VitalSurg: Outcomes From a Surgical Task-Shifting Training Program in a Humanitarian Context

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OBJECTIVE: The Vital Surgery Training Program (VitalSurg) is a task-shifting initiative designed to build local surgical capacity in surgical deserts by training generalist doctors to perform essential procedures. Implemented in partnership with Médecins Sans Frontières (MSF), the program has undergone 2 pilot iterations in South Sudan. This study evaluates the second iteration, which reflects a refined curriculum and integrated assessment strategy informed by lessons learned from the first iteration. We sought to examine the feasibility, effectiveness, and adaptability of competency-based surgical training embedded within humanitarian clinical care.

DESIGN: We conducted a mixed-methods summative evaluation of the training program. Quantitative trainee performance data—including pre- and postmodule quizzes, oral and written exams, case logs, and Entrustable Professional Activities (EPAs)—were analyzed alongside qualitative data from Key Informant Interviews (KIIs) with trainers, trainees, and MSF stakeholders.

SETTING: This study was conducted at Aweil State Hospital, an MSF-supported district hospital in Northern Bahr El Ghazal, South Sudan, which provides maternity and pediatric surgical care in a resource-limited setting.

PARTICIPANTS: Two local medical doctors were enrolled in the second VitalSurg cohort.

RESULTS: Over the 18-month training program, trainees performed an average of 1305 procedures and improved across all evaluation domains. 446 EPAs were completed, with significant variation between trainees (281 vs. 165 EPAs completed; 162 vs. 53 passed), reflecting differing levels of engagement and skill acquisition. EPA pass rates ranged widely, from 81.7% for skin graft to 43.5% for Caesarean section and 22.0% for laparotomy. Competency-based education tools were feasibly implemented despite infrastructure constraints. KIIs highlighted common training challenges—including case mix, service to education ratios, and trainer variability—as well as opportunities for refinement.

CONCLUSION: VitalSurg demonstrates the feasibility of embedding task-shifting surgical training into humanitarian clinical activities. This model offers a promising, scalable strategy to expand access to safe surgical care in conflict-affected settings. (J Surg Ed 82:103592. © 2025 The Authors. Published by Elsevier Inc. on behalf of Association of Program Directors in Surgery. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/))

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KEYWORDS: Global surgery, essential surgery, low-resource settings, task-shifting, task-sharing, surgical education

ABBREVIATIONS: ASH, Aweil State Hospital CAR, Central African Republic CBD, competence by design CBME, Competency-Based Medical Education COATS, concepts and opportunities to advance task shifting and task sharing EPA, entrustable professional activity FP-ESS, family physician with enhanced surgical skills FP-OSS, family physician with obstetrical surgical skills HIC, high-income country IMS, International mobile staff KII, key informant interview LMIC, low- and lower middle-income country MOH, ministry of health MSF, médecins sans frontières NGO, Nongovernmental Organization ObGyn, obstetrician-gynecologist TS/S, task-shifting/task-sharing UBC, University of British Columbia VitalSurg The Vital Surgery Training Program

COMPETENCY: Patient Care

INTRODUCTION

The availability of surgical care is disproportionately concentrated in urban centers in both high- and low-resource settings.[1,2] The concept of "surgical deserts" has been used to refer to regions with inadequate access to surgical care, defined either by the number of surgical providers per population or by spatially defined times to care.[1,3,4] District hospitals are key to increasing access to safe surgery in surgical deserts; indeed, estimates suggest that more than 90% of people in sub-Saharan Africa could access safe surgery if district-level surgical services were strengthened.[5] Yet numerous factors—including inadequate numbers of trained surgical and anesthesia providers as well as resource limitations such as inadequate materials, equipment, and infrastructure—constrain the volume and quality of surgical care provided at the district level.[6]

In complex humanitarian emergencies, including conflict and postconflict settings, a range of actors temporarily fill gaps in surgical care, particularly outside urban centers.[7] As protracted conflicts become more common, however, humanitarian deployments lengthen, and the caseloads of deployed surgical teams increasingly reflect baseline unmet surgical needs.[8] These trends have raised concerns about the sustainability and ethics of humanitarian surgical missions."[9-11]

Task-shifting and task-sharing (TS/S) programs have been widely used to address surgical workforce shortages.[12] Task-shifting involves transferring tasks to less-qualified personnel, while task-sharing refers to distributing them across a broader trained workforce.[13] Both approaches have been successfully implemented in Low- and Lower Middle-Income Countries (LMICs) as well High-Income Countries (HICs).[14-18] In HICs, examples of successful task-sharing programs include the creation of professional subcategories such as Family Physicians with Enhanced Surgical Skills (FP-ESS) or Obstetrical Surgical Skills (FP-OSS), specially-trained cadres of general practitioners who practice exclusively in remote regions of Canada.[19]

In LMICs, TS/S programs have trained nonsurgeons to achieve outcomes equivalent to those of surgeons for specific procedures.[20] CapaCare, a Nongovernmental Organization (NGO), operates a nationwide surgical task-sharing program in Sierra Leone and Liberia, partnering with local institutions to shift select surgical responsibilities from medical doctors to associate physicians.[21] Graduates of the program have demonstrated excellent surgical competence, with 1 study revealing a lower mortality rate for Cesarean sections, laparotomies, and hernia repairs as compared to medical doctors.[22,23] Further, a randomized controlled trial found that inguinal hernias repaired by CapaCare graduates recurred at a significantly lower rate than those repaired by medical doctors (0.9% vs. 6.9%)—comparable to the 1% benchmark reported for fully-trained general surgeons.[22] Despite the success and potential impact of TS/S training programs in LMICs, however, TS/S have not yet been systematically integrated into the activities of international humanitarian NGOs, particularly in conflict-affected settings where little emphasis has been placed on capacity building.

To address this gap, the University of British Columbia (UBC) and Médecins Sans Frontières (MSF) partnered to design the Vital Surgery Training Program (VitalSurg) in 2019. VitalSurg is a task-shifting program designed to empower general practitioners to provide essential surgical care in low-resource settings in sub-Saharan Africa. The first iteration of VitalSurg trained 3 physicians at an MSF-supported hospital in Aweil, South Sudan from 2019 to 2021.[24] Iterative refinements were made to the training program based on this experience, after which 2 trainees participated in the second iteration from 2023 to 2024. The objective of this 2-phase pilot implementation was to refine the program structure and demonstrate proof-of-concept to facilitate scaling in other settings, both through ongoing partnership with MSF and through direct partnership with national Ministries of Health (MOH).

