

Are American Surgical Residents Prepared for Humanitarian Deployment?: A Comparative Analysis of Resident and Humanitarian Case Logs

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Abstract

Background Effective humanitarian surgeons require skills in general surgery, OB/GYN, orthopedics, and urology. With increasing specialization, it is unclear whether US general surgery residents are receiving exposure to these disparate fields. We sought to assess the preparedness of graduating American surgical residents for humanitarian deployment.

Methods We retrospectively analyzed cases performed by American College of Graduate Medical Education general surgery graduates from 2009 to 2015 and cases performed at select Médecins Sans Frontières (MSF) facilities from 2008 to 2012. Cases were categorized by specialty (general surgery, orthopedics, OB/GYN, urology) and compared with Chi-squared testing. Non-operative care including basic wound and drain care was excluded from both data sets.

Results US general surgery residents performed 41.3% MSF relevant general surgery cases, 1.9% orthopedic cases, 0.1% OB/GYN cases, and 0.3% urology cases; the remaining 56.4% of cases exceeded the standard MSF scope of care. In comparison, MSF cases were 30.1% general surgery, 21.2% orthopedics, 46.8% OB/GYN, and 1.9% urology. US residents performed fewer OB/GYN cases ($p < 0.01$) and fewer orthopedic cases ($p < 0.01$). Differences in general surgery and urology caseloads were not statistically significant. Key procedures in which residents lacked experience included cesarean sections, hysterectomies, and external bony fixation.

Conclusion Current US surgical training is poorly aligned with typical MSF surgical caseloads, particularly in OB/GYN and orthopedics. New mechanisms for obtaining relevant surgical skills should be developed to better prepare American surgical trainees interested in humanitarian work.

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Introduction

Surgical humanitarianism has risen in popularity in recent years. Increased interest has been documented in surgeons, residents, and medical students from many high-income countries. After the 2010 earthquake in Haiti, more than 550 surgeons registered to volunteer through the American College of Surgeons (ACS) Operation Giving Back program [1]. A survey of ACS residents showed that 85% were interested in practicing internationally during their careers [2].

Because of geographical differences in the epidemiology of surgical disease and the relative lack of surgeons in most low- and middle-income countries (LMICs) [3], surgeons who practice internationally must be capable in many surgical specialties, including trauma, pediatrics, orthopedics, neurosurgery, urology, and obstetrics [4]. However, with increasing specialization in US surgical residencies and fellowships, many specialty fields are no longer a component of US general surgical training. A study on the change in general surgery chief resident operative experiences found that case mix has narrowed in the last two decades [5]. Residents perform an increasing number of alimentary tract and intra-abdominal cases, but exposure to other kinds of surgery is diminishing [5].

In contrast, surgical programs of medical humanitarian organizations such as Médecins Sans Frontières (MSF) typically provide a broad spectrum of care, though tailored to particular contexts [4]. For example, classic emergency surgical interventions (reacting to war, epidemics, or natural catastrophe) may be heavily focused on trauma in an urban or warzone environment. In contrast, choice interventions (responding to endemics, exclusion, and underserved populations) may require a surgical program to manage all surgical cases arriving in a district hospital, or to staff a maternity hospital focused on complicated obstetric interventions. Both types of programs require surgeons to possess a wide range of skills, some of which an American surgeon may not have accrued during his or her training.

The aim of this study was to assess the preparedness of American-trained general surgeons for humanitarian deployment. To do so, we compared ACGME case logs of graduating general surgery residents with MSF case logs

from a wide array of surgical interventions, and identified specialty areas of mismatch.

Materials and methods

Two sets of data were used for the analysis: American College of Graduate Medical Education (ACGME) general surgery chief resident case logs spanning 2009–2015 [6], and previously published summary data of MSF-Brussels (MSF-OCB) case logs spanning June 2008 to December 2012 [7].

