Comparison of Ugandan and North American Pediatric Surgery Fellows' Operative Experience: Opportunities for Global Training Exchange

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OBJECTIVE: North American pediatric surgery training programs vary in exposure to index cases, while controversy exists regarding fellow participation in global surgery rotations. We aimed to compare the case logs of graduating North American pediatric surgery fellows with graduating Ugandan pediatric surgery fellows.

DESIGN: The pediatric surgery training program at a regional Ugandan hospital hosts a collaboration between Ugandan and North American attending pediatric surgeons. Fellow case logs were compared to the Accreditation Council for Graduate Medical Education Pediatric Surgery Case Log 2018 to 19 National Data Report.

SETTING: Mulago National Referral Hospital in Kampala, Uganda; and pediatric surgery training programs in the United States and Canada.

RESULTS: Three Ugandan fellows completed training and submitted case logs between 2011 and 2019 with a mean of 782.3 index cases, compared to the mean 753 cases in North America. Ugandan fellows performed more procedures for biliary atresia (6.7 versus 4), Wilm's tumor (23.7 versus 5.7), anorectal malformation (45 versus 15.7), and inguinal hernia (158.7 versus 76.8). North American fellows performed more central line procedures (73.7 versus 30.7), cholecystectomies (27.3 versus 3), extracorporeal membrane oxygenation cannulations (16 versus 1), and congenital diaphragmatic hernia repairs (16.5 versus 5.3). All cases in Uganda were performed without laparoscopy.

CONCLUSIONS: Ugandan fellows have access to many index cases. In contrast, North American trainees have more training in laparoscopy and cases requiring critical care. Properly orchestrated exchange rotations may improve education for all trainees, and subsequently improve patient care. (J Surg Ed 77:606–614. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: pediatric surgery, global surgery, global health, fellowship training

COMPETENCIES: Medical Knowledge, Practice-Based Learning and Improvement, Systems-Based Practice

BACKGROUND

Many children in sub-Saharan Africa (SSA) die or live with chronic disability due in part to the limited availability of pediatric surgical subspecialists, and there is a large backlog of pediatric surgical procedures waiting to be performed.[1] There are few pediatric surgery training programs in SSA, and thus trainees in these programs have exposure to a large number of major pediatric cases.[2,3] However, many hospitals in SSA lack adequate critical care facilities and personnel, as well as laparoscopic equipment and consumable supplies, making it difficult for African trainees to obtain adequate exposure in pediatric critical care and laparoscopy.[4-6]

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In contrast, there is ongoing debate regarding whether too many pediatric surgeons are currently being trained in North America.[7] The Accreditation Council for Graduate Medical Education (ACGME) defines the minimum educational requirements for pediatric surgery fellowship training programs in North America.[8] As part of this accreditation, graduating fellows are required to perform minimum numbers of major pediatric surgery cases as surgeon during their program ("index cases"). As the number of pediatric surgery training programs expanded at the turn of the century to meet increasing demand for subspecialists, concerns about the variability of operative experience of graduating fellows and access to sufficient index cases for graduation and competence mounted, and some now estimate that the problem may actually worsen in the coming decade.[9-11] Therefore, additional opportunities for procedural training among North American pediatric surgical trainees is highly desirable, especially in certain important procedures and regions of the continent.[12] Complex index cases are needed in training, given a trend toward an increasing proportion of basic cases in pediatric surgical training.[13]

The certifying and examining body for surgeons and subspecialists with such authority in Uganda is the College of Surgeons of East, Central and Southern Africa (COSECSA). COSECSA has long allowed for its trainees to participate in international rotations in an explicit attempt to improve the breadth of their operative experiences and training in critical care. Up to 6 months may be spent outside of the home institution (inclusive of approved international experiences) to enrich the fellow's experiences, with particular attention toward experiencing a wide spectrum of surgical disciplines. Furthermore, fellows with only a single attending or consultant surgeon mentor at their home institution are required to pursue additional (often international) training for at least a year in order to achieve such breadth.[14]

In order to identify areas for potential collaboration and exchange, we aimed to quantify the operative experiences available to pediatric surgical trainees in a Ugandan training program, and then to compare those with the average North American trainee.

METHODS

The study was determined to be exempt from review by our institutional review board.