METHODS

Study Design

This was a single-center, mixed-methods observational study assessing the implementation and outcomes of

VitalSurg in South Sudan. This study evaluates the results of the second cohort and synthesizes lessons learned from both pilot iterations in South Sudan. Quantitative data were obtained from the multicomponent Competency-Based Medical Education (CBME) trainee evaluation strategy, including pre- and postmodule quizzes, oral and written exams, case logs, and Entrustable Professional Activities (EPAs). Qualitative data were obtained via semi-structured Key Informant Interviews (KIIs) with trainers, trainees, and MSF stakeholders. Ethical approval for this study was obtained from the MSF Ethical Review Board and the UBC Institutional Review Board.

Study Setting

The first 2 cohorts of the VitalSurg program were trained at Aweil State Hospital (ASH) in Northern Bahr El Ghazal, South Sudan. South Sudan is a surgical desert, with only 0.32 trained surgeons per 100,000 population, and there are no postgraduate surgical or anesthesia residency programs in the country.[25] Further, the region is affected by multiple protracted humanitarian crises, including conflict, climate disasters, and food insecurity, with large numbers of internally displaced persons and refugees from neighboring Sudan.

ASH is a district referral hospital with an established surgical program that has been supported by MSF since 2008. MSF supports maternity care as well as medical and surgical care for children under age 18, while the MOH provides all other services. The surgical ward includes 50 beds, with a designated section for burn care. Nearby tents house overflow surgical patients. There are 2 functional operating rooms and 1 dressing room. Surgical activities for children under 18 years old and pregnant or postpartum women are led by an international mobile staff (IMS) surgeon, IMS obstetrician-gynecologist (ObGyn), and IMS anesthetist, with support from South Sudanese doctors, clinical officers, nurses, and nurse anesthetists. Adult surgery is managed by the MOH. In 2021, approximately 110 procedures were performed *weekly* in the 2 MSF operating rooms.

Curricular Development

The scope of practice for VitalSurg graduates was defined through multiple rounds of stakeholder consultation, culminating in the design of an 18-month training program that embeds a 10-module didactic curriculum within on-the-job practical training. The curriculum covers core surgical competencies: safe surgery, basic anesthesia and critical care, trauma, source control, acute abdomen, orthopedics, burns, pediatric surgery, obstetrics and gynecology, and urology (Supplement 1). Content was developed by subject matter experts with experience working in resource-limited and conflict-affected settings and reviewed by a pedagogical specialist to ensure appropriateness for adult learners in sub-Saharan Africa. Educational materials, including modules, procedural videos, and assessments, were hosted on Google Classroom, a platform easily accessible with low bandwidth on smartphones and program-issued tablets.

The training program is structured according to the Royal College of Physicians and Surgeons of Canada Competence by Design (CBD) model, a framework for Competency-Based Medical Education (CBME). It is divided into 2 phases: foundation and consolidation. In the 10-month foundation phase, trainees complete the 10 didactic modules while participating in clinical activities in the hospital, with 1 afternoon weekly reserved for live lectures, delivered over Teams. In the 8-month consolidation phase, weekly live lectures continue, with greater emphasis placed on practical mentorship and trainee independence. After 18 months, trainees meeting all evaluation targets graduate, receive a certificate, and are authorized to work as physicians with essential surgical skills at participating hospitals, with ongoing mentorship from both MSF and UBC surgeons to facilitate continuing professional development.

Trainee Evaluation

Consistent with the CBME framework, VitalSurg trainees were evaluated using multiple tools. Knowledge was assessed for each module through formative assessments with pre- and postmodule quizzes. A written exam was completed prior to beginning the program, after the foundation phase, and at the conclusion of the program. Summative oral exams were held at the end of the program.

Sixty-three EPAs were developed to evaluate both technical and nontechnical competencies. Trainees were supervised and evaluated by IMS surgeons, ObGyns, and anesthetists, who were responsible for completing online EPAs on a routine basis. EPA performance was ranked on a 5-point Likert scale (where "I" refers to the trainer): (1) I had to do it myself, (2) I had to talk the trainee through it, (3) I had to prompt the trainee from time to time, (4) I had to be in the room just in case, and (5) I did not need to be there**.** To pass a given EPA, trainees were required to receive 3 scores of 4 or 5. Rate of improvement was tracked by monitoring EPA progress over time and quantified as the slope of the line of best fit. Additionally, trainees maintained detailed online case logs, recording patient demographics, diagnosis, procedure, and their level of involvement (ranging from observer to independent surgeon).

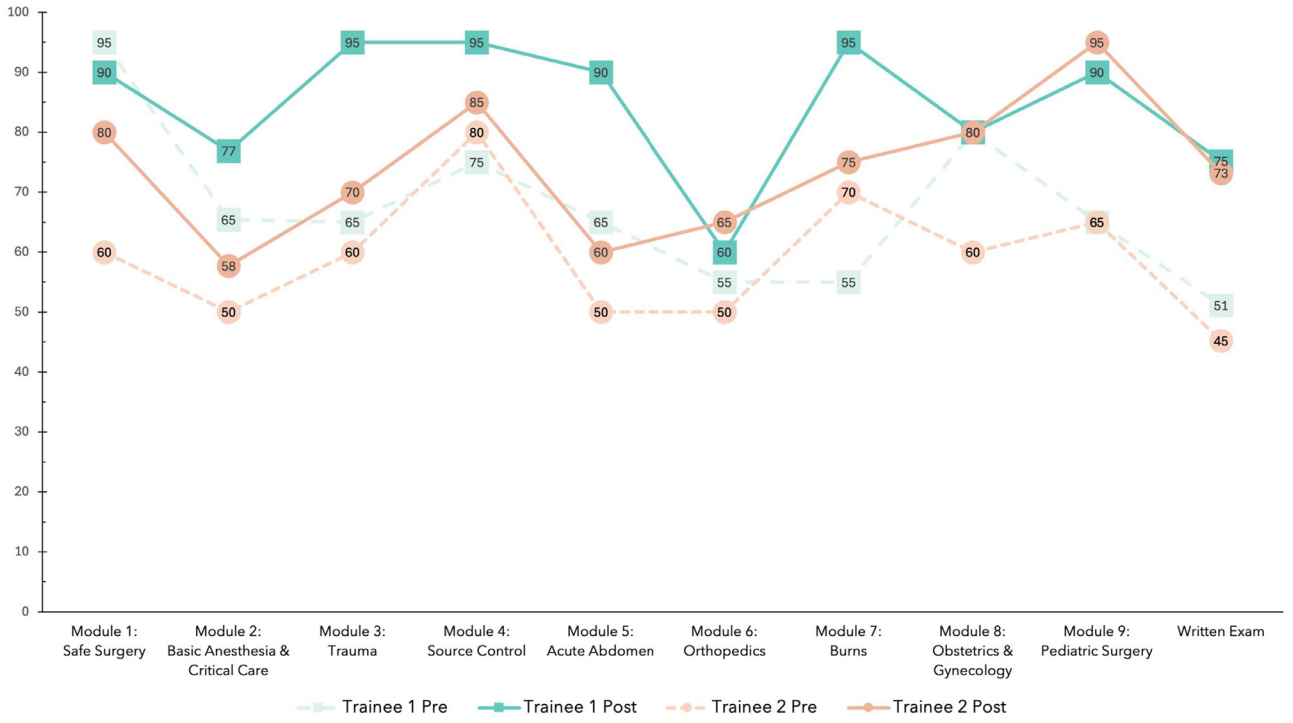

FIGURE 1. Trainee pre- and postmodule quiz scores and pre- and post-training written exam scores.