The ACGME is the accreditation body for medical residency and fellowship programs in the USA. The ACGME case logs analyzed in this study report the national average of procedures performed throughout general surgery residency training programs by graduating US general surgery residents, categorized by procedure type. While most ACGME procedure categories were operative in nature (e.g., “cholecystectomy,” “enterectomy”), some procedure categories involved perioperative or bedside care (e.g., “organ dysfunction,” “invasive line management/monitoring”). Such non-operative categories were considered irrelevant to this study and were excluded. With the remaining 114 procedure categories, case volumes were averaged over the 7 years of data.

MSF-Brussels is one of MSF’s five Operational Centers; the surgical logs used here covered operations performed at MSF-Brussels projects in 21 countries (14 in Africa, 1 in the Americas, 6 in the Middle East and South and East Asia) and comprised 93,385 procedures [7]. These were categorized into 28 procedure categories (6 obstetric/gynecologic, 1 urologic, 5 visceral, 10 orthopedic, 6 other). Three categories, “Wound debridement, abscess drainage, circumcision,” “Drain insertion, chest tube insertion, dressing change,” and “Dressing change (burns),” were excluded from analysis, as they were either not captured by ACGME case logs or were technically basic enough to assume surgical trainee proficiency.

In instances where multiple ACGME procedure categories corresponded to a single MSF procedure category (e.g., ACGME: “Open reduction of open/closed fracture,” “Closed reduction of fracture”; MSF: “Fracture reduction”), the ACGME categories were summed into a single data point for purposes of comparative analysis. The category groupings and equivalencies used to generate comparable data are delineated in Table 1.

Compiled procedure category data were grouped into five specialty categories: general surgery, obstetrics and gynecology, orthopedics, urology, and other procedures. Specialty category volumes in each data set were converted to percentages of total operative volume to facilitate

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Table 1 Procedure classifications

MSF category	ACGME category		
General surgery			
Herniorrhaphy, other anogenital	Hemorrhoidectomy (all) Sphincterotomy/ sphincteroplasty Drainage proc for anorectal abscess Repair anorectal fistula Other operations for anal incontinence	Repair rectal prolapse Other major anorectal Inguinal-femoral (all)-open Inguinal-femoral (all)-laparos Ventral	Other major hernias Herniorrhaphy, inguinal/ umbilical Define op for Hirschsprungs/ Imperf anus
Minor tumor resection	Remove skin moles, small tumors, etc	Removal subcut small tumors, cysts, fbs	
Exploratory laparotomy	Gastric trauma-closure/ resect/exclusion Duodenal trauma-closure/ resect/exclusion Sm bowel trauma-closure/ resect/exclusion Colon trauma-closure/ resect/exclusion Explor laparotomy-open Drainage pancreatic injury Resection of pancreatic injury Repair of abdominal aorta/vena cava Exp lap exclusive of trauma-open Drainage intra-abdominal abscess Maj retroperit/pelvic node dissec-open Other major ab-general- lap complex Esophago-gastrectomy Antireflux proc-open Gastrostomy (all types)- open Gastric resect, partial- open Gastric resect, total Vagotomy, trun/sel w/drainage/res-open Repair perf-gastric dis	Prox gast vagotomy, highly select-open Gastric reduc for morbid obesity (all) Enterolysis - open Repair perf-duodenal dis Repair perf-small bowel dis Ileostomy (not assoc w/colectomy)-open Diverticulectomy Appendectomy-open Colostomy (all types) Repair perf-colon dis Lobectomy or segmentectomy Wedge resection/open biopsy Drainage liver abscess Cholecystostomy Cholecystectomy w/wo oper grams-open Common bile duct explor-open Choledochenteric anastomosis Sphincteroplasty (oddi) Drainage pancreatic abscess Resection for pancreatic necrosis Panc resection, distal	Panc resection, whipple Panc resection, total Drainage pseudocyst (all types) Pancreaticojejunostomy Open repair infrarenal a-i aneurysm, ruptured Open repair infrarenal a-i aneurysm, elective Repair suprarenal aortic aneurysm Celiac/sma endarterectomy, bypass Renal endarterectomy, bypass Embolectomy/ thrombectomy, renal Antireflux procedure-open (peds) Rep intestinal atresia/ stenosis Repair pyloric stenosis Operation for malrotation/ intussuscept Proc for meconium ileus/nec enterocolit Exc wilms tumor/ neuroblastoma Rep omphalocele/gastroschisis
Bowel resection	Enterectomy - open Colectomy/proctectomy- open	Colectomy/proctectomy-laparoscopic Colectomy w/ileoanal pull-thru	Colectomy w/continent reconstruct Abdomino-perineal resection
Skin/muscle graft	Skin-grafting, non-burn (all)	Composite tissue transfer	Burn debridement and/or grafting

