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North American pediatric surgery fellows' preparedness for humanitarian surgery

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ABSTRACT

Introduction: The overwhelming burden of pediatric surgical need in humanitarian settings has prompted mutual interest between humanitarian organizations and pediatric surgeons. To assess adequate fit, we correlated pediatric surgery fellowship case mix and load with acute pediatric surgical relief efforts in conflict and disaster zones.
Methods: We reviewed pediatric (age < 18) cases logged by the Médecins Sans Frontières Operational Centre Brussels (MSF-OCB) from a previously validated and published database spanning 2008–2014 and cases performed by American College of Graduate Medical Education (ACGME) pediatric surgery graduates from 2008 to 2018. Non-operative management for trauma, endoscopic procedures, and basic wound care were excluded as they were not tracked in either dataset. ACGME procedures were classified under 1 of 32 MSF pediatric surgery procedure categories and compared using chi-squared tests.
Results: ACGME fellows performed procedures in 44% of tracked MSF-OCB categories. Major MSF-OCB pediatric cases were comprised of 62% general surgery, 23% orthopedic surgery, 9% obstetrical surgery, 3% plastic/reconstructive surgery, 2% urogynecologic surgery, and 1% specialty surgery. In comparison, fellows' cases were 95% general surgery, 0% orthopedic surgery, 0% obstetrical surgery, 5% urogynecologic surgery, and 1% specialty surgery. Fellows more frequently performed abdominal, thoracic, other general surgical, urology/gynecologic, and specialty procedures, but performed fewer wound and burn procedures (all $p < 0.05$). Fellows received no experience in Cesarean section or open fracture repair. Fellows performed a greater proportion of surgeries for congenital conditions ($p < 0.05$).
Conclusion: While ACGME pediatric surgical trainees receive significant training in general and urogynecologic surgical techniques, they lack sufficient case load for orthopedic and obstetrical care – a common need among children in humanitarian settings. Trainees and program directors should evaluate the fellow's role and scope in a global surgery rotation or provide advanced preparation to fill these gaps. Upon graduation, pediatric surgeons interested in humanitarian missions should seek out additional orthopedic and obstetrical training, or select missions that do not require such skillsets.
Level of evidence: III

Nearly 5 billion persons lack access to safe and timely surgical care; nearly half of these patients are children (age < 18) [1, 2]. The report of Lancet Commission on Global Surgery has helped define the scale and scope of this enormous problem [1], ushering in an era of local, national, and international action to fill the gap. In tandem, pediatric surgical societies headquartered in high-income countries (HICs) have responded to significant interest among their pediatric surgeons and trainees eager to help [2–6]. The rising interest in international surgical volunteerism has been particularly apparent among trainees [5, 7]. While the Accreditation Council for Graduate Medical Education (ACGME) voted in 2014 to not permit international electives during pediatric surgical training, there have been calls to rescind this ruling [5]. Trainees who complete international rotations cite such experiences as essential to their commitment to careers in global surgery [8].

Pediatric surgeons benefit from their prior general surgical training to care for adults, a prerequisite for participation in humanitarian surgical organizations such as Médecins Sans Frontières (MSF). Tasks for surgeons vary based upon the country and setting in which they are performed. Additionally, the scope of practice for surgeons in humanitarian settings is may expand to include trauma, pediatrics, orthopedics, neurosurgery, urology, and obstetrics [9–11]. As we consider renewed interest in international rotations, it is important to understand the

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expected duties and necessary preparation. Similarly, graduate pediatric surgeons with an interest in surgery in these variable-resource settings should understand gaps in their training and experience prior to involvement in such activities.

Considering differences between humanitarian settings and the HIC training environment, we assessed whether pediatric surgery fellowship case mix and load is sufficient preparation for acute surgical relief efforts in humanitarian surgery. If not, what were the specific skills globally-directed pediatric surgeons should acquire? To answer this question, we compared ACGME case logs of graduating pediatric surgery fellows to the pediatric case logs of the MSF.

1. Methods

1.1. Study design and approval

We accessed de-identified data from the two repositories: 1) previously validated and published case logs of the Médecins Sans Frontières Operational Centre Brussels (MSF-OCB) from 2008 to 2014 [12], and 2) the published case logs from the ACGME from 2008 to 2018 [13]. This study was deemed exempt from IRB approval by the MSF Ethical Review Board and Mayo Clinic Instiutional Review Board.