Bellwether procedures were defined as caesarean delivery, laparotomy, and open fracture management.[26]

Quarterly Competency Committee meetings attended by the UBC VitalSurg program directors, module leads, IMS surgeons, ObGyns, and anesthetists, local MSF medical leadership, and the MSF surgical referent, were held to evaluate trainee progression and develop plans for increased support or remediation, if necessary. Descriptive statistics were used to analyze quiz and exam scores, case logs, and EPAs for the second trainee cohort (Figs. 1-5). Since evaluation strategies evolved between the first and second cohort, results are presented only for the second cohort, as these data are representative of the mature evaluation strategy.

Qualitative Data Collection and Analysis

KIIs were conducted to provide qualitative insight into factors facilitating or inhibiting successful implementation of the Vital Surgery Training Program. Interviewees were purposively selected to represent 3 key stakeholder groups: trainers, trainees, and MSF stakeholders. This sampling strategy ensured the representation of diverse perspectives and experiences within the program. After participants provided verbal consent, interviews were conducted virtually, audio-recorded, and transcribed prior to thematic analysis. Interviews followed a semi-structured guide with open-ended questions probing domains including program impact, operational challenges, and potential improvements (Supplement 2). Interviews were conducted until thematic saturation was reached.

The objective of the qualitative component of this mixed-methods study was to provide narrative contextualization of the quantitative findings and to inform programmatic planning for subsequent deployments of the VitalSurg training program. Formal qualitative analysis using coded data in a software platform was therefore outside the scope of this study; however, interviews were analyzed thematically, incorporating elements of grounded theory and using both deductive and inductive approaches to derive major themes from the study instrument.[27] An initial list of themes was developed by 2 independent investigators (HVR, KP) using the interview guide. These themes were then evaluated against the transcripts to assess completeness, add any new themes that emerged from transcript content, and condense duplicative or synergistic themes. A list of codes was generated by each investigator during the first review of transcripts, applied and iteratively refined during a first round of coding to develop the final codebook which was then used for definitive coding. Assessment of inter-rater reliability was outside the scope of study aims. Narrative synthesis was then used to present findings thematically (Table 1).

TABLE 1. Themes and Quotes From Interviews

Theme	Code	Subcodes	Quotes
Training impact	Clinical competence	- Development of independent surgical capabilities - Ability to perform major cases and open surgeries	"The training has made me confident in handling surgical emergencies independently, which was not the case before."—Trainee "I have benefited a lot that I gained more experience deeply in a theoretical part in the theory of the surgery and the practical. That now I am able to at least do some major cases confidently."—Trainee
	Professional growth	- Improved surgical decision-making abilities - Appropriate referral recognition - Increased confidence in surgical abilities	"I can be able to intervene immediately… also able with my knowledge to detect things that are beyond my capacity"—Trainee "If there is no expat, I have enough confidence I can take over those what I can do in a confident way"—Trainee
	Service delivery	- Reduced dependence on expatriate surgeons - Enhanced emergency surgical response - Positive impact on urgent cases	"This program has positively impacted the activities in the hospital. Especially the patient care… It has positively changed the care. Especially the surgical care in our area"—MSF program administrator "In my capacity and what I have gained from here is, for example, I am in a war in the other state hospital or county hospital, I can be able to intervene immediately. I can help the population there."—Trainee "This training… gave me capability to be a middle cutter. I know that I am not a real surgeon, but somebody in the middle there who can actually bridge the gap between the surgeon and the other medical doctors who don't have technical skills."—Trainee
	Quality of care	- Good surgical outcomes reported - Safe independent practice demonstrated	"We did not lose patients, both mothers or babies. . . All the C-sections had some issues like meconium or low APGAR. . . but his surgical hand is good. . . I'm very satisfied."—IMS surgeon-trainer "On gynecological obstetrical procedure, he can do a normal C-section from the start to the end. . . he made it a subtotal hysterectomy for uterine rupture. . ."—IMS surgeon-trainer
Facilitators of successful program implementation	Integration of hands-on training within the didactic curriculum	- Balance between practical and didactic - Harmonization of module content and case load	"The training is not just about skill process. It is about knowledge. So, we have topics similar. . .to go into the depth of things in certain case that is interesting. So, you will go work and read the textbook and that case."—Trainee "The major change always come on hands-on training. . .The way they give you the information in different ways. It's actually motivating. I really like that. That thing should continue because if you find somebody in Vancouver is like telling you the same information, you feel like I got training in Canada or something like that. It gives you a really good feeling and it motivates, actually it makes a lot of difference."—Trainee
	Context-appropriate modules	- Adaptation of curriculum to patient needs at the study site - Appropriateness of curriculum for local adult learners	"There is a lot of modules that we learned so much from them. How to do skin grafts, and source control plus pediatric consideration. . .So, I think there is certain procedure that in the future you can talk about."—Trainee "Yes, I think, because most of the things that we are doing in the training are the things that we have in the ward and we do it every time. So, I think it was really applicable, all settings."—Trainee
	Multifaceted constructive feedback mechanisms	- Different evaluation strategies - Mode of feedback delivery	"There was feedback on what's an issue and raise it to the formation, and formation raise it to people who helped and then the feedback to the problem to us."—Trainee "Our evaluation now is better. . .like there is a part that you did it good, there is part that you did it you need to improve that part and what is missing. . .Because you will know at which part you are weak and at which part you are good."—Trainee
	Individual trainee motivation	- Consistent improvement in technical abilities - Effective knowledge transfer	"A lot of experience and skills. And so, he was really independently doing all the procedures"—IMS surgeon-trainer "He's proactive, absolutely more proactive. And he likes to be engaged. He likes to show his autonomy, but in a good sense."—IMS Surgeon-Trainer

(*continued*)

TABLE 1 (*continued*)