Table 1 continued

MSF category	ACGME category		
Repair/resection of spleen, liver, kidney	Lobectomy or segmentectomy	Splenectomy for disease-lapar	Hepatic resection for injury
	Wedge resection/open biopsy	Splenectomy/splenorrhaphy-open drainage hepatic lacs-open	Repair/resect for kidney trauma
	Splenectomy for disease-open		Lobectomy or segmentectomy
Obstetrics and gynecology			
Cesarean delivery	–		
Complex delivery, episiotomy, perineal laceration repair	–		
Curettage	–		
Hysterectomy, oophorectomy, pelvic tumorectomy	Hysterectomy (all) Salpingo-oophorectomy	Other major gynecology	Other major gynecology - laparoscopic
Orthopedics			
Fasciotomy, amputation	Fasciotomy	Fasciotomy for injury	Amputation, digit
Fracture reduction	Closed reduction of fracture		
Internal fixation of fracture	Open reduction of open/closed fracture		
Limb amputation	Amputation, transmetatarsal Amputation, below knee	Amputation, above knee	Amputation, upper extremity
Debridement of osteomyelitis	–		
Urology			
Urological procedures	Hydrocelectomy Cystostomy Cystectomy	Ileal urinary conduit Other major genito-urinary Other major genito-urinary - lap basic	Other major genito-urinary - lap complex Repair epi- and hypo-spadias Orchiopexy

comprehension of case distribution across specialties and to enable comparison between the two data sets. Differences across specialty categories were assessed for statistical significance using Chi-squared testing (RStudio Version 0.99.903).

Results

From 2008 to 2012, MSF-OCB performed a total of 93,385 procedures. Of these, 21.9% were minor cases and excluded from further analysis. Of major cases, 46.8% were obstetrics and gynecology, 30.1% were general surgery, 21.2% were orthopedics, and 1.9% were urology (Table 2). The most common general surgery cases were herniorrhaphy (13.5%), bowel resection (6.8%), and minor tumor resection (4.5%). The most common obstetrics and gynecology cases included cesarean delivery (33.1%), complex delivery (4.1%), dilation and curettage (3.4%), and hysterectomy (3.1%). The most common orthopedic procedures included fasciotomy or amputation of fingers and

toes (11.7%), fracture reduction (4.0%), and external fixation of fracture (1.3%).

From 2009 to 2015, general surgery residents performed an average of 1328 cases by the completion of their residency. Of these, 25.8% were non-major cases, endoscopic, or perioperative management, and excluded from further analysis (Table 3). Of the remaining 985 cases, 430 (43.6%) corresponded to surgeries done at MSF facilities, and the remaining 555 (56.4%) had no corollary in the MSF case logs. The majority of cases that corresponded to MSF surgeries were general surgery procedures (41.3%), followed by orthopedics (1.9%), obstetrics and gynecology (0.1%), and urology (0.3%). The most common general surgery procedures included herniorrhaphy (16.6%), exploratory laparotomy (12.7%), and bowel resection (8.0%). The only recorded obstetrics and gynecology procedure was hysterectomy (0.1%). The only recorded orthopedic procedures included major amputation (1.2%) and fasciotomy or amputation of fingers and toes (0.5%).

In comparison with MSF surgeons, residents of ACGME programs performed fewer orthopedic procedures (1.9 vs.

