuable insights into areas where military general surgery training and education may be improved. A potential MUC that would address some of the concerns outlined in this survey includes annual surgical skills courses, minimum vascular, urology and obstetrics/gynaecology patient requirements obtained on community general surgery rotations, and non-operative education via such existing programs as the Joint Trauma System weekly conference call specifically geared towards residents. This would further provide military residents at military and civilian training programs with exposure to and engagement with military faculty with operational or combat experiences. Future studies are warranted to analyze faculty insights into MUC, and analysis of fellowship-level MUC, and expansion of surveys to include other surgical specialties that care for combat casualties.

CONCLUSION

The majority of military surgical residents surveyed are satisfied with their training in adult trauma, critical care, and emergency general surgery, although a large number of trainees think they will not be ready to deploy and manage combat casualties. Opportunities exist for more diverse deployment-relatable surgical training to improve military trainee readiness and preparation for future combat support missions, especially with annual surgical skills courses and having faculty with military experience.

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