Theme	Code	Subcodes	Quotes
Barriers to successful program implementation	Infrastructure Limitations	- Poor internet connectivity affecting online learning	"One of them is poor internet connectivity in Aweil. So sometimes lectures, online lectures, have to be cancelled or postponed because of no good internet connection"—MSF program administrator
	Resource Constraints	- Limited equipment and facilities - Lack of MD replacements during training	"Another challenge is that sometimes we have very high workload and there is no staff to cover the trainee, then we have to let him continue with the patient care in the ward instead of the training"—MSF program administrator "(At site 2) the problem was due to lack of material that we have not been allowed to do a certain number of elective cases… There's a real need for elective cases in a certain number to support the training."—IMS surgeon-trainer
Recommendations for future program implementation and scaling	Training site selection/case exposure	- Limited case variety at training sites - Predominance of pediatric cases - Seasonal variation in surgical emergencies	"Actually, it's not a teaching hospital. It's focusing on the pediatrics. . . when there is a surgical adult, they are not there. That affects the inflow of the patient. . . you can take time to get, for example, a case."—Trainee "In Aweil, for example, we have only pediatric surgery and maternity. So, you have 1 problem: the case variety."—IMS surgeon-trainer
	Consistent trainer engagement	- Inconsistent teaching approaches - Variable IMS surgeon-trainer engagement	"Only those expats who are well briefed about the content of the program and how is the program is run… we really benefit from them, and they know really what to give us in that moment"—Trainee "You have to be committed to teach them, to challenge them, to motivate them."—IMS surgeon-trainer "The expats, they are working with a lot of pressure, so there is no time to sit and talk and explain, especially during emergencies."—Trainee
	Balancing clinical duties with protected educational time	- Excessive working hours - Competing priorities (patient care vs. training) - Burnout and exhaustion	"Evening I continue to be with them and night, and I get tired, really tired. Because from morning up to morning. Sometimes the whole night I'm standing in the theatre."—Trainee "When we are doing the practical, we don't have time to go and attend the theory."—Trainee
	Formal program recognition	- Lack of government certification - Absence of international accreditation - Limited professional advancement opportunities	"They don't recognize the certificate that is to be given later on… they consider me as a medical doctor"——Trainee "It has to be sure that the Ministry of Health. . .(recognizes) the trainees and after that they are paying them to work in the provinces where they are needed. The priority is to include them in the civil service and to be sure that they are there will be paid by the Ministry of Civil Service."—MSF program administrator "Because, you know, they got the taste of surgery and at the end they will find there's no official recognition, neither by MSF nor by the government about the training. But they got the taste of surgery and want to go for postgraduate studies." IMS surgeon-trainer

RESULTS

Trainee Demographics and Outcomes

Five trainees participated in the VitalSurg training program, including 3 in the first pilot cohort and 2 in the second. Most trainees were male (n = 4, 80%). Within the first cohort, 1 trainee left midway through the training program to begin General Surgery residency in Ethiopia. One graduate entered ObGyn residency, also in Ethiopia, while the other graduate remained in Aweil to deliver surgical care and function as a trainer for the second cohort. Within the second cohort, Trainee 1 successfully completed the program after 18 months and continued working at ASH, including assuming the duties of international staff during temporary absences or staffing gaps. Trainee 2 did not meet all predefined criteria within 18 months and was therefore assigned to an 8-month remediation period, which he successfully completed. Note that the data below are from the 18-month training period and do not include cases logged during Trainee 2′s remediation period.

Quizzes and Examinations

Postmodule quiz scores and final written exam scores improved compared to premodule and precourse exam scores (Fig. 1). Mean quiz prescores for Trainee 1 and Trainee 2 were 68.9% and 60.6%, while mean postscores were 85.8% and 74.2%, respectively. The average

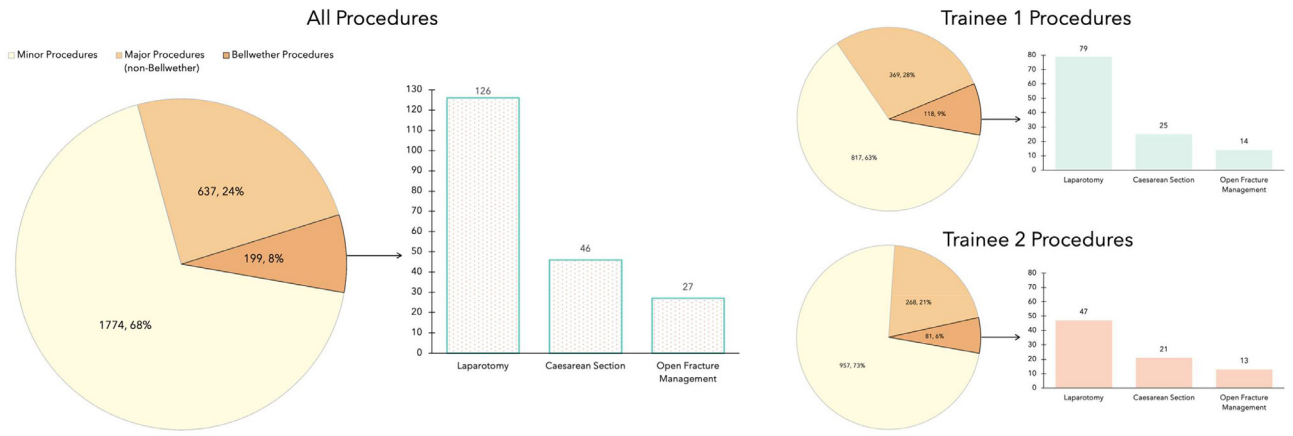

FIGURE 2. Procedure breakdown by minor, major, and Bellwether procedures (left), further broken down by trainee (right).

difference between pre- and postscores was 16.8% and 13.6%. Trainee 1 passed the final exam with a score of 75.2% on the written portion (51.1% pretraining) and passed all 8 oral exam stations. Trainee 2 had a final written exam result of 73.2% (45.2% pretraining) but failed 3 of 8 oral exam stations. Trainee 1 performed higher than Trainee 2 on 6 of 9 post-tests.

Case Logs

In total, 2610 cases were logged by both trainees, with an equal distribution between individuals (Trainee 1 n = 1304; Trainee 2 n = 1306) over the course of the 18-month training program. Each trainee averaged 72.5 cases per month. Overall, 1774 cases (68.0%) were considered minor (dressing changes and I&D of abscesses), and 836 cases (32.0%) were considered major (Fig. 2). Of the total number of procedures performed, 7.6% (n = 199) were Bellwether procedures: 4.8% laparotomy (n = 126), 1.8% Caesarean section (n = 46), and 1.0% open fracture management (n = 27) (Fig. 2). Trainee 1 performed more major procedures and Bellwether procedures than Trainee 2, even though overall case numbers were almost identical. This trend was observed across numerous major procedures in addition to Bellwether procedures, apart from skin grafting, and was most pronounced for laparotomies (n = 79 for Trainee 1 compared to n = 47 for Trainee 2).