Uganda is a 93,000-square mile country with a population of 45 million people, half of which are children.[15] In 2011, there was a single practicing pediatric surgeon in the country, and other countries surrounding Uganda had no pediatric surgeon.[16] During this time, a collaboration was formed between the sole Ugandan pediatric surgeon and several pediatric surgeons in North America, and out of this collaboration, a pediatric surgery fellowship program was initiated at the physician's regional hospital. This facility has 1500 beds and an average of 100 babies are delivered daily.[17] Pediatric patients from across Uganda and surrounding countries seek surgical care at this hospital, which provides the highest level of surgical care available in the country.[18,19] However, there is limited infrastructure for pediatric and neonatal critical care and no pediatric laparoscopy, as is common in many hospitals in sub-Saharan Africa. This hospital is the training site of the only pediatric surgery training program in the country, and is approved by COSECSA.[2] Trainees of this program complete the majority of their training in Uganda, but participate in various North American surgical courses and North American clinical rotations to gain experience in pediatric and neonatal critical care and laparoscopy. Ugandan trainees applying for certification in pediatric surgery must submit case logs to COSECSA as evidence of their experience and competence during formal fellowship training. Upon satisfactory review of their case logs, they are permitted to sit for a qualifying written and subsequent oral exam in pediatric surgery, analogous to the board certification process in North America. In addition to a breadth of cases across pediatric general surgery, fellows are required to complete a total of 3 years of dedicated training in their program in order to qualify for pediatric surgical boards.

We used the self-reported case logs from Ugandan trainees completing their pediatric surgical fellowships from 2011 to 2019 as data. These case logs were sufficiently detailed to organize the procedures on the foundation of diagnosis and procedure type similar to those for North American trainees. For comparison, we used the 2018 to 2019 ACGME Pediatric Surgery Case Log from the Council's National Data Report, which reports mean case numbers of graduating North American fellows in accredited training programs. This report is available on the ACGME's website.[20] The procedures considered in this analysis were selected a priori to reflect major index cases as required of pediatric surgery fellows in North America (Table 1).

Overall and mean numbers of procedures were reported. The mean number of cases in which the fellow reported any surgical role was captured and reported using the ACGME National Data Report for US fellows in accredited pediatric surgery training programs.[20] Microsoft Excel and GraphPad Prism were used to generate figures and calculate means for comparison of Ugandan fellows' case logs with those of North American graduates.

RESULTS

Between 2011 and 2019, we collected case logs for 3 Ugandan pediatric surgery fellows. The first fellow

TABLE 1. List of Index Cases Considered for Total and Categorical Procedures

Soft tissue and/or skin
Pectus repair
Thoracic tumor resection
Tracheoesophageal fistula
Congenital diaphragmatic hernia repair
Central venous catheter (central line) placement
Extracorporeal membrane oxygenation cannulation
Nissen fundoplication
Pyloromyotomy
Stoma creation or stoma closure
Appendectomy
Gastrostomy tube creation
Anorectal malformation repair
Pullthrough procedure for Hirschsprung's
Omphalocele repair
Gastroschisis repair
Retroperitoneal tumor and/or neuroblastoma resection
Sacrococcygeal teratoma resection
Inguinal herniorrhaphy
Umbilical herniorrhaphy
Liver resection
Biliary atresia procedure
Cholecystectomy
Choledochal cyst procedure
Splenectomy
Pancreatic resection
Nephrectomy
Circumcision
Orchiopexy
Ovarian procedure
Orchiectomy
Endoscopic foreign body removal
Hypospadias correction

logged 1124 major cases overall, the second fellow logged 726, and the third fellow logged 497. Therefore, the mean number of procedures was 782.3. This compared to the 42 fellows considered in the ACGME's report with a mean case number logged of 753 (Fig. 1).

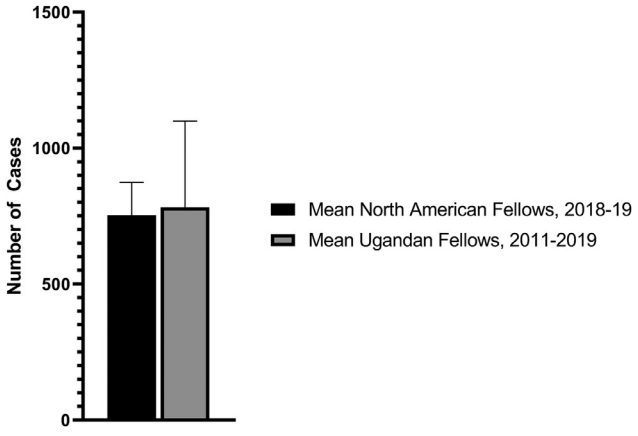

FIGURE 1. Comparison of total procedure case volumes.