1.2. Data

MSF-OCB operates globally in humanitarian surgical efforts. As one of MSF's five operational centers, it records operations performed using a standardized Patient Surgical Record (PSR). Flynn-O'Brien et al. validated and categorized these records to report case logs of MSF-OCB for 24,576 children served by the organization in 19 countries from 2008 to 2014 [12]. The procedures span six mutually exclusive categories: minor surgery, wound surgery, visceral surgery, orthopedics, obstetrics/gynecology/urology, and specialized surgery [12, 14].

The ACGME oversees pediatric surgery fellowship programs in the United States and Canada. ACGME case log statistical reports are issued annually, and the reports list the national averages of procedures performed by graduating pediatric surgery fellows over the course of fellowship. Case logs mostly cover surgical procedures but also track the full scope of training, including non-operative management for trauma and endoscopic procedures.

1.3. Definitions

To facilitate comparison of case logs, ACGME procedures were classified under 1 of 32 MSF pediatric surgery procedure categories based on previous work [12]. These categories were labeled by nine practice systems: abdominal, thoracic, head/neck, wound, urogynecologic, obstetric, orthopedic, plastic/reconstructive, or specialty. We excluded procedures from ACGME case logs that described non-operative management for trauma and endoscopic procedures since this analysis focused on surgical procedural skills. We also excluded basic wound and drain care as these were considered basic skills that each group of surgeons could perform. Circumcision was also excluded as the circumcisions coded by pediatric surgery fellows only reflect those performed in the operating room, and thus may not be comparable to the routine procedures performed in the MSF-OCB setting.

1.4. Analysis

Total counts for procedures were obtained from case logs. In the case of ACGME reports, the raw total counts of annual procedures are not publicly reported. Therefore, an estimate of total case counts performed was made by multiplying the average number of procedures by the number of graduating fellows each year. We reported the case mixes of MSF-OCB surgeons and pediatric surgery fellows as percentages of the total operative volume over each cohort. We utilized chi-square tests to examine differences across categories and between settings. All statistical tests were performed using STATA 15.1 (College Station, Texas).

2. Results

From 2008 to 2014, MSF-OCB case logs reported 109,828 patients receiving operations, 22% (n = 24,576) of whom were children. These operations occurred across 19 countries and included 26,284 procedures. Of the previously categorized and recorded, 21% (n = 7805) were classified as simple wound closure, incision and drainage, or circumcision. These procedures were excluded from further analysis and a total of 18,479 procedures were analyzed. Major pediatric cases were comprised of 62% general surgery, 23% orthopedic surgery, 9% obstetrical surgery, 3% plastic/reconstructive surgery, 2% urogynecologic surgery, and 1% specialty surgery, Table 1. The most common general surgery procedures were extensive wound debridement (38%), burn management (25%), and gastrointestinal (GI) surgery with or without bowel resection (12%). Orthopedic procedures predominately involved fracture management (84%), while the most common obstetrical procedure was Cesarean delivery (87%).

Between 2008 and 2018, pediatric surgery fellows logged 441, 024 major cases. This included 10,995 circumcisions performed in the operating room, which were excluded from further analysis. The number of patients for whom these procedures were performed is not tracked in the ACGME system. Fellows performed procedures in 44% of tracked MSF-OCB procedure codes. Major pediatric cases included 95% general surgery, 0% orthopedic surgery, 0% obstetrical surgery, 5% urogynecologic surgery, and 1% specialty surgery, Table 1. Using MSF-OCB categorizations, the most common general surgery procedures were exploratory laparotomy (48%), other general surgical procedures (14%), and hernias/hydroceles/hemorrhoids (13%). Urogynecologic procedures were 78% urology, 18% hysterectomy or pelvic tumor removal, and 4% other obstetrical/gynecologic procedures. Fellows reported no obstetrical experience, but did perform 2400 gynecologic procedures. These included laparoscopic hysterectomy/salpingectomies (976), open hysterectomy/salpingectomy (n = 289), open vaginal procedures (n = 613), complex repairs of the vagina/perineum (n = 361), and procedures for intersex conditions (n = 161).There were no procedures performed under the categories of orthopedic or plastic/reconstructive surgery.

Comparing MSF-OCB surgeons to pediatric surgery fellows, MSF-OCB surgeons less frequently performed abdominal (19% vs 69%), thoracic (<1% vs 10%), other general surgical (4% vs 13%), urology/gynecologic (2% vs 5%), and specialty procedures (<1% vs 2%, all $p < 0.001$). MSF-OCB more frequently performed wound (23% vs 1%) and burn procedures (15% vs 1%, both $p < 0.001$) compared to ACGME fellows, Fig. 1.

