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ORIGINAL ARTICLE

Ten Global Surgical Care Statements for Children: examining our commitment to the future

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Abstract

Background The lack of access to essential surgery for many of our world's children is a global health crisis. A third of all deaths in the pediatric population are due to surgical conditions. In low- and middle-income countries, an average of nine in ten children lack access to basic surgical care.

Methods This review examines ten commitment statements ratified by numerous global pediatric surgical organizations aimed at addressing existing gaps in global surgical care for children. They are substantiated by a review of literature and represent over-arching principles.

Results They prompt the recognition of childhood surgical disease as a global health priority and advocate for availability to safe surgical and anesthetic care. Calls to action highlight the importance of capacity building in the areas of education, data gathering, workforce, research, and international collaborations.

Discussion Eventually, there is the hope for widespread approval of the guiding principles they represent and that the statements themselves, as encapsulations of these beliefs, may act as a continued call for advocacy and action for the necessary work, resources, and funding to mitigate global pediatric surgical disparities.

Keywords Pediatric · Surgery · Global · Equity · Health disparity · Access to care · Global health

Introduction

Surgical conditions are responsible for nearly one-third of global burden of disease [1, 2]. Yet, despite being identified as an essential part of primary healthcare, today an estimate of five billion people lack access to safe and affordable surgical and anesthetic care [2–4]. This surgical disparity reflects social inequities and its burden is borne most heavily by the world's poor. This is widespread across high-income countries (HICs) and in low- and middle-income countries (LMICs) alike. Strikingly in LMICs, nine in ten people do not have access to basic surgical care [5]. Additionally, in the world's poorest countries, children can represent up to 50–60% of the population making pediatric surgery an especially critical area of need [6–8].

Over the years, many individuals and organizations have compassionately and responsibly provided surgical and anesthetic care to thousands of LMIC children. Academic partnerships have formed, and generous funding has flowed, all with commendable aims to improve the health of children globally. However, despite projects and ventures, each with one or more specific mandates, geared to ameliorate the

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myriad of problems afflicting the provision of global surgical care of children, there is a seeming lack of over-arching principles to guide such endeavors.

Ten commitment statements—the Global Surgical Care for Children Commitment Statements—reflecting and encapsulating the ideals of global surgical care for children, were composed by two paediatric surgeons along with advice from a number of organizations engaged in various aspects of global pediatric surgery [9, 10]. These statements have been brought before many internationally prominent pediatric surgical organizations and their respective international or global committees for discussion. There has been general concurrence by each organization with formal ratification where possible. These organizations include the: Global Initiative for Children's Surgery (GICS), Canadian Association of Pediatric Surgeons (CAPS), American Pediatric Surgical Association (APSA), British Association of Pediatric Surgeons (BAPS), Pacific Association of Pediatric Surgeons (PAPS), and World Federation of Associations of Pediatric Surgeons (WOFAPS) [7, 11–15].

Each statement, it may be argued, is right and true on a prima facie basis; yet, our aim in this paper is to provide corroboration and brief comment supportive of each statement. The statements may stand as both warrants and tenets for individuals, organizations and governments—indeed any who are involved or have interest in the delivery of surgical care for children globally—to commit to action.

Global Surgical Care for Children Commitment Statements

1. To advocate for the recognition that childhood surgical disease, whether of congenital, acquired or traumatic etiology, is an important global health issue.

Children can represent 50–60% of the population in the world's poorest countries and an estimated 90% of people in LMICs do not have access to basic surgical care [5–7]. Surgical conditions in children account for a third of all childhood deaths around the world [5, 16]. The importance of pediatric surgical care is striking when considering the need for surgical care over the course of a child's life. One recent study examining the epidemiology of pediatric surgical needs in LMICs found that 19% of children had a surgical need. In countries such as Rwanda, Sierra Leone, Nepal and Uganda, up to 85% of children by age 15 will experience a surgically treatable condition [17].

Trauma is a significant area of need in pediatric surgery. Globally for children over the age of one, injury has been reported as the leading cause of death [8, 18, 19]. Congenital conditions also account for significant disease burden in pediatric populations with 2.6 million children born every year with conditions requiring surgical care including cleft lip and palate, hernias, anorectal malformations, spina bifida, clubfoot, among others [8, 20].

2. To support efforts to improve the availability of and access to safe, competent surgical and anesthetic care for all children of the world and that no child be denied necessary surgical care because of prejudice or for want of payment.