When classified by diagnosis, burns represented 37.2% of all cases (n = 972), while another 41.8% (n = 1091) were a combination of wounds, abscesses, and foreign body management. "Wounds" included diagnoses such as snake bites and postoperative wound infections and excluded traumatic injuries, which were categorized under "Trauma." Of the remaining 21% of cases, orthopedic (n = 180, 6.9%), general surgical (n = 148, 5.7%), and ObGyn diagnoses (n = 98, 3.8%) made up the majority. Notably, since most patients were under 18 years of age given MSF's area of responsibility within the hospital, pediatric surgery was used as a classifier only for congenital cases, which represented a small minority of the case volume (n = 23, 0.9%).

Case numbers for select major procedures are shown in Figure 3, broken down by trainee. Consistent with the large volume of burns managed at ASH, skin grafting (n = 78, 3.0%) was the most common major procedure for both trainees. Caesarean section (n = 46, 1.8%) and inguinal hernia repair (n = 49, 1.9%) were the next most-logged cases by both trainees, followed by fracture reduction (n = 32, 1.2%), appendectomy (n = 36, 1.4%), and laparotomies for other indications (n = 36, 1.4%). The majority (88.6%) of these cases were self-reported as being performed independently by the trainee, with the remainder performed as primary surgeon (9.1%) or first assistant (1.6%). When dressing changes (n = 1493, 56.1%) were excluded, the proportion of cases logged as performed independently was 74.9%, indicating increased levels of supervision for nonminor cases.

EPAs

In total, 446 EPAs were logged by both trainees, with an unequal distribution between individuals (281 by Trainee 1 and 165 by Trainee 2). The number of EPAs submitted varied by module (Fig. 4). The modules with the most EPAs submitted from both trainees were obstetrics and gynecology (n = 98), acute abdomen (n = 87), and burns (n = 70).

The modules with the highest percentage of passed EPAs were safe surgery (n = 36/41, 87.8% pass), burns (n = 55/70, 78.6% pass), and trauma (n = 14/18, 77.8%

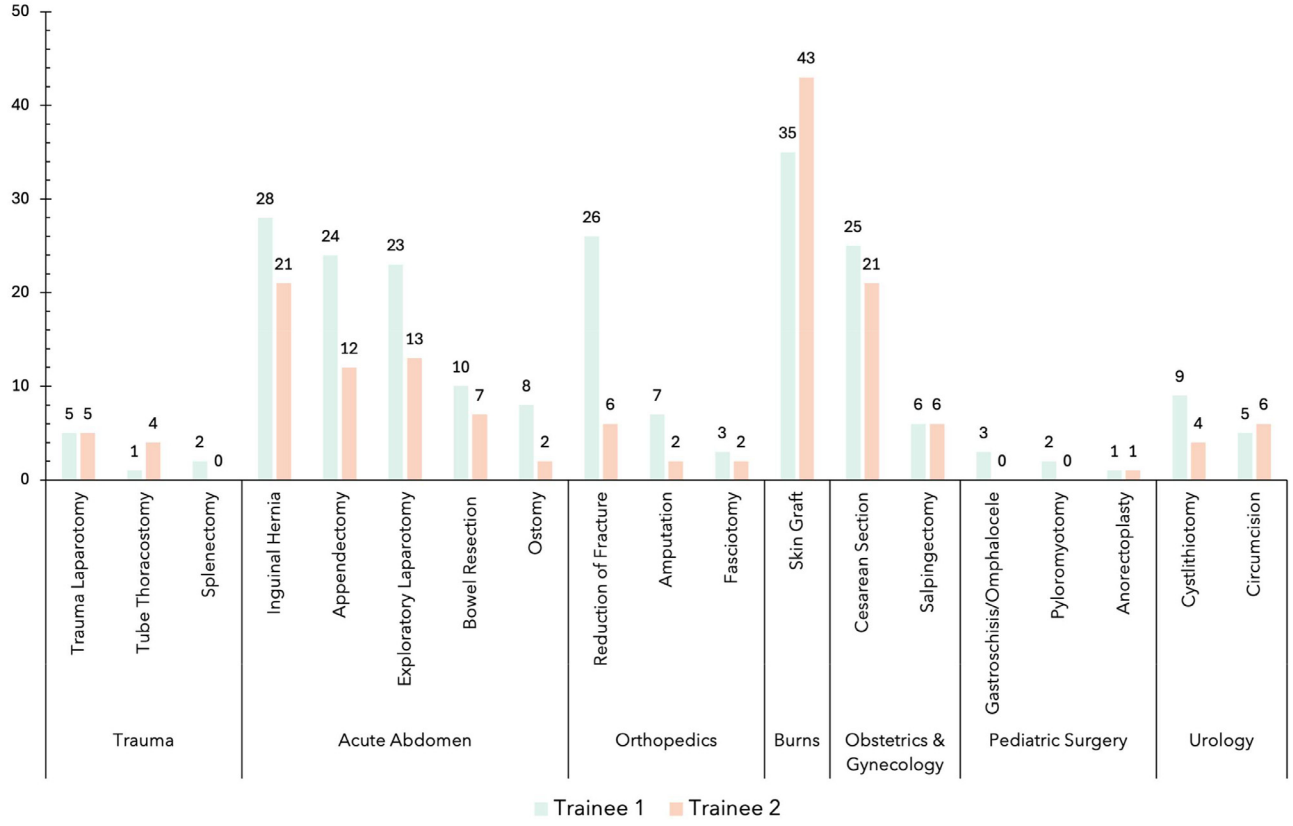

FIGURE 3. Case numbers for select major procedures, broken down by trainee.