Indications for surgery differed between MSF-OCB operations and cases logged by pediatric fellows, Fig. 2. The majority (57%) of MSF operations were performed for trauma compared to just 3% of operations logged in fellowship ($p < 0.001$). Congenital anomalies represented 1% of total cases in MSF-OCB's setting, while hernias and hydroceles represented 8%. Fellows, by contrast performed 25% of cases for congenital anomalies and 13% hernias and hydroceles ($p < 0.001$ for both comparisons).

3. Discussion

The purpose of ACGME pediatric surgery fellowships is to train surgeons for work in the United States and Canada—not for settings with variable- or limited-resources. Given the differences in scope of practice between HIC and humanitarian settings, our analysis found pediatric surgery fellowships focused on cases relevant to MSF humanitarian surgical care less than half the time. The humanitarian setting requires

Table 1
Comparison of MSF-OCB and ACGME fellowship pediatric case logs.

Specialty procedures		MSF-OCB		ACMGE pediatric surgery fellows	
		Number	%	Number	%
General surgery					
	Extensive debridement	4271	23	3275	1
	Burn care	2794	15	3212	1
	Bowel resection or other GI surgery	1416	8	49,761	12
	Hernia, hydrocele, hemorrhoids	1400	8	54,007	13
	Exploratory laparotomy	621	3	191,502	45
	Foreign body removal	358	2	0	0
	Solid viscus procedures	125	<1	0	0
	Thoracotomy	21	<1	43,661	10
	Other general surgical procedures	361	2	55,985	13
	Total	11,367	62	401,403	95
Orthopedic surgery					
	Fracture reduction, traction	1895	10	0	0
	Open reduction internal fixation	969	5	0	0
	External fixation	478	3		
	Hardware removal	304	1	0	0
	Other orthopedic procedures	265	1	0	0
	Limb amputation	250	1	0	0
	Osteomyelitis curettage	153	1	0	0
	Joint surgery	19	<1	0	0
	Bone graft	6	<1	0	0
	Total	4339	23	0	0
Obstetrics					
	Cesarean delivery	1492	8	0	0
	Obstetric fistula	55	<1	0	0
	Ectopic pregnancy	30	<1	0	0
	Total	1577	9	0	0
Urogynecologic surgery	Urologic procedure	261	1	14,952	4
	Dilation and curettage	118	<1	0	0
	Hysterectomy, pelvic tumor removal	34	<1	5768	1
	Other gynecologic procedure	143	1	1135	<1
	Total	556	3	21,885	5
Plastic/Reconstructive surgery	Skin/muscle graft or flap	432	2	0	0
	Plastic procedures	42	<1	0	0
	Oral and maxillofacial procedures	10	<1	0	0
	Total	484	3	0	0
Specialty surgery					
	Neurosurgical procedures	40	<1	0	0
	Ophthalmology procedures	32	<1	0	0
	Otolaryngology procedures	30	<1	5177	1
	Vascular procedures	21	<1	1200	<1
	Nerve procedures	11	<1	0	0
	Other specialist procedures	22	<1	394	<1
	Total	156	1	6771	1
Total		**18,479**		**430,029**	

skills in orthopedic, obstetrical, and plastic/reconstructive surgery that are not reflected in ACGME fellows' case logs. These differences in training experience have important implications for bidirectional benefits of fellow and practicing surgeon participation in humanitarian surgical efforts.

3.1. Participation in surgery in LMICs during pediatric surgery fellowship

Based on these data and guidance from pediatric surgical societies [5], fellows looking to participate in humanitarian surgical efforts should select opportunities carefully. Trainees' participation in unsupervised rotations in LMICs is unethical and should be discouraged [5, 9]. Since fellows are actively engaged in training, their participation in pediatric surgery in LMIC settings should come with the same expectation of supervision and clinical instruction they receive in their home country. When implemented with appropriate autonomy and cooperative spirit, such rotations will prepare fellows to effectively plan and perform surgeries in variable-resource settings in future [8, 15]. In instances in which such supervision is unavailable, trainees should operate within the scope of their general surgery training and avoid practicing advanced pediatric surgery [9]. We believe this is a good model for pediatric surgery fellowships to address the gaps identified by our data when caring for children in LMICs.