Distinct from adult surgery, pediatric surgery must take into account fundamental anatomic and size differences, physiologic change throughout stages of development, and implications for a child's future growth potential. Despite the significant need for pediatric expertise in the delivery of surgical care to children, there continues to be a severe shortage of pediatric surgeons in many regions of the world. Along with this, there is an estimated 1.7 billion of the world's children who lack access to appropriate anesthetic care [21]. Deficiencies are highlighted in sub-Saharan Africa where safe and affordable surgery cannot be accessed by 94% of the population. In Uganda, a country with a population of 43 million, there are currently only about a half dozen of fully trained practising pediatric surgeons [22]. In more than half of the countries in continental Africa, there is no full-time pediatric surgeon available, highlighting the critical mismatch between public need and level of services available [6, 23, 24].

However, the health economics of surgical care is compelling. Recent evidence reveals that providing surgery is highly cost-effective [25]. The Third Edition of Disease Control Priorities found a 10:1 economic benefit-to-cost ratio, a basis to advocate for early inclusion of surgery within Universal Health Coverage [26]. Further economics research has ranked essential surgical procedures among the most cost-effective health interventions to improve welfare of the world's poor [2, 27–29].

The lack of government investment in surgical training is an area of echoed importance through analyses conducted in the Lancet Commission Global Surgery 2030 [8]. This report recommended a ratio of 40 surgeons for every 100,000 people which stands in stark contrast to the current ratio in areas, such as East, Central, and Southern Africa, with 0.53 surgeons per 100,000 people, 85% of which serve 15% of the urban population [8]. This makes the case for government-level funding schemes as well as partnerships that build the clinician workforce, including remote care, in LMICs.

3. To promote global standards for the performance of safe pediatric surgical and anesthetic practice.

Lack of surgical safety continues to be responsible for intra-operative and peri-operative deaths. While precise statistics for global pediatric mortality are difficult to obtain with a paucity of data, worse peri-operative outcomes are seen in LMIC settings where measured [30, 31]. Cheung's study of 2090 children in Uganda found peri-operative

mortality as high as 15% in children with congenital anomalies [32]. Torborg's recent study in South Africa of 2024 children found an overall post-operative complication rate of 9.7%, with 7.3% secondary to infection. There was an in-hospital mortality of 1.1% (a rate 10 times higher than HICs) [33]. Another study of 6005 children in Kenya found 7-day peri-operative mortality rates of 3.7% in primary hospitals and 2.4% in tertiary hospitals (Newton).

Worse outcomes in pediatric anesthesia and surgery are connected to neonatal surgery, severity of disease, infective indication for surgery, and urgency of surgery, all of which often occur at higher rates in low resource settings. Many of these are significant surgical morbidities that are preventable [21, 34, 35]. In efforts to address this ongoing issue, the World Health Organization (WHO) launched the World Alliance for Patient Safety in 2004. They identified four areas where dramatic improvements in the safety of surgical care could be made: surgical-site infection prevention, safe anesthesia, safe surgical teams, and measurement of surgical services [35]. The WHO Safe Surgery Saves Lives program places heavy emphasis on reduction of anesthetic risk [36]. The establishment of blood donation programs and blood banks should be made a priority [37]. Local government, local institutions, and institutions in HICs may work in partnership to address the shortage in available training for pediatric surgeons, anesthetists, and anesthetic nurses.

A nineteen-item safe surgery checklist was developed as part of the Second Global Patient Safety Challenge "Safe Surgery Saves Lives" in recognition of the success of checklists in preventing human error and patient harm both in and out of the operating room [35, 38]. The items on the checklist add a layer of safety in procedural technique, equipment integrity, medication availability, and improves teamwork and communication [35, 36]. Much work remains in the area of surgical safety with local programming and execution at the core of impact on patient care. Operating on children brings with it special challenges but the practice of pediatric surgery anywhere must be in step with the modern trends of surgical safety without exceptions [39].

4. To encourage the development of surgical patient records and registries in all healthcare jurisdictions in order that treatments and outcomes may be carefully monitored and result in improved care.

Data collection and analysis is imperative, yet in many LMICs, data collection poses unique challenges. Most LMICs lack a reliable national database of adverse outcomes and causes of death (COD) [40, 41]. Basic documentation requires data on age, gender, and identified disease or pathology—key information that reveals important demographic and pathological data on a population's health.