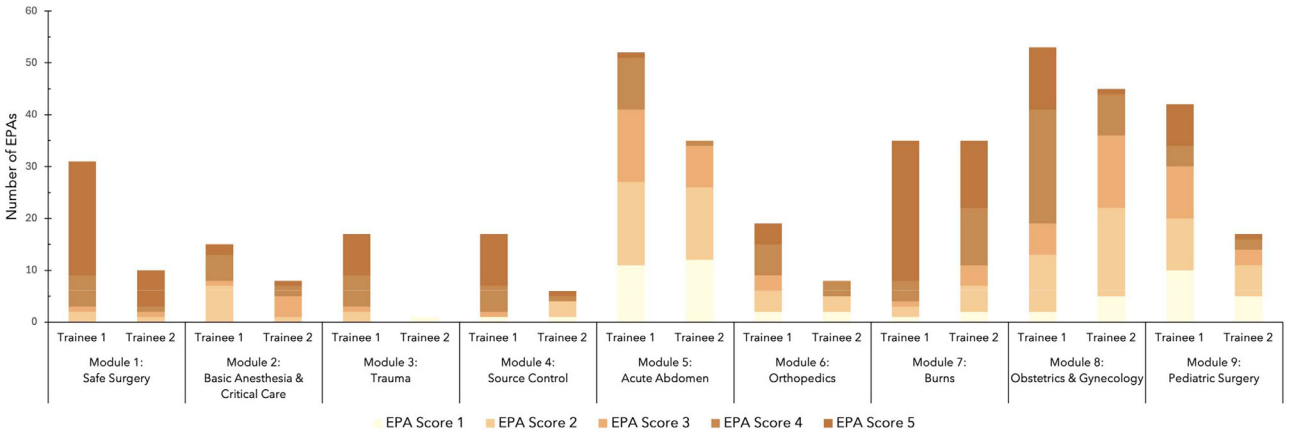

FIGURE 4. Breakdown of EPAs by module, score, and trainee. EPAs were scored on a 5-point Likert scale: (1) I had to do it myself, (2) I had to talk the trainee through it, (3) I had to prompt the trainee from time to time, (4) I had to be in the room just in case, and (5) I did not need to be there.

pass). While the trauma EPA pass rate was relatively high, this was also the module with the lowest total number of EPAs submitted, reflecting a relatively low burden of major trauma at ASH. The modules with the lowest percentage of passed EPAs were acute abdomen (n = 12/87, 13.8% pass) and pediatric surgery (n = 15/59, 25.4% pass) (Fig. 4). There were 2 Bellwether procedures that made up a significant portion of EPA submissions but had low pass rates: laparotomy (n = 50, 57.5% of acute abdomen EPAs; n = 11/50, 22.0% pass) and Caesarean section (n = 46, 46.9% of ObGyn EPAs; n = 20/46, 43.5% pass). Other procedures with low pass rates

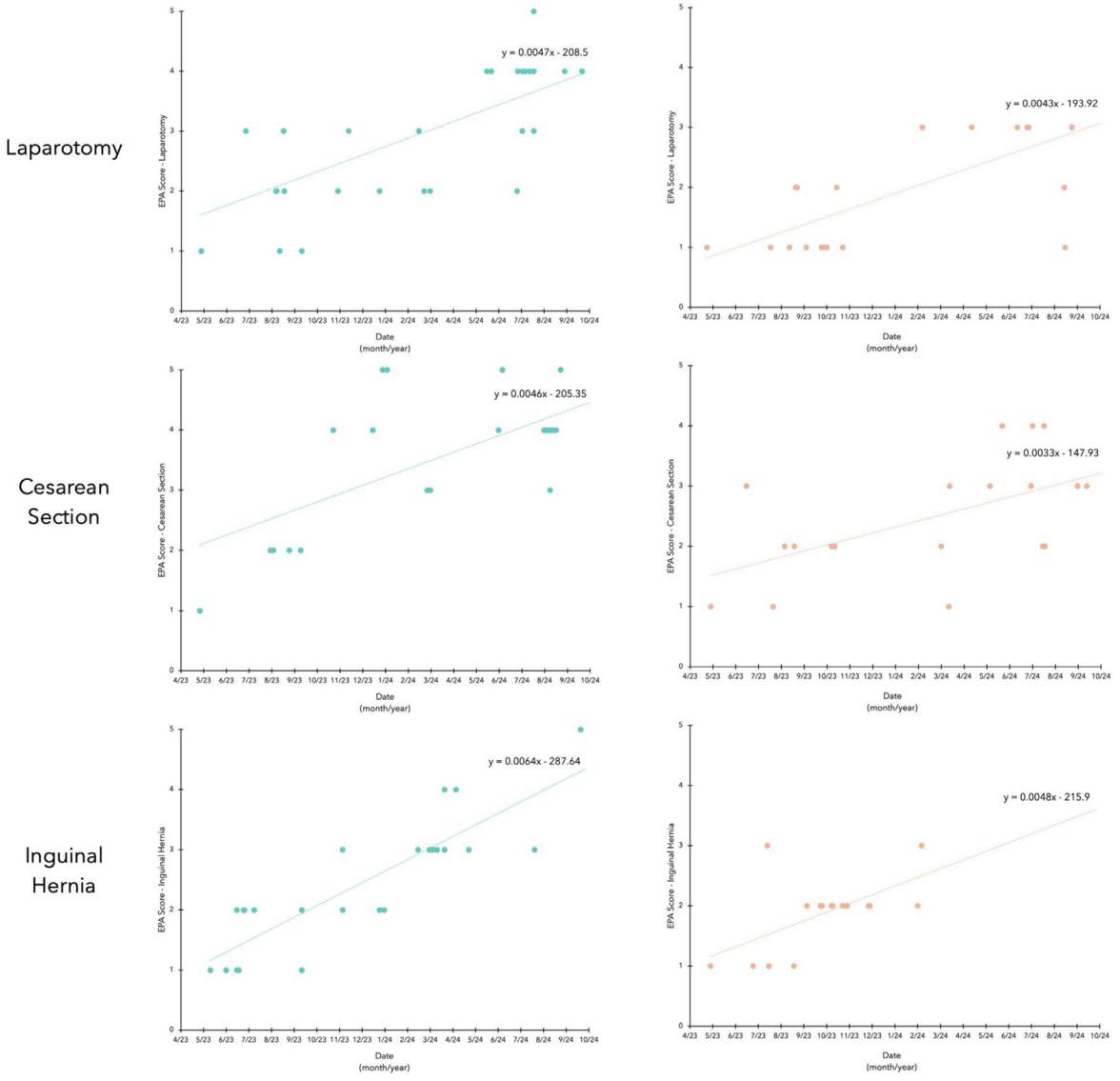

FIGURE 5. EPA progression for laparotomy, Cesarean section, and inguinal hernia repair, broken down by trainee.

included pediatric inguinal hernia (n = 2/21, 9.5% pass) and adult inguinal hernia (n = 1/22, 4.5% pass). Minor procedures including wound debridement (n = 8/9, 88.9% pass), skin graft (n = 49/60, 81.7% pass), and incision and drainage of abscess (n = 5/8, 62.5% pass) had higher pass rates.