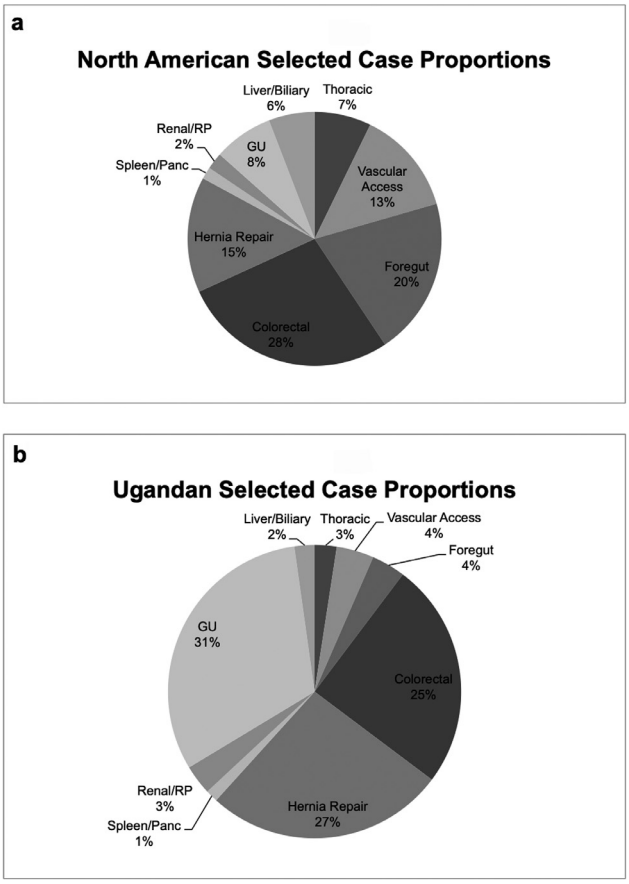

FIGURE 2. (a) Case proportions of selected types of procedures for North American pediatric surgery fellows. (b) Case proportions of selected types of procedures for Ugandan pediatric surgery fellows.

The composition of cases differed considerably between the 2 groups (Fig. 2). The 3 Ugandan fellows performed more procedures compared to North American fellows for biliary atresia (6.7 versus 4), Wilm's tumor (23.7 versus 5.7), anorectal malformation (45 versus 15.7), and inguinal hernia (158.7 versus 76.8). North American fellows had more central line procedures (73.7 versus 30.7), cholecystectomies (27.3 verus 3), extracorporeal membrane oxygenation (ECMO) cannulations (16 versus 1), and congenital diaphragmatic hernia repairs (16.5 versus 5.3). Selected cases are compared in Figures 3-7.

North American fellows had limited experience in chest wall and mediastinal tumor resection (mean: 4.3 cases) and moderate experience with pectus repair (mean: 16.6 cases). The 3 Ugandan fellows did not log any chest wall and mediastinal tumor resection cases, and the average number of pectus repairs was 3.7. North American fellows logged a mean of 11.3 tracheoesophageal fistula repairs compared to 9.7 among Ugandan fellows.

Of note, Ugandan fellows did not perform any laparoscopic procedures at their regional training hospital, as this

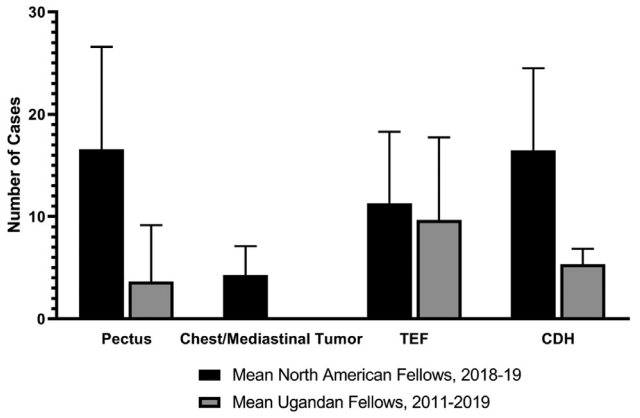

FIGURE 3. Comparison of thoracic procedure case volumes.

operative technique was not available. With some exceptions (i.e., stoma creation and some herniorrhaphies), the ACGME National Data Report does not distinguish between procedures performed in North America by both laparoscopic and open; therefore, it was not possible to categorize or otherwise control for this difference. Similarly, Ugandan fellows did not report any endoscopic foreign body removal procedures, while the average North American fellow performed 18.1 of such procedures.

DISCUSSION

Case Numbers and Complexity in Uganda

Although there were only 3 Ugandan pediatric surgical fellows whose case logs were available for analysis, there were several strong trends that became apparent when comparing their operative experiences with those reported by North American fellows. The number of cases was overall greater than the mean number of cases for North American fellows, although there was substantial variation in the number of cases logged by each Ugandan fellow.