Table 2 Comparison of ACGME case logs with MSF case logs

Specialty	MSF		ACGME	
	Number of procedures	%	Number of procedures	%
General surgery				
Herniorrhaphy, other anogenital	9873	13.5	163.38	16.6
Bowel resection	4949	6.8	78.63	8.0
Minor tumor resection	3316	4.5	11.17	1.1
Exploratory laparotomy	2498	3.4	125.60	12.7
Skin/muscle graft	789	1.1	14.00	1.4
Repair or resection of spleen, liver, kidney	570	0.8	14.78	1.5
Total	21,995	30.1	407.38	41.3
Obstetrics and gynecology				
Cesarean delivery	24,182	33.1	0	0.0
Complex delivery, episiotomy, or perineal laceration repair	3002	4.1	0	0.0
Curettage (obstetric)	2462	3.4	0	0.0
Hysterectomy, oophorectomy, pelvic tumorectomy	2228	3.1	1.32	0.1
Obstetrical fistula repair	1585	2.2	0	0.0
Ectopic pregnancy	663	0.9	0	0.0
Total	34,122	46.8	1.32	0.1
Orthopedics				
Fasciotomy, amputation of fingers or toes	8566	11.7	4.53	0.5
Fracture reduction	2945	4.0	0.37	0.0
External fixation of fracture	974	1.3	0	0.0
Limb amputation	841	1.2	11.72	1.2
Internal fixation of fracture	803	1.1	0.30	0.0
Other (corrective procedure, ortho)	624	0.9	0.97	0.1
Internal fixation removal	464	0.6	0	0.0
Curettage for osteomyelitis	193	0.3	0	0.0
Joint procedure	35	0.0	0	0.0
Bone graft	35	0.0	0	0.0
Nerve repair	18	0.0	0.30	0.0
Total	15,498	21.2	18.18	1.9
Urology				
Urological procedures	1354	1.9	3.12	0.3
Total	1354	1.9	3.12	0.3
Total for analysis	72,969	78.1	430.00	43.6

21.2%, $p < 0.01$) and fewer obstetric and gynecologic procedures (0.1 vs. 46.8%, $p < 0.01$). US residents performed relatively more general surgery procedures (41.3 vs. 30.1%, $p = 0.10$) and fewer urology procedures (0.3 vs. 1.9%, $p = 0.29$), although these differences were not statistically significant (Fig. 1).

Discussion

Our study found that less than one-half of cases performed in ACGME general surgical residencies are directly relevant to surgical practice in MSF projects. Furthermore,

only one-third of major surgery performed in MSF projects corresponds to typical ACGME general surgical training.

ACGME general surgery residents spend a majority of their training (56%) engaged in advanced general surgical or specialty procedures with no direct corollary in MSF projects. Furthermore, they receive minimal exposure to orthopedic surgery (2% of cases), even though orthopedic procedures comprise a significant portion of the surgical work in MSF facilities (21%). The discrepancy is even greater in obstetrics and gynecology, while obstetric and gynecologic case volume totaled 47% of MSF cases, it totaled less than 1% of ACGME cases. Most striking, while the single most commonly performed surgery in MSF

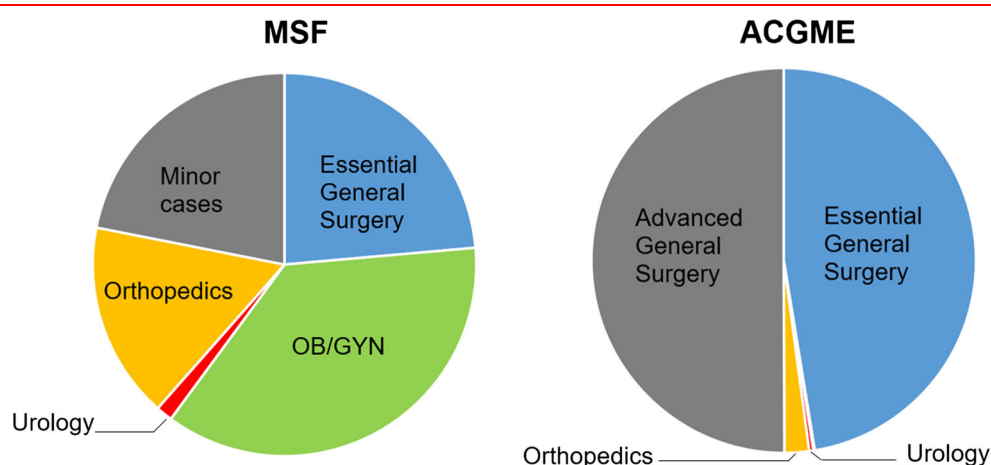
Table 3 Excluded non-major and perioperative procedure categories