It is important to note that fellows can expect advantages from experiences where mentored, evidence-based surgical care is being taught and practiced in variable-resource contexts. A long-term partnership at an LMIC hospital with local trainees provides important bidirectional benefits, affording fellows and pediatric surgeons the ability to gain necessary skills while also increasing pediatric surgical capacity and educational experiences in LMIC setting [6, 15]. For example, surgical critical care can and should be practiced in LMIC settings but gaps in education and technology limit availability [16]. Fellows can greatly assist with education and cooperative solutions to fill such gaps [16, 17].

3.2. Graduates' preparedness for participation in humanitarian surgery

Pediatric surgical training is rightly directed toward abdominal and thoracic surgical procedures, and in most cases has a broader practice compared to other subspecialty fellowships. Yet, there are concerns that training in HICs is poorly aligned with LMIC needs. Notably, the spectrum of surgical exposure during ACGME training has become more narrow [18], and is increasingly focused on minimally invasive techniques [19]. In contrast, humanitarian and LMIC surgical organizations provide care to children with a broad range of conditions, usually without laparoscopic availability [12, 20, 21]. Our analysis demonstrates that fellowship graduates have extensive experience managing general surgical conditions for pediatric patients. This experience, however, is in the HIC setting with ample clinical resources and minimally invasive equipment. While fellows logged comparatively fewer cases of wound and burn care, this deficit is usually supplemented by their general surgical training. Proficiency in basic and complex wound care is assumed for fellowship level [22]. Burn care, while part of the general surgical curriculum, is not often practiced by surgeons without a particular interest or fellowship in this area. Exposure and experience is dependent on prior medical school and general surgical training, as many burn care patients are referred to specialized centers [23, 24]. Furthermore, we found that less than 1% of pediatric surgery fellowship training is devoted to burn care, a trend that is stable over time [25].

Fellows receive no pediatric orthopedic surgical training and limited obstetrical training, both of which represent a significant proportion of the surgeries MSF provides to children and older adolescents. The absence of orthopedics in fellowship training is unlikely to be mitigated by prior general surgical training, as ACGME general surgery graduates report only 2% of procedures falling under orthopedics [14]. Pediatric surgery fellows have valuable experience in gynecology but still lack the essential skill of C-section. Our review found that fellows reported no experience with C-section—the most common obstetric procedure performed by MSF. Similarly, studies report that the average general surgery resident does not participate in a single C-section during the course of training [14]. Subspecialty pediatric care is ideally in the hands of either pediatric or adult subspecialists, but variable-resource settings often do not have experts in such subspecialty care. For LMICs, it is imperative to scale up the model of care in a number of subspecialities. But humanitarian missions often grapple with resource and environmental factors that preclude such systems of care. For MSF in particular, a small number of surgeons with a broad skillset often provides the most utilitarian response in disaster or conflict settings.

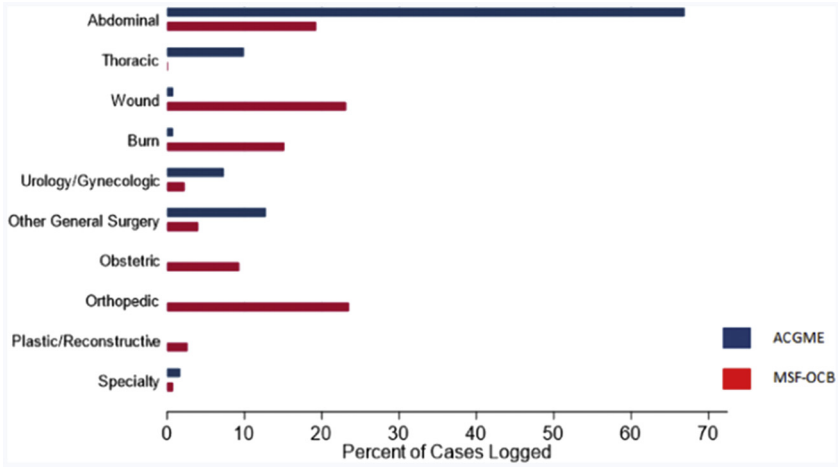

Fig. 1. Comparison of Case Mix for ACGME Pediatric Surgery Fellows and MSF-OCB Surgeons.