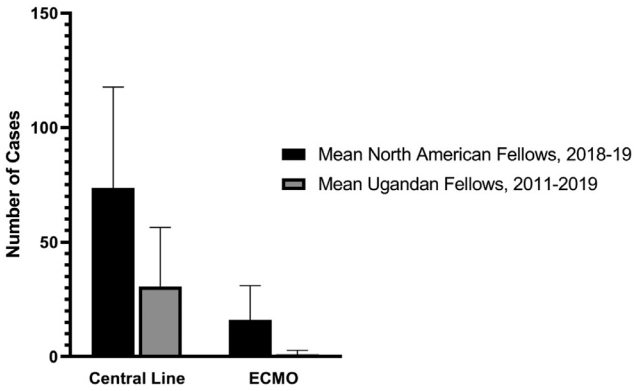

FIGURE 4. Comparison of vascular procedure case volumes.

We were not able to identify any single specific explanation for the considerable variability in the total numbers of cases logged among the 3 Ugandan fellows. However, anecdotally, fellows frequently stopped fastidiously logging cases after the completion of sufficient numbers and breadth for graduation; a practice that may also occur in North America. Additionally, there are overwhelming numbers of children who need surgery in Uganda and it is impossible for all of these procedures to be performed. Consequently, certain fellows may complete larger numbers of certain cases than others. For example, there may be a period when a local or visiting neonatologist was available and therefore a large number of esophageal atresia cases could be completed during that time period. At other times, neonatal care (including ventilators) may not be available and esophageal atresia cases cannot be performed, and therefore priority is given to other cases, such as anorectal malformations or nephrectomies. The substantial interpersonal variability in overall case numbers among graduating Ugandan fellows is a potential limitation of the current study that should be considered when comparing numbers to those in North America. However, there were strong trends in case categories that persisted among all 3 fellows despite the variability in overall case numbers.

Pediatric cases at the Ugandan hospital are limited by pediatric anesthesia availability and consumable resources, such as sutures, infant-sized urinary catheters, and pediatric endotracheal tubes. There are many weekdays that the pediatric surgery team is unable to perform surgery due to lack of anesthesia providers. As a result, many children present to the hospital and do not receive care.[21] If pediatric anesthesia providers were consistently available, the Ugandan fellow case numbers would likely be even higher. The ramifications of this lack of anesthesia support and material resources on a trainee's experience should be considered in the approach to potential global collaboration. In particular, such resources may create a bottleneck in the volume and acuity of cases available, and might therefore be an opportunity for improvement prior to formalizing such a collaboration. Approaching the problem in a multidisciplinary fashion at the level of the institution might promote change, particularly if other departments might be incentivized to create similar international training exchanges (i.e., anesthesia or critical care training opportunities globally).

The sustainability of any efforts at improving the material or infrastructural resources of a hosting country in such an exchange must be considered carefully prior to attempting such changes. An illustrative example is the potential application of laparoscopy in LMICs, such as Uganda. Although laparoscopy is an attractive modality to pediatric surgeons in Uganda, power outages and the