MSF	ACGME
Wound debridement, abscess drainage, circumcision	Laryngoscopy
Drain insertion, chest tube insertion, dressing change	Bronchoscopy
Dressing change (burns)	Sclerotherapy/banding esoph varices
	Esophago-gastro-duodenoscopy
	Percutan endo gastrostomy (peg)
	ERCP w/wo papillotomy
	Sigmoidoscopy, rigid/flexible
	Flexible colonoscopy w/wo bx/polypect
	Choledochoscopy
	Cysto/urethrosopy
	Other endoscopy
	Repair minor wounds and grafts
	Banding/incision thrombosed hemorrhoid
	Endorectal ultrasound [miscellaneous]
	Other endorectal procedures
	Non-operative trauma
	Ventilatory management
	Bleed (non-trauma) >3 units
	Hemodynamic instability
	Organ dysfunction
	Dysrhythmias
	Invasive line manage/monitoring
	Parenteral/enteral nutrition

projects is cesarean section, the average graduating general surgery resident reported never having participated in a single one.

While these data suggest a significant mismatch between US surgical training and surgical needs abroad, they fail to capture yet another layer of training deficiency. Even with common surgical procedures such as inguinal herniorrhaphy, the approach and technique utilized in limited-resource environments may differ dramatically from that taught to residents at tertiary training facilities in the USA. The lack of access to mesh, laparoscopic equipment, surgical staplers, and at times electric dermatomes, requires that surgeons be familiar with alternative, low-technology methods for completing the same general surgical procedures one may perform routinely at home. Furthermore, diagnostic tools upon which US surgeons rely routinely, such as CT scans and interventional radiology services, are notably absent in humanitarian environments. Although ultrasound is widely available, few general surgery residents graduate with advanced familiarity in utilizing ultrasound technology for either diagnostic or therapeutic purposes.

Given such training disparities, US surgeons in humanitarian contexts may find themselves incompletely prepared to meet the broad demands made of them. To address key deficiencies and augment essential skills, several focused training courses are available to surgeons preparing for humanitarian missions. For its own volunteers, MSF offers a 4-day cadaver-based surgical skills workshop in Düsseldorf, Germany. The Royal College of Surgeons (London) offers its Surgical Training in Austere Environments (STAE) course, an intensive 5-day cadaver-based course open to civilian and military surgeons. Other courses include Stanford University's Continuing Medical Education (CME)-accredited International Humanitarian

Fig. 1 Comparison of MSF and ACGME surgical cases

Aid Skills Course, and the American College of Surgeons' (ACS) International Humanitarian Aid Surgery course offered during the annual ACS Clinical Conference. For surgical and obstetrical residents interested in global health careers following graduation, the University of Colorado holds its annual Humanitarian Surgical Skills Workshop, a 2-day cadaver-based course focused exclusively on training senior-level residents.

Efforts are also being made to create more integrated training in global health within the structure of surgical residency. Vanderbilt University has created a global acute care surgery fellowship, a 2-year experience for residents to gain technical and research skills to practice in underserved settings [8]. Numerous surgical residencies throughout the country are adding formal global health tracks to their curricula, designed to augment interest in and exposure to the science and research aspects of global surgical care delivery. As of 2015, 34 general surgery residency programs had incorporated international rotations into their curricula [9]. Residents may alternatively seek training through one of the ten rural surgery residency tracks recognized by the ACS; these programs generally expose trainees to a wider spectrum of surgical specialties, notably including obstetrics, gynecology, and orthopedics [10].