The lack of documented information on adverse outcomes in pediatric surgery as well as the absence of standardized reporting processes creates difficulties in crafting targeted solutions to reduce intra- and post-operative deaths [42–44]. The peri-operative mortality rate (POMR), defined as the number of deaths during or after surgery divided by the total number of procedures performed, has been widely used in HICs and extensively cited as an effective indicator for surgical safety institutionally and nationally. The Lancet Commission on Global Surgery recommends using POMR as one of six key indicators to assess the strength a country's surgical system [45]. POMR shows promise as a simple and effective metric for tracking adverse outcomes in LMICs [45, 46].

5. To focus on relevant research carried out in resource-constrained settings and primarily led by individuals who work in those settings, to determine the unique needs and potential context-specific innovations that can improve the care of children with surgical problems.

Despite the need to better understand surgery within global health and resource-constrained settings, only 4.1% of global health research is surgical and 4.3% of that surgical research worldwide is relevant to underserviced populations [2, 47]. The limitations of surgical research in LMICs are multifactorial and surgeons hoping to contribute to global research can face systemic barriers [2]. Among the most commonly cited reasons are the absence of a culture of research, lack of research training, challenges with data management, lack of funding, and lack of protected time for research [2, 48].

Limited research from LMICs and underserviced populations globally addressing surgical and anesthetic care for children limits the understanding of pediatric surgical conditions in these settings and factors relating to healthcare disparities [49]. Challenges to both the quantity and quality of research in LMICs are "compounded by poor accessibility of research that does not exist and limited dissemination of research findings" [49]. Further limits that hinder development include access to funding, mentors in research, electronic access, strong research networks, and proficiency in English, French, Spanish, Portuguese, Italian, or other mainstream languages of publication [6]. Research is core to advocacy efforts which inform the public and policy-makers about pediatric surgical conditions that have significant impacts on the morbidity and mortality of a child [49].

Recommendations to enable pediatric surgical research in LMICs include free access to peer-reviewed journals, coordinated efforts by international agencies, such as WHO and UNICEF, to lead global data collection, and increase research capacity through research education, partnerships, and funding [49, 50].

6. To commit to the formation and support of international collaborations which can help define problems and develop solutions to local pediatric surgical needs.

Humanitarian efforts in pediatric surgery span disaster relief, short-term surgical missions, and long-term projects, such as the development of pediatric specialty

hospitals and long-standing academic partnerships between LMIC and HIC institutions [46]. Each model holds distinct roles in meeting global pediatric surgical need and possesses collaborative strengths and drawbacks.

Médecins Sans Frontiéres (MSF) and International Committee of the Red Cross (ICRC) are foremost examples of disaster relief organizations specially equipped for crisis settings and rapid deployment. The limits of this model by nature of its unstructured rapid execution include a lack of capacity building and training of local providers [46].

Short-term missions are exemplified by specialty services, such as Smile Train and Operation Smile, which perform thousands of cleft lip and palate repairs annually. There remains controversy in efficacy, cost effectiveness, and sustainability in short-term missions [46]. Kynes highlighted that the benefit from efforts to integrate training into missions may be neutralized by the disadvantage of stressors on local infrastructure and distortion of local health markets. Stressors on local infrastructure results from disharmony created by short-term, siloed goals and lack of coordination with existing structures which can disrupt local funding and human resource flow. Lack of harmonization from multiple organizations operating in the same area with duplicated effort is a commonly observed inefficiency. The 'mission' method is still deemed among the most inefficient and costly methods of service delivery. However, projects, such as periodic HIC-LMIC, partnered team surgical camps held in LMIC locales do provide some needed surgical services, short-term training opportunities and, perhaps most significantly, can engender even closer collaborations and friendships between HIC and LMIC personnel [51].

Historically, foreign aid has created siloed healthcare operations with little connection to primary care and referral services. The Lancet Commission emphasizes the importance of capacity building that equips local providers to deliver quality, affordable care and an investment in local education and training as key priorities in global surgery. The model of equal partnerships between academic institutions of HICs and LMICs can show meaningful reciprocal learning, mentorship, and improvement in the quality of surgical education and healthcare delivery in both settings [52]. This is illustrated by the Global Partners in Anesthesia and Surgery (GPAS) where a sustainable model of partnership between North America and Uganda has resulted in increased local training, workforce expansion, an annual research conference, and cross-sector collaborations in Uganda [53]. Collaborations between HIC and LMIC academic institutions have received much support; however, collaborations amongst and within LMICs, especially between settings facing similar challenges show promise and should not be overlooked.