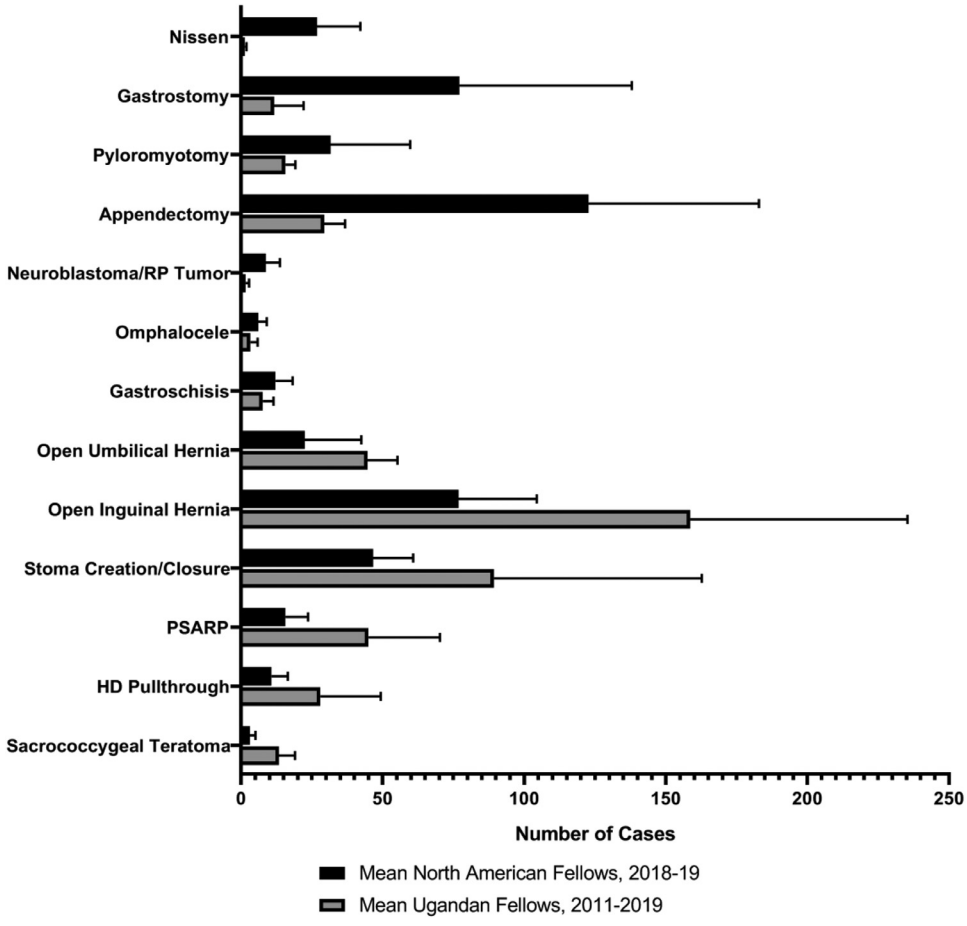

FIGURE 5. Comparison of abdominopelvic procedure case volumes.

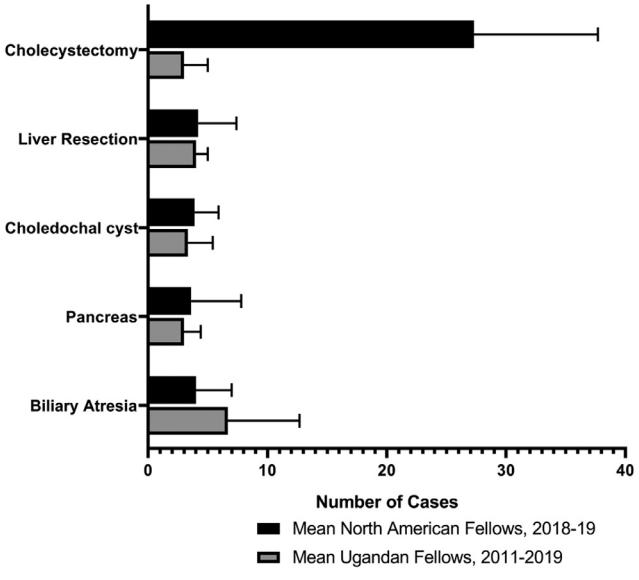

FIGURE 6. Comparison of hepatobiliary procedure case volumes.

need for carbon dioxide for gas insufflation pose formidable challenges to adoption of current equipment used routinely in North America. An ideal system would provide similar benefits to the patient without requiring unavailable infrastructural resources. Such a system is under development but not yet available for implementation.[22] However, the authors believe that surgical training should be implemented with a view toward the future, including training surgeons to be able to thrive not only in their current environment but also that a decade from now. We are optimistic that pediatric surgery in Uganda will include laparoscopy and critical care in the coming years; as such, we are working to build capacity in a multidisciplinary fashion with other colleagues and institutions.

The breadth of the Ugandan fellow experience was robust and included large and complex operations that are less frequent in North America. In particular, operations for simple and complex anorectal malformations were quite common, and a long backlog of children

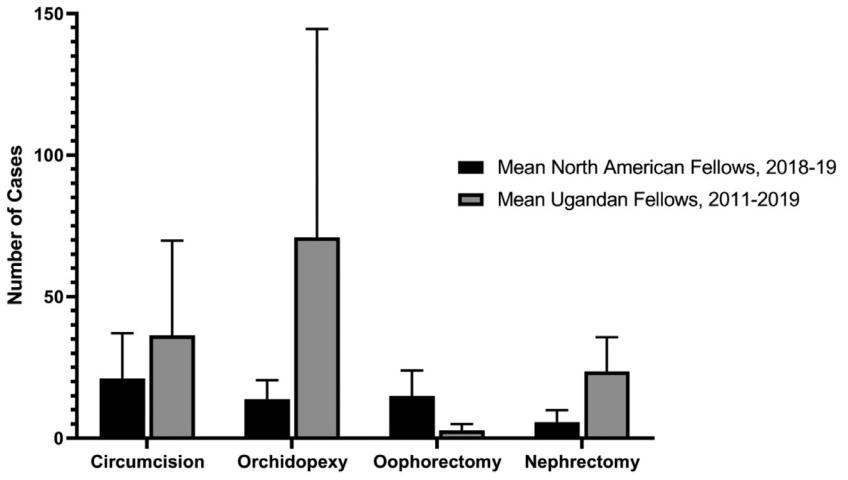

FIGURE. 7. Comparison of genitourinary procedure case volumes.

requiring surgery contributed to this experience in Uganda.[19] Although not reflected in these data, many children present late for repair of anorectal malformations and Hirschsprung's disease, which presents a unique set of challenges. Many patients with anorectal malformations have received a loop colostomy as an infant, rather than a properly divided colostomy. This renders the distal colon chronically distended with inspissated stool and nonfunctional. Likewise, late presentations of Hirschsprung's disease result in distended and nonfunctional colons. Additionally, preoperative imaging of anorectal malformations is often unavailable due to inadequate capacity in pediatric radiology and financial burden to families. These factors add to the complexity of the pelvic dissection and subsequent repair.