We plotted EPA progress over time for the duration of the training program for 3 key procedures: laparotomy, Caesarean section, and inguinal hernia repair (Fig. 5). Rate of improvement was calculated by the slope of the linear trend line. EPA scores for these procedures improved with time but improved more quickly for Trainee 1 than Trainee 2. Indeed, Trainee 1 not only submitted significantly more EPAs (281 vs. 165) and passed significantly more EPAs (n = 162, 57.6% vs. n = 53, 32.1%) but also demonstrated improvement at a faster rate compared to Trainee 2. As Figure 5 shows, Trainee 1 progressed at a faster rate for laparotomy (0.0047 vs. 0.0043), Cesarean section (0.0046 vs. 0.0033), and inguinal hernia repair (0.0064 vs. 0.0048) (Fig. 5).

Qualitative Findings

A total of 9 interviews were conducted with 5 surgical trainees, 2 IMS surgeon-trainers, and 2 MSF program administrators (the Aweil-based medical activity manager and Paris-based surgical referent). Five thematic categories were identified: (i) training impact, (ii) facilitators of

successful program implementation, (iii) barriers to successful program implementation, and (iv) recommendations for future program implementation and scaling (Table 1).

Training Impact

The training program had meaningful effects across multiple domains. At the individual level, trainees demonstrated significant growth in clinical judgment and technical skill, progressing to independent decision-making and safe execution of essential procedures. Interviewees described increased confidence in both performing procedures and identifying cases that should be referred:

> *"In my capacity and what I have gained from here is, for example, if I am in a war in the other state hospital or county hospital, I can be able to intervene immediately. I can help the population there. . .I am also able with my knowledge to detect things that are beyond my capacity, and I will not delay (referral)."* (Trainee)

At the patient care level, the program improved service delivery and access to emergency surgical care, particularly during gaps in coverage by IMS surgeons and ObGyns. Indeed, the presence of trained local physicians with essential surgical skills, referred to below as "surgical MDs," enhanced emergency response capacity and reduced reliance on international staff:

> *"Before this training, we used to have a challenge of surgical emergencies if we (didn't) have the expert-surgeon available (. . .) The patients used to suffer (. . .) So now if we don't have a surgeon, we will rely on surgical MDs, who are trained to do emergencies—surgical emergencies and obstetric emergencies."* (Trainee)

Trainers observed that trainees demonstrated sound clinical judgment and achieved favorable patient outcomes. Program effectiveness was reflected in steady skill acquisition and knowledge transfer. However, impact varied by trainee engagement, aptitude, and willingness to work outside standard hours:

> *"The trainer will feel also frustrated (. . .) I had it very often in Aweil. I was doing a lot of procedures on my own, because the trainees were not available at weekend or at night."* (Trainer)

Facilitators of Successful Program Implementation

Interviewees highlighted several key facilitators of program success. The most important was a program design that aligned with the local context and fostered professional growth and confidence among trainees. Specific facilitators included: (i) integration of hands-on training within the didactic curriculum, (ii) context-specific modules, (iii) multifaceted constructive feedback mechanisms, and (v) individual trainee motivation. Detailed and continuous constructive feedback was particularly valued for identifying weaknesses and guiding improvement. Individual trainee factors including engagement and willingness to learn were highlighted as equally critical facilitators.

Barriers to Successful Program Implementation

Interviewees identified several challenges that hindered implementation of the VitalSurg program in South Sudan. Poor internet connectivity at times disrupted online teaching and access to digital materials. Human resource shortages also created tension between service delivery and education, a challenge faced by training programs globally. Case mix was another barrier: Bellwether and other major procedures were relatively limited, and often occurred at night, when trainees were rarely present.

Contextual factors also played a role. MSF's role at ASH reduced exposure to adult surgery. Security concerns and ethnic tensions limited the feasibility of trainee rotations between sites, which could have broadened clinical exposure. Additionally, training quality varied depending on IMS trainers' understanding of and engagement with the program, which led to inconsistent mentorship experiences.

A final barrier was the lack of formal program recognition by the South Sudanese MOH, which undermined long-term trainee retention. Graduates had no clear path for career progression. This issue was compounded by limited financial compensation and a lack of integration into the public health system:

> *"They got the taste of surgery and at the end they will find there's no official recognition, neither by MSF nor by the government about the training. But they got the taste of surgery and want to go for post-graduate studies."* (MSF Program Administrator)

Recommendations for Future Program Implementation and Scaling

Interviewees provided a range of recommendations to enhance the effectiveness and sustainability of future iterations of the VitalSurg training program. These focused on: (i) appropriate training site selection and exposure to a broad range of surgical cases, (ii) consistent trainer engagement, (iii) balancing clinical duties with protected educational time, and (iv) formal program recognition.

Key factors influencing optimal training site selection included case diversity, community impact, logistical feasibility, and safety. Interviewees consistently emphasized the importance of choosing sites with sufficient

volume and case mix. One proposed solution was trainee rotation across MSF sites in South Sudan:

> *"Like in the Aweil project, the trainees will be exposed to cases that are related to pediatrics. . .but with the other projects, there are trauma cases, cancer cases, which are not happening in Aweil. . .within South Sudan, if we are to train some doctors again for surgical activities, we should rotate them—each one should come to Aweil for 2 months, Abyei for 2 months, Malakal for 2 months, like this."* (MSF Program Administrator)

Interviewees also stressed the importance of orienting new IMS surgeon-trainers to ensure understanding of program goals and prioritization of teaching, as this had a significant impact on trainee learning experience. To increase dedicated time for the training program, some proposed shifting to a full-time educational model with the hiring of additional clinical staff to maintain service delivery. Finally, interviewees recommended stronger collaboration with the MOH to enable formal recognition of the training program. Further, they suggested establishing a distinct professional tier above general practitioner level, securing civil service integration, and ensuring stable pay and clear advancement pathways.

DISCUSSION

This report evaluates the VitalSurg training program pilot in Aweil, South Sudan—a task-shifting initiative that leverages the activities of MSF, an international humanitarian NGO, to build local surgical workforce capacity. By focusing on the second iteration of the pilot, we aimed to illustrate the refined training program structure, including curricular improvements and an expanded multifaceted evaluation strategy. Several key findings were identified. First, VitalSurg is a feasible and effective training model for surgical task-shifting in conflict-affected settings. Second, best practices in CBME adapted from high-resource settings were successfully implemented and reliably assessed trainee performance. Third, while the program was effective in promoting knowledge and skill acquisition, variation in trainee aptitude, engagement, and progression underscores the need for flexible, individualized training approaches. Fourth, trainers and trainees encountered challenges and opportunities common to training programs globally. In sum, the VitalSurg pilot experience in Aweil demonstrates proof-of-concept of the feasibility and efficacy of surgical task-shifting in conflict-affected settings in sub-Saharan Africa.