7. To enhance communication and collaboration amongst all those in the world who are devoted to the surgical care of children, irrespective of national or political borders, in efforts to improve the health of all children through shared research, shared training and shared support.

Improving access to global surgery is shifting toward a multi-country and multi-sector approach. This is shown in the formation of the Lancet Commission on Global Surgery in 2014 bringing together advisors and collaborators from over 110 countries across six continents.

The Global Initiative for Children's Surgery (GICS) was established in 2016 to bring together surgical expertise from low-income countries for shared learning and defining the optimum resource requirements of health facilities to provide pediatric surgical care at the primary, secondary, tertiary, and national referral levels [7, 13]. This collaboration aims to address previously overlooked pediatric surgical issues through engaging health, advocacy, and policy experts within LMICs. In their most recent 4th meeting, 225 providers of children's surgical care (including nurses, anesthesiologists, and multiple surgical subspecialists) from 44 countries attended, with 75% representing LMICs. The outcomes include prioritized needs and solutions for infrastructure, service delivery, training, and research. The Optimal Resources for Children's Surgery document created by GICS includes recommendations for human and equipment needs across all defined areas of children's surgery [7]. Ongoing projects are widespread including equipping operating rooms, training adult general surgeons or general practitioner surgeons in pediatric surgery, and creating international databases [54].

The Global Pediatric Surgical Network (GPSN) founded in 2010 was established to connect surgical subspecialty organizations for harmonization of efforts between independent groups working toward a common goal. In 2017, GPSN joined with GICS in collaborative effort. An important leading organization for connecting needs with resources is InterSurgeon [55]. Disharmony from duplicated efforts and inefficiencies are frequently observed from projects unaware of the work of surrounding projects [46]. InterSurgeon connects groups and offers guidance for project success in global surgery. They enable collaborations ranging from the inclusion of partners in the design and delivery of training curricula to clinical care and sharing of equipment and resources.

The complexities of addressing the global shortage of pediatric surgical care require coordinated work irrespective of national or political borders, although local commitment from politicians and government are essential to success.

8. To encourage educational initiatives that can improve the quality of surgical and anesthetic care of all children.

Education initiatives that further the training of local providers and build capacity to improve the quality of surgical and anesthetic care overtime include equal sustainable partnerships between academic institutions of LMICs and HICs

and also those within LMICs [2, 13, 52]. There exists formidable systemic and financial barriers to the development of an academic surgeon [56]. Despite well-meaning partnerships, the majority of publications from HIC and LMIC academic partnerships remain credited to authors from HICs [57]. This is in part a result of some barriers explored in statement six. Much work remains in addressing implicit biases when HIC institutions work in partnership with LMICs to create truly equal goals, partnerships, and outcomes. A key question that remains is how funding in these inter-facility collaborations can be sustained into the future. Examples of existing pediatric surgical education efforts include surgical resident exchange programs between HICs and LMICs; at times referred to as 'North–South' programs with inherent asymmetries, and the possibly more symmetric 'South–South' collaboratives between institutions, countries or facilities in the similar contexts of resource and training needs allowing the propagation of training in both global and local contexts [58]. There is an increased need for programs, such as WHO's Special Programme for Research and Training in Tropical Diseases (TDR), which offers educational grants and project funding to students and early-career physicians [59]. As global surgical development becomes a global health priority, surgical perspectives must include the importance of academia and equal partnerships in the global health dialogue [56].

9. To facilitate the provision of quality surgical and anesthetic care as close to where the child and family reside as possible, and thus assist in the necessary surgical and anesthetic education and training of local and regional health care workers to provide such care.

The ideal model of health care reform would see timely surgical care for children provided in a local setting and afford adequate post-operative follow-up [60]. The Lancet Commission Global Surgery 2030 core indicators includes a goal of 80% coverage of populations to Bellwether Procedures (laparotomy, open fracture treatment, and caesarean deliveries) within 2 h [4]. However, pediatric surgery even in many HIC with higher proportions of surgeons to population is restricted to major urban centres [61]. For example, many geographically distant communities in rural Canada—an HIC—lack the necessary infrastructure to provide full, timely access to care [62]. This further emphasizes the challenge in rural and remote regions in LMICs where often there are very few pediatric surgeons serving an entire country. This is compounded by the financial barrier of transportation, food, and lodging required to access care [2, 63]. Both an increase in government support and collaborative community leadership are needed to improve surgeon allocation, retention, and sustainable service infrastructure [64].