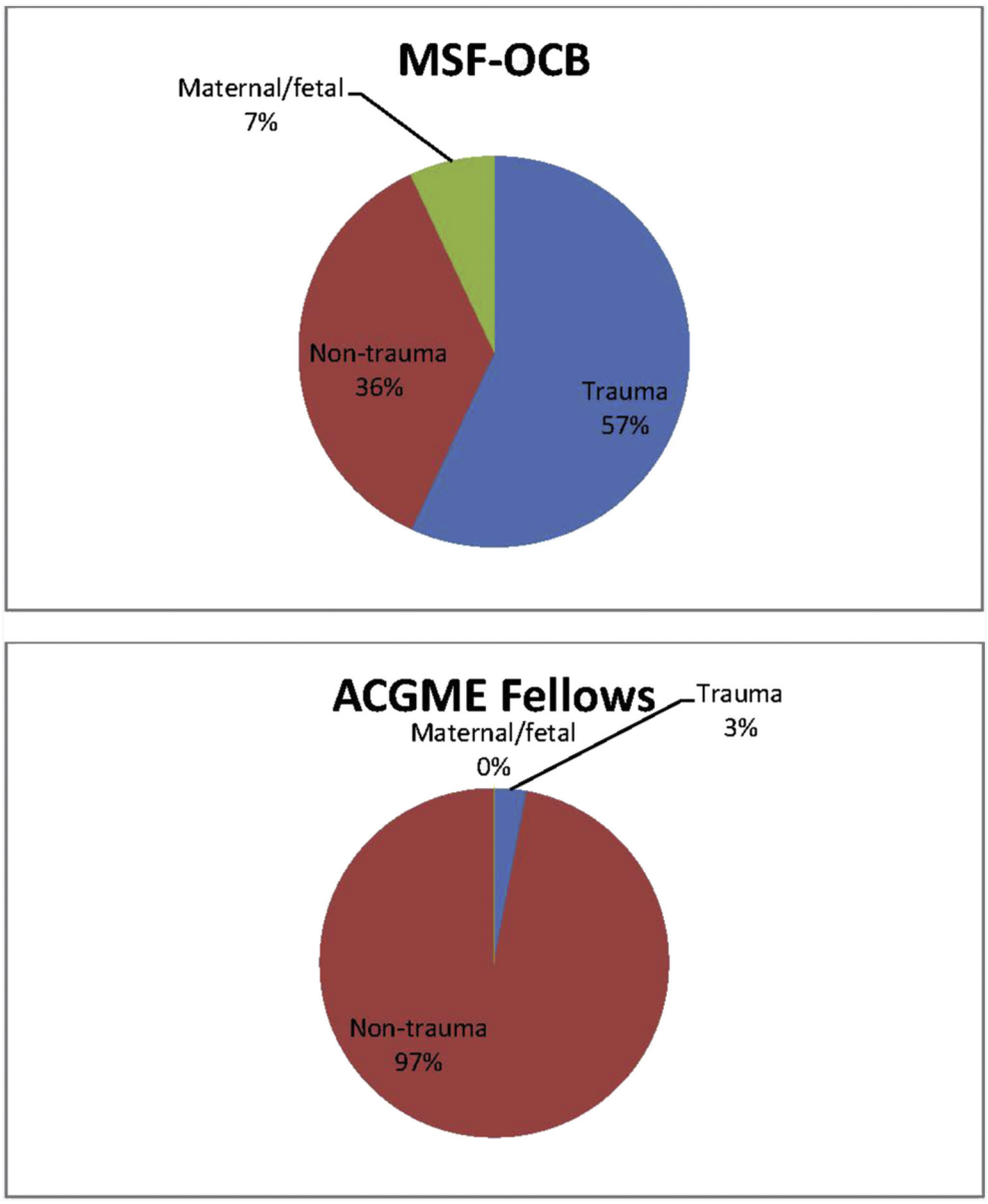

Fig. 2. Comparison of operative indications by setting.

3.3. Pediatric surgeons' role in humanitarian surgery

Though this comparison found that pediatric surgery fellowship graduates lacked essential skills required during humanitarian surgical response, participation in surgical efforts is possible with additional training and/or an appropriate setting. Efforts to improve HIC-trained surgeons' practice skills in orthopedic and obstetric care include international rotations during training [4, 8], a focus on broader skillsets through rural general surgical residency [26], and the option of a two-year fellowship in global surgery [17]. Many of these opportunities could be limited for pediatric surgeons during general surgical residency; and the already lengthy training for pediatric surgeons discourages an additional 2 years fellowship. Furthermore, fellows currently can only utilize vacation time for international rotations. Fortunately, pre-deployment courses have been encouraged at MSF and other humanitarian organizations. MSF supports surgeon participation in the International Committee of the Red Cross (ICRC) war surgery course and a new University Catholic Leuvain (UCL) course on Humanitarian Surgery in Austere Environment [27]. The organization also holds annual workshops where theory and practice of common field surgical interventions are taught and reviewed.