Final cohort trainees improved across all evaluation domains—including quizzes, exams, and EPAs. Case volumes were high, averaging 72.5 cases per month per trainee. These findings align with prior task-shifting successes in sub-Saharan Africa, including those of CapaCare in Sierra Leone and Liberia.[21-23,28,29] To our knowledge, however, this is the first structured surgical task-shifting program that has been successfully integrated into a humanitarian NGO's clinical activities. This innovative aspect of the VitalSurg training model holds potential to improve sustainability of humanitarian surgical care by decreasing reliance on international staff and bolstering the resilience of the local healthcare workforce. Scaling this model could increase access to safe essential surgery across surgical deserts in sub-Saharan Africa.

VitalSurg aligns with the Concepts and Opportunities to Advance Task Shifting and Task Sharing (COATS) framework, which describes key implementation criteria for TS/S interventions.[30] All 4 core criteria were met. First, the study site had both motivated trainees and qualified trainers. This strength was inherent to the study setting, since international staff with requisite technical expertise are already present at MSF projects to provide surgical training to local doctors, the willing trainees. This is a key advantage of leveraging NGO clinical platforms and is transferable to similar contexts. Second, the program addresses a critical surgical workforce shortage (0.3 surgeons per 100,000 in South Sudan).[31] Third and fourth, clinical efficacy and service delivery potential were demonstrated by outcomes of the 18-month program, far shorter than formal surgical residencies.

The 4 additional "important considerations" outlined by the COATS framework also surfaced in the VitalSurg pilot: (i) adequacy of resources, (ii) significance of the health problem addressed, (iii) protocolized/algorithmic intervention design, and (iv) social acceptability. Resource limitations that pose challenges to surgical training in LMICs are well described and were present at the study site.[32] The multifaceted evaluation strategy used by the VitalSurg program required significant coordination and predeployment planning to address these challenges among other systems-level barriers. With respect to low bandwith and limited connectivity, VitalSurg mitigated challenges by using training materials that required minimal connectivity (for example, providing trainees with tablets preloaded with educational material to facilitate offline use) and a Google forms-based case logging system. To address the lack of dedicated teaching staff on-site, the program leveraged existing MSF and volunteer UBC personnel for training and supervision. Specifically, the concept of a "Competency Committee" which convened online and was composed of multiple volunteer stakeholders helped ensure holistic evaluation of program trainees and identify opportunities for remediation. During its pilot phase, gaps in

surgical equipment and infrastructure were outside the scope of the Vital Surg; however, In future iterations, integrated funding packages could support infrastructure improvements for surgical and critical care alongside training nonsurgeon clinicians.[33]

With respect to "social acceptability," the program was well received at the study site. However, assessment parameters for program acceptability were limited to narrative synthesis of interview results. This topic, therefore, represents an opportunity for more structured inquiry in future research. The next implementation of VitalSurg is planned in the Central African Republic (CAR), where similar workforce gaps exist (0.36 surgeons per 100,000 population).[34] To optimize social acceptability, comprehensive and inclusive contextual analyses will be conducted to inform intervention design, ensuring stakeholder engagement from government representatives, local surgical educators, hospital administrators, and surgical trainees.

VitalSurg's standardized and replicable design—from context-relevant modules and videos to its robust assessment system—is a major strength. This "package" is highly scalable. The successful use of EPAs was particularly notable. EPAs are gold standard tools in HIC surgical education and have demonstrated correlation with patient care.[35,36] In contrast, their application in LMICs is rare—and particularly rare in TS/S programs.[37] The novel application of this evaluation strategy in the study context was both feasible and, in our study sample, indicative of both trainee engagement and competence. For example, Trainee 1 submitted more EPAs (281 vs. 165), passed more EPAs (162 vs. 53), consistently scored higher on quizzes and exams, and was subjectively judged as more proficient by trainers.

Individual factors impact surgical skills acquisition, regardless of training context.[38,39] CBME acknowledges that trainees progress at varying rates and may require different lengths of time to achieve clinical competence.[40] VitalSurg responded to this reality by monitoring trainees' individual progress through regular Competency Committee meetings, with a contingency plan for remediation for trainees requiring additional time to achieve clinical competency markers. EPA data highlighted not only individual variation between trainees, but also significant variation in pass rates between EPA categories. These trends highlight that some competencies have steeper learning curves. This observation informed the addition of a supervised clinical independence phase in the next program iteration, which will allow for targeted mentorship in low-performing categories.

Elucidated challenges mirrored those faced in all surgical training programs: balancing service to education ratios, ensuring adequate case volume and mix, and mitigating varying trainer engagement. These challenges have been raised in high-resource settings and are not unique to VitalSurg.[41-43] Interviewees proposed practical solutions: hiring additional medical doctors to reduce trainee workload; designing call schedules to ensure trainees' exposure to emergency cases; emphasizing commitment to clinical education when selecting IMS surgeons and ObGyns; providing in-depth briefings for IMS trainers; rotating trainees across MSF sites, despite logistical and sociocultural constraints; and ensuring formal credentialing of graduates to promote retention and acceptance within MOH structures.

This study has several limitations. First, the sample size was small, with findings drawn from only 2 trainees in the second pilot cohort. However, the primary objective was to assess VitalSurg as a proof-of-concept for scalable integration of task-shifting into humanitarian care. Second, the single-site design limits generalizability. Nonetheless, many surgical deserts across sub-Saharan Africa share structural barriers, making this model relevant to other contexts. Third, trainees self-reported their level of independence in case logs, which may introduce bias. However, trainee performance was triangulated using trainer-completed EPAs, which offer a more objective reflection of clinical competence and autonomy. Despite these limitations, this evaluation suggests that a surgical task-shifting training program like VitalSurg can be successfully integrated into the clinical activities of an international NGO.

CONCLUSION

This report presents a mixed-methods summative evaluation of the Vital Surgery Training Program—a task-shifting initiative designed to train local doctors in essential surgical care by leveraging the existing clinical activities of humanitarian NGOs. The mature iteration of the program integrated best-practice elements of competency-based medical education, which, in our study sample, proved both feasible to implement and correlated with clinical performance. Key recommendations for future implementation include conducting predeployment contextual analyses to inform program design, choosing sites with adequate case volume and broad case mix, selecting trainers with a clear commitment to education, and enhancing integration with Ministries of Health to enable formal recognition of graduates as a distinct cadre of surgical providers. Overall, evaluation of the VitalSurg pilot provides insights to guide future task-shifting partnerships between NGOs and Ministries of Health in conflict-affected settings, which could, in turn, strengthen local surgical capacity and reduce reliance on international staff in regions facing protracted insecurity.

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SUPPLEMENTARY INFORMATION

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