10. To foster efforts to increase and retain the pediatric surgical, anesthetic, nursing and health care provider workforce in nations where such a workforce is deficient.

An estimate of 30% of the world's population receives 73.6% of the world's surgical procedures and the poorest one-third receive only 3.5% of all surgeries [65]. The disparities of health, wealth, and the availability of essential pediatric surgery are wide. Particularly concerning are the eastern, central, and southern African regions where there are only 52 pediatric surgeons in total, averaging 1 pediatric surgeon per 7 million people [8]. Thus, pediatric surgeries in LMICs face a triple burden of increased disease prevalence, a shortage of pediatric surgeons and healthcare staff, and access issues for rural and remote populations.

The need for increased scientific research and implementation of surgical training in LMICs is clear. However, the concept of 'brain drain' is one commonly cited in the narrative of physicians and scientists in LMICs [66]. The migration of health workers in our increasingly globalized world from lower to high resource settings is amongst the most controversial of issues [67]. Countries without the resources for surgical fellowships, PhD programs, or advanced technical courses send trainees abroad, often in partnership with HIC academic institutions with the expectation that trainees would return to their country of origin to offer their skills. Migration patterns, however, indicate that many of these scholars choose to stay in HICs where there are increased opportunities and improved quality of life for themselves and their families [68, 69]. This phenomenon creates a shortage of healthcare workers in the 'donor' country and fosters dependence on foreign healthcare professionals in the 'recipient' country. As an issue in pediatric surgery this, at present, remains somewhat ill-defined but is still viewed as a threat, either current and real or potential.

In an attempt to find solutions to this global dilemma, the WHO created a Global Code of Practice on the International Recruitment of Health Personnel in 2010 [70]. This document outlines an ethical framework for the recruitment of healthcare professionals and offers guidance for bilateral agreements between member states when accepting international trainees [68]. Although this policy document helps mitigate the issue to an extent, the ultimate solution lies in creating sustainable training programs in LMICs [68].

Conclusion

Despite strong evidence supporting access to essential pediatric surgery as a public health priority and the identification of surgery as one of the most cost-effective health interventions with a benefit-to-cost ratio of 10:1, pediatric surgery remains inaccessible to many children globally. Approximately, 90% of children in LMICs cannot access essential surgery with extreme deficiencies in the surgical care workforce [70].

Core to our solution is the will of local policy-makers and government to prioritize this critical global health issue. Actionable steps include:

1. Investment in local pediatric surgery and anesthesiology training and retention infrastructure in both urban and rural settings.
2. Increased resources and opportunities for data gathering, research, and innovation in equitable partnerships between HICs and LMICs, and within LMICs.
3. Prioritizing the development of local and national surgical registries including cause of death data, adverse surgical outcomes, and the establishment of safe standards.
4. Investment into multi-sector international collaborations that address access to pediatric surgery.
5. Working alongside individuals, organizations, and governments to commit to building and sustaining long-term solutions in pediatric surgery.

Improving surgical access for children globally is shifting toward a multi-country, multi-sector approach with sustainable and equal partnerships which will build local surgical, research, and infrastructure capacity. In all grand ventures, over-arching guiding principles should be known and agreed to by multiple stakeholders. The Global Surgical Care for Children Commitment Statements could be such needed counsel for action for those individuals and groups who seek to ensure the health and welfare of the world's most vulnerable citizens.

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Declarations

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Ethical approval This article does not contain any studies with human participants or animal participants performed by any of the authors.