Likewise, many patients present with infection, due to chronic untreated surgical disease. Most infants with tracheoesophageal fistula present after several days of life, and are malnourished, dehydrated, and have aspiration pneumonia. With limited critical care capacity, this presents a challenging perioperative scenario.

Exposure to thoracic procedures was variable for all fellows including those in North America, and the majority of these cases were represented by pectus excavatum repair in North America and TEF repair in Uganda. In Uganda, pediatric lung malformations are rarely discovered due to the limited availability of prenatal ultrasound and variable training of ultrasonographers in detecting these lesions. Even symptomatic lung malformations are rarely diagnosed, as infections may be attributed to bacterial pneumonia, tuberculosis, or malaria; and tomographic imaging results in substantial monetary cost for families.

The Ugandan fellows performed 4 to 6 times the number of nephrectomies for Wilm's tumor as North American fellows. The Ugandan regional hospital has a multidisciplinary pediatric tumor board that meets weekly to discuss all pediatric oncology cases. While not reflected in this data set, our team has noted that patients often present with extremely large and aggressive Wilm's tumors, and previous studies have shown biological differences in Wilm's tumors of Kenyan children.[23] Uganda follows the protocol for treatment of Wilm's tumor as defined by the International Society of Paediatric Oncology, and therefore patients receive chemotherapy before surgery. Despite pretreatment with standard chemotherapy, many tumors remain large and can invade into the retroperitoneum or adjacent organs. Again, these represent particularly challenging cases in the setting of inadequate supply of blood products and difficult operative exposure secondary to limited retractors, instruments and lighting, as well as the absence of a postoperative intensive care team at the end of the case.

Critical Care Availability in North America

North American fellows had greater experience with congenital diaphragmatic hernia, ECMO cannulations, and central venous catheter placement. This is a reflection of access to the highest levels of critical care including the material and human resources required for conventional ventilation, oscillatory ventilation, ECMO, total parenteral nutrition, and other modalities used in the care of these children.[24] It is also strongly influenced by access to prenatal care and routine screening that identify congenital anomalies and allow for multidisciplinary coordination of care and plan for delivery in a tertiary care center. Prenatal ultrasound is limited in Uganda and the accuracy is variable.[18] Therefore, most congenital anomalies are discovered after birth. Babies who are born in Uganda with immediately life-threatening anomalies are not stabilized for surgical intervention because most are not born in a facility offering even

rudimentary pediatric critical care or surgical care.[21,25] Hospitals that do provide pediatric services have limited conventional ventilators and no ECMO or oscillatory ventilators.[26]

Opportunities for Exchange

There is a surgical workforce crisis in sub-Saharan Africa and other low- and middle-income countries (LMICs), leaving billions of people without access to surgical care.[27] Children constitute approximately half of the population in these countries, necessitating training of local pediatric surgeons. Conversely, there is evidence that the number of North American pediatric surgery graduates is exceeding population growth and that in the near future, supply of pediatric surgeons in North America will exceed the demand.[7] Therefore, from a workforce perspective, it makes sense to offer training opportunities to candidates from LMICs.

By analyzing case logs, we have shown that Ugandan pediatric surgery trainees have a wealth of experience with operative management of certain complex pediatric surgical conditions, such as anorectal malformations, Hirschsprung's disease, biliary atresia, TEF, and Wilm's tumors. In contrast, North American trainees have more experience with appendectomies, cholecystectomies, central lines, ECMO cannulation, and operative cases that require a high level of intensive care management. Therefore, by promoting bilateral opportunities for training exchange, both Ugandan and North American trainees could benefit from the opportunities provided by the opposite program.

Attending surgeons and trainees from high-income countries may discover that there is much to be learned in an environment with limited resources and lack of critical care. Surgeons in LMICs have learned to maximize the resources that are available, a skill that could benefit our surgical systems in high-income countries that generate a large amount of waste. In situations where traditional critical care is unavailable, surgeons are required to tap the fundamentals of their knowledge regarding human physiology in order the save the lives of their patients, and not just rely upon another colleague to take over care. This can be a valuable exchange of life-saving care for an LMIC patient and awakening of latent skills for the surgeon.