The disparities identified here may suggest that organizations like MSF ought to focus on expanding its portfolio of specialist surgeons in its many surgical projects across the globe. While seemingly a straight forward solution, this approach fails to take account of the multiple other constraints facing MSF humanitarian interventions, including the logistics of inserting, housing, and extracting practitioners in potentially tenuous security contexts, and human resources issues such as the reliable availability of desired practitioner types. Rather, our belief is that the most flexible, durable, and efficient solution to this issue remains a focus on expanding the portfolio of procedures performable by the cadre of current and future MSF general surgeons.

There are several limitations to this study. First, the primary data set relies on the reporting accuracy of both ACGME and MSF surgical case logs. ACGME case reporting is closely monitored by surgical program directors, and studies suggest case log reporting accuracy of more than 95% among chief residents [11]. MSF case log generation involves a chain of information transfer from surgical theater to project office to MSF Operational Center headquarters, a multi-step process that may be comparatively more prone to error. To our knowledge, external auditing of the fidelity of this process has either not been performed or not been made public.

A second limitation pertains to the granularity of our data sets. The ACGME data set was de-identified and did not permit us to subgroup analyze case logs by urban or

rural training programs. Possibly, case log data from rural programs would have been more on par with MSF data, particularly with respect to critical procedures such as cesarean section and bony external fixation. However, we were unable to assess this possibility. With respect to the MSF data set, we were unable to subgroup analyze cases by type of surgical practitioner. MSF projects occasionally employ specialist surgeons; in such projects, specialists are more likely to perform the bulk of procedures germane to their specialty, thereby reducing or obviating the burden of such cases on general surgeons. Our inability to remove case log data pertaining to specialists may have resulted in overestimating the true orthopedic, obstetric, and gynecologic operative burden on MSF general surgeons. However, the presence of specialists in MSF missions remains the exception, and, in the authors' experience, the case log data remain a qualitatively accurate reflection of the overall demands placed upon MSF general surgeons.

A third limitation has to do with the narrow scope of our comparison: case logs of surgical trainees from a single country, and one wing of a large humanitarian non-governmental organization. With respect to case logs of trainees, we did make attempts to obtain similar case log data from other national training systems, including those of the College of Surgeons of East, Central and Southern Africa; the Royal Australasian College of Surgeons; the United Kingdom's Joint Committee on Surgical Training, and the Royal College of Surgeons in Ireland. However, despite our efforts, we were unable to convince these organizations to share proprietary data. While such data would have been useful to explore the variability in training across national health systems, our impression is that the advanced degree of specialization in American surgical training likely represents a "worst case" comparison with respect to the needs of humanitarian organizations. With respect to the MSF data, there is some variability in surgical projects across MSF's six Operational Centers; our data pertained only to the case logs of MSF OC-Brussels. The generalizability of this data to the broader context of humanitarian surgery is difficult to verify. However, the high burden of orthopedic and obstetric cases identified here is not unique to MSF projects and has been reported in other humanitarian and austere surgical contexts. A systematic literature review on surgical care during humanitarian crises found that the most common procedures were soft tissue surgery, orthopedic surgery, cesarean sections, hernia repairs, and appendectomies [12]. In a military context, US Forward Surgical Teams (FSTs) in Afghanistan reported that 17% of all cases were orthopedic and 23% were subspecialty in nature, while only 20% were classic general surgery [13]. Still, future research comparing surgical trainee experience from multiple national health systems with case logs of other international aid agencies or standardized criteria

such as the DCP-3 Essential Surgery [14] categories may be useful.

Conclusion

A rising generation of American surgical trainees is increasingly expressing interest in global surgical volunteerism and humanitarian work. However, our study raises serious questions about the ability of current US surgical training to adequately prepare graduates to be effective in such environments. Graduates of US general surgical training programs spend a majority of their time in advanced general surgery and specialty care impractical in most humanitarian settings. US trainees are also critically deficient in exposure to basic and essential obstetrical, gynecological, and orthopedic care. New mechanisms for obtaining relevant surgical skills must be developed to better prepare the many American surgical trainees who now express a profound interest in humanitarian work as part of their professional careers.

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Compliance with ethical standards

Conflicts of interest There are no financial or personal relationships which could potentially and inappropriately influence this work and conclusions.

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