References

1. Shrime MG, Bickler SW, Alkire BC, Mock C (2015) Global Burden of Surgical Disease: an estimation from the provider perspective. Lancet Glob Health 3:S8–S9
2. Ng-Kamstra JS, Greenberg SLM, Fizan A, Vanda A, Anderson GA, Matchecane C, Ainhoa C-C et al (2016) Global Surgery 2030: a roadmap for high income country actors. BMJ Glob Health 1:e000011
3. Mahler H (1980) Surgery and Health for All (1980). https://www.who.int/surgery/strategies/Mahler1980speech.pdf?ua=1
4. Meara JG, Greenberg SL (2015) The Lancet Commission on Global Surgery Global surgery 2030: evidence and solutions for achieving health, welfare and economic development. Surgery 157:834–835
5. Meara JG, Leather AGM, Hagander L, Alkire BC, Alonso N, Ameh EA, Bickler SW et al (2015) Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. Lancet 386:569–624
6. Butler MW, Ozgediz D, Poenaru D, Ameh E, Andrawes S, Azzie G, Borgstein E et al (2015) The global paediatric surgery network: a model of subspecialty collaboration within global surgery. World J Surg 39:335–342
7. Goodman LF, St-Louis E, Yousef E, Cheung M, Ure B, Ozgediz D, Ameh EA et al (2018) The Global Initiative for Children's Surgery: optimal resources for improving care. Eur J Pediatr Surg 28:51–59
8. Derbew M (2019) Pediatric surgery in Eastern Africa: the unmet need. J Pediatr Surg 54:21–26
9. Blair G, Youngson G (2017) Personal communication
10. Baird R, Pandya K, Lal DR, Calkins CM, Oldham KT, Tsai A, Naik-Mathuria B, St-Louis E, Luc MK, LaRusso K, Petroze R (2018) Regarding global pediatric surgery training opportunities. J Pediatr Surg 53:1256–1258
11. Boix-Ochoa J, Sigalet D (2020) History of WOFAPS, history of WOFAPS (1963–2019). Pediatr Surg Int 36:541–550
12. The Canadian Association of Paediatric Surgeons (2020) https://www.caps.ca/
13. Lakhoo K, Youngson G (2018) Global paediatric surgery: meeting an unmet need—the response of the British Association of Paediatric Surgeons. Pediatr Surg Int 34:1369–1373
14. Young DG (2009) American Pediatric Surgical Association (APSA) a history of surgical paediatrics 569–570. https://www.worldscientific.com/doi/abs/10.1142/9789812772282_0037
15. Miyano T, Campbell JR (2009) Pacific Association of Pediatric Surgeons (PAPS) a history of surgical paediatrics 606–623. https://www.worldscientific.com/doi/abs/10.1142/9789812772282_0045.
16. Bickler SW, Kyambi J, Rode H (2001) Pediatric surgery in Sub-Saharan Africa. Pediatr Surg Int 17:442–447
17. Butler EK, Tran TM, Nagarajan N, Canner J, Fuller AT, Kushner A, SOSAS 4 Country Research Group et al (2017) Epidemiology of pediatric surgical needs in low-income countries. PLoS One 12. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0170968
18. Murray CJL, Lopez AD (1996) The Global Burden of Disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Harvard University Press, Cambridge
19. Bradshaw CJ, Bandi AS, Muktar Z, Hasan MA, Chowdhury TK, Banu T, Hailemariam M, Ngu F, Croaker D, Bankolé R, Sholadoye T (2018) International study of the epidemiology of paediatric trauma: PAPSA Research Study. World J Surg 42:1885–1894
20. Wu VK, Poenaru D, Poley MJ (2013) Burden of surgical congenital anomalies in Kenya: a population-based study. J Trop Pediatr 59:195–202
21. Cooper MG (2020) Global safe pediatric anesthesia care. Anesthesiology 132:413–415
22. Blair G (2020) Personal correspondence. Vancouver
23. Elhalaby EA, Uba FA, Borgstein ES, Rode H, Millar AJ (2012) Training and practice of pediatric surgery in Africa: past, present, and future. Semin Pediatr Surg 21:103–110