Of note, similar international exchange programs in which pediatric surgery fellows from SSA travel abroad for additional operative experience are documented in nearby countries (Kenya, Nigeria). We anticipate that similar opportunities for bilateral exchange exist at these sites as well.[28]

Rather than replacement or revision of a significant portion of any program's pediatric surgical education, we envision the creation of a dedicated trainee exchange rotation between an LMIC with adequate infrastructure and (especially) complementary case breadth and volume to that in North America. The faculty and fellows at each program would assume stewardship for the program's stability, relevance, and credibility. The ACGME already has an administrative precedent for such exchanges that utilizes a rotation review committee, although we believe that maximizing the autonomy and responsibility of the faculty and trainees in each program would maximize productivity and educational opportunities.[29]

Some North American pediatric surgeons have thoughtfully opposed the creation of international exchange rotations during fellowship, citing omnipresent concerns over the length of training, diminishing case volumes, need for standardization of content and quality in training, and fear that introduction of a global surgery rotation will ultimately diminish the North American fellow's short training experience.[30] However, our pediatric surgical colleagues in LMICs are performing complex operations in children, and their operative volumes exceed our own in North America. They are regularly performing these procedures in children with extremely challenging pathology under limited working conditions. We therefore submit that our LMIC colleagues have considerable value to offer in the educational process of our North American trainees.

CONCLUSIONS

We have demonstrated a considerable volume and breadth of procedural training opportunities available to Ugandan pediatric surgical fellows, and in particular, a large case volume of procedures for congenital anomalies and Wilm's tumors. Opportunities for training in pediatric and neonatal critical care and laparoscopy are currently lacking in Uganda, although these specialties and modalities are receiving increasing attention with specific interest in addressing the needs of LMICs.

In contrast, North American fellows have exposure to a high level of critical care and operative cases that are dependent on critical care. It is known that North American fellows graduate with a high level of competency in laparoscopic surgery. The disparities in case volumes, operative complexity, availability of pediatric critical care, and access to laparoscopy between North America and Uganda supports the growing sentiment that global training exchange programs may bilaterally enrich trainees' experiences and ultimately improve patient care for both populations.[31,32] Proper orchestration and study of such exchange opportunities is critical in order to ensure that these rotations obtain their

intended goals of improving trainees' access to valuable learning experiences.