Partnerships in which pediatric surgeons are part of a multispecialty surgical team offer a suitable alternative setting for HIC-trained pediatric surgeons. Roles should be clearly defined and the choice of volunteer site scrutinized. Multi-surgeon teams allow for familiar HIC division of surgical labor by maximizing specialty surgeons' skillsets [28, 29]. Such teams, however, are currently not feasible in the typical MSF-OCB setting, where security risks and space severely limit perioperative infrastructure and the ability to include a large number of surgeons [9, 12, 14]. There are many other opportunities for pediatric surgeons to work in larger referral hospitals in LMICs. These countries have severe shortages in pediatric surgical workforce [30], but adequate infrastructure may exist for pediatric care. For example, pediatric surgeons have already established a training program in Kijabe, Kenya (BethanyKids) [8], and other fellowship trained pediatric surgeons are entering practice across the continent.

Finally, pediatric surgery fellows and graduates have an essential role to play in capacity building. As the standard of care for congenital conditions has become more complex and the burden of disease continues to climb, pediatric surgeons are in demand in LMICs and humanitarian sites [8, 15, 31]. In fact, MSF-Paris has recently opened two positions for pediatric surgeons in their missions in Lebanon and Liberia [32]. More still, there have been calls for increased participation of pediatric surgeons in congenital surgeries during humanitarian missions [12]. In our analysis, fellows had much greater experience in procedures for congenital anomalies compared to MSF-OCB surgeons. It is estimated that the majority of severe congenital anomalies occur in LMICs due to disproportionate burdens of malnutrition and infections [33, 34]. The need for surgeons to care for congenital conditions in LMICs is great but the experience and ability to provide such care are scarce [34, 35]. The limited congenital practice seen in the MSF-OCB setting is no doubt affected by the conditions that prompted their presence, namely disasters. Trained human resources are often not available in the field to manage these cases in low-resource settings [35]. Additionally, as traumatic conditions predominate, fewer surgical resources are available to attend to such cases [12, 36]. Congenital conditions, however, do not disappear in the face of disaster, rather many might be neglected. When Flynn-O'Brien et all reviewed MSF-OCB projects, infant deaths were much higher than other age groups with one-third of deaths attributable to congenital conditions [12].

3.4. Limitations

This study has several important limitations. First, the datasets utilized are self-reported case logs. MSF-OCB case logs involve a multi-step transfer of this information and thus may be subject to error [14]. ACGME case logs are monitored by residency program directors but studies have suggested that they may not be an accurate representation of resident/fellow experience and subject to reporting bias [37]. Still, the case mixes reported in our study reflect operative trends in both settings. Second, MSF projects do occasionally include specialist surgeons, such as orthopedists or obstetricians [9]. Cases performed by such specialists are not able to be separated from the case log data contained in the MSF dataset; and they may overestimate the burden of orthopedic and obstetric care placed on the typical MSF surgeon. Third, our results may not be generalizable to all humanitarian surgical efforts. Importantly, MSF operates in conflict and disaster zones, presenting unique patient needs and logistical challenges. These influence the scope and nature of pediatric surgical care provided. As mentioned previously, there are a number of alternate opportunities for pediatric surgeons aspiring to work in LMIC settings.

4. Conclusion

Interest in pediatric surgical volunteerism is rising and represents an important opportunity to improve the health of children in vulnerable situations. Pediatric surgical trainees receive key training in adult surgery through prerequisite general surgery residency, essential pediatric general surgery, and surgery for congenital conditions. However, they lack sufficient case load for orthopedic and obstetrical care and may need to refresh burn and wound care– common needs among children in humanitarian settings. Trainees and program directors should consider the fellow's role and scope in a global surgery rotation or provide advanced preparation to fill important gaps. Pediatric surgeons interested in humanitarian missions should seek out additional orthopedic and obstetrical training, or select missions that do not require such skillsets. Upon graduation, there is a great need and sufficient opportunity for pediatric surgeons to participate fully in the scope of surgery in austere settings. Moreover, efforts to bring all pediatric surgeons into the discourse and activities of global pediatric surgery must continue to help address the enormous burden of untreated surgical conditions among children.

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