24. Chirdan LB, Ameh EA, Abantanga FA, Sidler D, Elhalaby EA (2010) Challenges of training and delivery of pediatric surgical services in Africa. J Pediatr Surg 45:610
25. Smith ER, Concepcion TL, Niemeier KJ, Ademuyiwa AO (2019) Is global pediatric surgery a good investment? World J Surg 43:1450–1455
26. Mock CN, Donkor P, Gawande A, Jamison DT, Kruk ME, Debas HT (2015) Essential surgery: key messages from disease control priorities. Lancet 385:2209–2219
27. OutcomelCopenhagen Consensus Center. [Cited March 29 2019]. https://www.copenhagenconsensus.com/copenhagen-consensus-iii/outcome
28. LeBrun DG, Chackungal S, Chao TE, Knowlton LE, Linden AF, Notrica MR, Solis CV, McQueen KAK (2014) Prioritizing Essential Surgery and Safe Anesthesia for the Post-2015 Development Agenda: operative capacities of 78 district hospitals in 7 low- and middle-income countries. Surgery 155:365–373
29. Eeson G, Birabwa-Male D, Pennington M, Blair GK (2015) Costs and cost-effectiveness of pediatric inguinal hernia repair in Uganda. World J Surg 39:343–349
30. Newton MW, Hurt SE, McEvoy MD, Shi Y, Shotwell MS, Kamau J, Nabulindo S, Ngumi ZW, Sandberg WS, Sileshi B (2020) Pediatric perioperative mortality in Kenya: a prospective cohort study from 24 hospitals. Anesthesiology 132:452–460
31. Barbour RD (2017) Paediatric anaesthesia for low-resource settings. Bja Educ 17:351–356
32. Cheung M, Kakembo N, Rizgar N, Grabski D, Ullrich S, Muzira A, Ozgediz D (2019) Epidemiology and mortality of pediatric surgical conditions: insights from a tertiary center in Uganda. Pediatr Surg Int 35:1279–1289
33. Torborg A, Cronje L, Thomas J, Meyer H, Bhettay A, Diedericks J, Cilliers C, Kluyts H, Mrara B, Kalipa M, Rodseth R (2019) South African Paediatric Surgical Outcomes Study: a 14-day prospective, observational cohort study of paediatric surgical patients. Br J Anaesth 122:224–232
34. Gonzalez LP, Pignaton W, Kusano PS, Modolo NSP, Braz JRC, Braz LG (2012) Anesthesia-related mortality in pediatric patients: a systematic review. Clinics 67:381–387
35. World Health Organizations (2007) World Alliance for Patient Safety. Second Global Patient Safety Challenge: safe surgery saves lives in World Health Organization. World Health Organization, Geneva
36. Safety WP (2009) World Health Organization guidelines for safe surgery: 2009: safe surgery saves lives. Vol. no. WHO/IER/PSP/2008.08-1E
37. Sood R, Raykar N, Till B, Shah H, Roy N (2018) Walking blood banks: an immediate solution to rural India's blood drought. Indian J Med Ethics 3:134–137
38. Hales BM, Pronovost PK (2006) The checklist—–a tool for error management and performance improvement. J Crit Care 21:231–235
39. Oak SN, Garasia MB, Parelkar SV (2015) Surgical checklist application and its impact on patient safety in pediatric surgery. J Postgrad Med 61:92–94
40. Jha P (2014) Reliable direct measurement of causes of death in low- and middle-income countries. BMC Med 12:19
41. Garber K, Cabreram CCR, Dinh QL, Gerstle JT, Holterman A, Millano L, Muma NJ, Nguyen LT, Tran H, Tran SN (2019) The heterogeneity of global pediatric surgery: defining needs and opportunities around the world. World J Surg 43:1404–1415
42. Wesonga A, Situma M, Lakhoo K (2020) Reducing gastroschisis mortality: a quality improvement initiative at a Uganda Pediatric Surgery Unit. World J Surg 44:1395–1399
43. Toobaie A, Emil S, Ozgediz D, Krishnaswami S, Poenaru D (2017) Pediatric surgical capacity in Africa: current status and future needs. J Pediatr Surg 52:843–848
44. Krishnaswami S, Nwomeh BC, Ameh EA (2016) The pediatric surgery workforce in low-and middle-income countries: problems and priorities. Semin Pediatr Surg 25:32–42
45. Ng-Kamstra JS, Arya S, Greenberg SL, Kotagal M, Arsenault C, Ljungman D, Yorlets RR, Agarwal A, Frankfurter C, Nikouline A, Lai FYX (2018) Perioperative mortality rates in low-income and middle-income countries: a systematic review and meta-analysis. BMJ Glob Health 3. https://gh.bmj.com/content/3/3/e000810.abstract
46. Kynes JM, Zeigler L, McQueen K (2017) Surgical outreach for children by international humanitarian organizations: a review. Children 4:53
47. Sullivan R (2015) Global Surgery 2030: The State of Research. In: North American Launch of the Lancet Commission of Global Surgery. Boston, MA
48. Elliott IS, Sonshine DB, Akhavan S, Shantz AS, Caldwell A, Shantz JSS, Gosselin RA, Coughlin RR (2015) What factors influence the production of orthopaedic research in East Africa? A qualitative analysis of interviews. Clin Orthop Relat Res 473:2120–2130
49. Greenberg SL, Ng-Kamstra JS, Ameh EA, Ozgediz DE, Poenaru D, Bickler SW (2016) An investment in knowledge: research in global pediatric surgery for the 21st century. Semin Pediatr Surg 25:51–60
50. Poenaru D (2016) The burden of pediatric surgical disease in low-resource settings: discovering it, measuring it, and addressing it. J Pediatr Surg 51:216–220
51. Blair GK, Duffy D, Birabwa-Male D, Sekabira J, Reimer E, Koyle M, Hudson GR, Stanger J, Langer M, Eeson G, Gan H (2014) Pediatric surgical camps as one model of global surgical partnership: a way forward. J Pediatr Surg 49:786–790
52. Cadotte DW, Blankstein M, Bekele A, Dessalegn S, Pain C, Derbew M, Bernstein M, Howard A (2013) Establishing a surgical partnership between Addis Ababa, Ethiopia, and Toronto, Canada. Can J Surg 56:E19–E23
53. Lipnick M, Mijumbi C, Dubowitz G, Kaggwa S, Goetz L, Mabweijano J, Jayaraman S, Kwizera A, Tindimwebwa J, Ozgediz D (2013) Surgery and anesthesia capacity-building in resource-poor settings: description of an ongoing academic partnership in Uganda. World J Surg 37:488–497
54. (2019) Global Initiative for Children's Surgery: a model of global collaboration to advance the surgical care of children. World J Surg 43:1416–1425. https://link.springer.com/article/10.1007/s00268-018-04887-8
55. InterSurgeon (2020) [cited 2020 December 11]. https://intersurgeon.org/
56. Calland JF, Petroze RT, Abelson J, Kraus E (2013) Engaging academic surgery in global health: challenges and opportunities in the development of an academic track in global surgery. Surgery 153:316–320
57. Elobu AE, Kintu A, Galukande M, Kaggwa S, Mijjumbi C, Tindimwebwa J, Roche A, Dubowitz G, Ozgediz D, Lipnick M (2014) Evaluating International Global Health Collaborations: perspectives from surgery and anesthesia trainees in Uganda. Surgery 155:585–592
58. Riviello R, Ozgediz D, Hsia RY, Azzie G, Newton M, Tarpley J (2010) Role of collaborative academic partnerships in surgical training, education, and provision. World J Surg 34:459–465
59. Käser M, Maure C, Halpaap BM, Vahedi M, Yamak S, Launois P, Casamitjana N (2016) Research capacity strengthening in low and middle income countries—an evaluation of the WHO/TDR career development fellowship programme. PLoS Negl Trop Dis 10:e0004631
60. Ozgediz D, Chu K, Ford N, Dubowitz G, Bedada AG, Azzie G, Gerstle JT, Riviello R (2011) Surgery in global health delivery. Mt Sinai J Med J Transl Pers Med 78:327–341