REFERENCES

1. Toobaie A, Emil S, Ozgediz D, Krishnaswami S, Poenaru D. Pediatric surgical capacity in Africa: current status and future needs. *J Pediatr Surg*. 2017;52:843–848. PubMed PMID: 28168989.
2. College of Surgeons of East, Central and Southern Africa 2015. Available from: http://www.cosecsa.org/.
3. Elhalaby EA, Uba FA, Borgstein ES, Rode H, Millar AJ. Training and practice of pediatric surgery in Africa: past, present, and future. *Semin Pediatr Surg*. 2012;21:103–110. PubMed PMID: 22475115.
4. Chao TE, Mandigo M, Opoku-Anane J, Maine R. Systematic review of laparoscopic surgery in low- and middle-income countries: benefits, challenges, and strategies. *Surg Endosc*. 2016;30:1–10. PubMed PMID: 25875087.
5. Derbew M. Pediatric surgery in Eastern Africa: the unmet need. *J Pediatr Surg*. 2019;54:21–26. PubMed PMID: 30454942.
6. Robertson F, Mutabazi Z, Kyamanywa P, et al. Laparoscopy in Rwanda: a national assessment of utilization, demands, and perceived challenges. *World J Surg*. 2019;43:339–345. PubMed PMID: 30232568.
7. Nakayama DK. Workforce issues in pediatric surgery. *Am Surg*. 2017;83:660–665. PubMed PMID: 28637571.
8. (ACGME). ACGME Program Requirements for Graduate Medical Education in Pediatric Surgery. 2018 February 4, 2018. Report No.
9. Tina Thomas RR, Ballard T, William J, Pozehl AC, Peter FE. ACGME case requirements for general surgeons in pediatric surgery: evaluation of current operative volume on resident completion of index cases. *J Am Coll Surg*. 2015;221:1.
10. Ricketts TC, Adamson WT, Fraher EP, et al. Future supply of pediatric surgeons: analytical study of the current and projected supply of pediatric surgeons in the context of a rapidly changing process for specialty and subspecialty training. *Ann Surg*. 2017;265:609–615. PubMed PMID: 27280514.
11. Fingeret AL, Stolar CJ, Cowles RA. Trends in operative experience of pediatric surgical residents in the United States and Canada. *J Pediatr Surg*. 2013;48:88–94. PubMed PMID: 23331798.
12. Behr CA, Hesketh AJ, Akerman M, Dolgin SE, Cowles RA. Recent trends in the operative experience of junior pediatric surgical attendings: a study of APSA applicant case logs. *J Pediatr Surg*. 2015;50:186–190. PubMed PMID: 25598121.
13. Bruns NE, Shah MA, Dorsey AN, Ponsky TA, Soldes OS. Pediatric surgery - a changing field: national trends in pediatric surgical practice. *J Pediatr Surg*. 2016;51:1034–1038. PubMed PMID: 26987709.
14. COSECSA. Regulations and syllabus relating to fellowship examination in paediatric surgery 2016. Available from: http://www.cosecsa.org/sites/default/files/FCSpaed%20Regulations%20%26%20syllabus%202016.pdf.
15. State House Uganda2018. Available from: https://www.statehouse.go.ug/.
16. College of Surgeons of East, Central and Southern Africa Global Surgery Map 2015. Available from: http://www.cosecsa.org/global-surgery-map.
17. Nolens B, Lule J, Namiiro F, van Roosmalen J, Byamugisha J. Audit of a program to increase the use of vacuum extraction in Mulago Hospital, Uganda. *BMC Pregnancy Childbirth*. 2016;16:258. PubMed PMID: 27590680. Pubmed Central PMCID: 5010743.
18. Wesonga AS, Fitzgerald TN, Kabuye R, et al. Gastroschisis in Uganda: opportunities for improved survival. *J Pediatr Surg*. 2016;51:1772–1777. PubMed PMID: 27516176.
19. Muzira A, Kakembo N, Kisa P, et al. The socioeconomic impact of a pediatric ostomy in Uganda: a pilot study. *Pediatr Surg Int*. 2018;34:457–466. PubMed PMID: 29368076.
20. ACGME. National Data Report Pediatric Surgery Case Logs. 2015-2016.
21. Cairo S, Kakembo N, Kisa P, et al. Disparity in access and outcomes for emergency neonatal surgery: intestinal atresia in Kampala, Uganda. *Pediatr Surgery Int*. 2017;33:907–915. PubMed PMID: 28677072.
22. Fitzgerald T.Low-cost laparoscopic surgery with tele-mentoring 2018 [October 20, 2019]. Available from: https://bassconnections.duke.edu/project-teams/low-cost-laparoscopic-surgery-tele-mentoring-2018-2019.
23. Carter NH, Avery AH, Libes J, Lovvorn HN, Hansen EN 3rd. Pediatric solid tumors in resource-constrained settings: a review of available evidence on

management, outcomes, and barriers to care. *Children*. 2018;5. PubMed PMID: 30360527. Pubmed Central PMCID: 6262277.

24. Okafor UV. Challenges in critical care services in Sub-Saharan Africa: perspectives from Nigeria. *Indian J Crit Care Med*. 2009;13:25–27. PubMed PMID: 19881176. Pubmed Central PMCID: 2772254.

25. Badrinath R, Kakembo N, Kisa P, Langer M, Ozgediz D, Sekabira J. Outcomes and unmet need for neonatal surgery in a resource-limited environment: estimates of global health disparities from Kampala, Uganda. *J Pediatr Surg*. 2014;49:1825–1830. PubMed PMID: 25487493.

26. Sippel S, Muruganandan K, Levine A, Shah S. Review article: use of ultrasound in the developing world. *Int J Emerg Med*. 2011;4:72. PubMed PMID: 22152055. Pubmed Central PMCID: 3285529.

27. Meara JG, Leather AJ, Hagander L, et al. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet*. 2015;386:569–624. PubMed PMID: 25924834.

28. Ekenze SO, Onumaegbu OO, Nwankwo OE. The current status of international partnerships for child surgery in sub-Saharan Africa. *Int Surg*. 2014;99:616–622. PubMed PMID: 25216431. Pubmed Central PMCID: 4253934.

29. ACGME. International Rotations Review Committee for Obstretics and Gynecology2017. Available from: https://www.acgme.org/Portals/0/PFAssets/ProgramResources/220_International_Rotations.pdf?ver=2017-10-05-144717-587.

30. Tracy TF. Building the foundation for expert care and future contributions in pediatric surgery. *J Pediatr Surg*. 2017;52:2091–2092. PubMed PMID: 28943133.

31. Emil S, O'Neill J, Poenaru D. Let our fellows go: a plea for allowing global surgery electives during pediatric surgical training. *J Pediatr Surg*. 2017;52:2088–2090. PubMed PMID: 28947325.

32. Baird R, Pandya K, Lal DR, et al. Regarding global pediatric surgery training opportunities. *J Pediatr Surg*. 2018;53:1256–1258. PubMed PMID: 29605263.