61. Sevean P, Dampier S, Spadoni M, Strickland S, Pilatzke S (2009) Patients and families experiences with video Telehealth in rural/remote communities in Northern Canada. J Clin Nurs 8:2573–2579
62. Caron NR, Pinney SJ (2011) Surgery in rural Canada: challenges and possible solutions. Rural surgery. Springer, Berlin, pp 7–14
63. Shrime MG, Dare AJ, Alkire BC, O'Neill K, Meara JG (2015) Catastrophic expenditure to pay for surgery worldwide: a modelling study. Lancet Glob Health 3:S38–S44
64. Baker DK (2009) Rural surgery in Canada. World J Surg 30:1632–1633
65. Bickler SW, Spiegel DA (2008) Global surgery—defining a research Agenda. Lancet 372:90–92
66. Hutch A, Bekele A, O'Flynn E, Ndonga A, Tierney S, Fualal J, Samkange C, Erzingatsian K (2017) The Brain Drain Myth: retention of specialist surgical graduates in East, Central and Southern Africa, 1974–2013. World J Surg 41(12):3046–3053
67. Cometto G, Tulenko K, Muula AM, Krech R (2013) Health Workforce Brain Drain: from denouncing the challenge to solving the problem. PLoS Med 10:e1001514
68. Aluttis C, Bishaw T, Frank MW (2014) The workforce for health in a globalized context—global shortages and international migration. Glob Health Action 7. https://www.tandfonline.com/doi/full/10.3402/gha.v7.23611
69. Hagander LE, Hughes CD, Nash K, Ganjawalla K, Linden A, Martins Y, Casey KM, Meara JG (2013) Surgeon migration between developing countries and the United States: train, retain, and gain from brain drain. World J Surg 37:14–23
70. World Health Organization (2010) WHO global code of practice on the international recruitment of health personnel. World Health Organization, Geneva