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Implementation of a contextually appropriate pediatric emergency surgical care course in Uganda

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ABSTRACT

Background: Low- and middle-income countries like Uganda face a severe shortage of pediatric surgeons. Most children with a surgical emergency are treated by nonspecialist rural providers. We describe the design and implementation of a locally driven, pilot pediatric emergency surgical care course to strengthen skills of these providers. This is the first description of such a course in the current literature.

Methods: The course was delivered three times from 2018 to 2019. Modules include perioperative management, neonatal emergencies, intestinal emergencies, and trauma. A baseline needs assessment survey was administered. Participants in the second and third courses also took pre and postcourse knowledge-based tests.

Results: Forty-five providers representing multiple cadres participated. Participants most commonly perform hernia/hydrocele repair (17% adjusted rating) in their current practice and are least comfortable managing cleft lip and palate (mean Likert score 1.4 ± 0.9). Equipment shortage was identified as the most significant challenge to delivering pediatric surgical care (24%). Scores on the knowledge tests improved significantly from pre- ($55.4\% \pm 22.4\%$) to postcourse ($71.9\% \pm 14.0\%$, $p < 0.0001$).

Conclusion: Nonspecialist clinicians are essential to the pediatric surgical workforce in LMICs. Short, targeted training courses can increase provider knowledge about the management of surgical emergencies. The course has spurred local surgical outreach initiatives. Further implementation studies are needed to evaluate the impact of the training.

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Surgery is an essential component of child health; however 1.7 billion, or two-thirds of children worldwide lack access to safe and affordable surgery [1]. This disparity is most pronounced in low- and middle-income countries (LMICs) where more than half of the population are children, owing to high birth rates and short life expectancy. Thus, meeting many of the Sustainable Development Goals such as providing universal health coverage, reducing poverty, improving gender equity and reducing neonatal, infant and under-five mortality will require expanding access to children's surgical care [2].

Arguably one of the most prominent contributors to poor access to pediatric surgery in LMICs is a severe shortage of specialized pediatric

surgeons and anesthesia providers [3,4]. Africa alone needs 3000 additional pediatric surgeons to meet the workforce density standards of HICs [5]. As a result, most children who require surgery in this setting, especially those with surgical emergencies, will be treated by general surgeons, nonspecialist physicians, and in some settings nonphysician clinicians [6,7]. Additionally, 71% of surgeons in East Africa practice in cities, making the access to surgery especially dire for those living in rural areas [8].

Though long-term efforts to train additional pediatric surgeons and anesthesiologists are an essential component of capacity building for children's surgery, this does not address the immediate need for providers who are trained to handle surgical emergencies. One way to bridge this gap is to implement training courses geared towards providers who are already caring for these children. Courses that focus on teaching pediatric critical care to nonintensivists, and pediatric anesthesia to nonspecialists, have been shown to improve knowledge and skills, and have even led to sustained behavior change [9,10]. This strategy has been used for other

Abbreviation: PESC, Pediatric Emergency Surgical Care Course.

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areas of surgery, most notably trauma, which also has a high burden in LMICs [11–13]. However, no such course focusing on pediatric surgery has been described.

Uganda is a country in sub-Saharan Africa that faces many of the same challenges as other LMICs. It has a population of 20 million children and at the time of this intervention there were only 4 pediatric surgeons practicing in two cities. Many children with surgical emergencies are unable to reach a specialist pediatric surgeon for care and if they do, they are often underresuscitated or have not received appropriate temporizing measures. As part of an existing multidisciplinary collaboration, a course focusing on teaching rural nonspecialist providers how to identify and treat common pediatric surgical conditions was developed [14,15]. In this study, we describe the design and delivery of the Pediatric Emergency Surgical Care (PESC) course, detail the surgical needs of rural providers as described by the course attendees, and examine its impact on provider knowledge.

1. Methods

The PESC is a didactic course geared towards rural healthcare providers in Uganda. In Uganda there are 259 surgeons, a majority (71%) practicing in the nation's capital, Kampala [8]. Most district hospitals do not have access to a general surgeon, and almost all hospitals rely on medical officers, who in Uganda are physicians without specialist training, to perform emergency surgery [16]. Given this, contextually appropriate course materials targeted towards general surgeons and medical officers were developed. Course content was created collaboratively by multiple Ugandan and HIC pediatric surgeons and remained the same for all iterations of the course. Topic selection was informed by local expertise as well as previous studies of local epidemiology and barriers to accessing care [17,18]. For example, congenital anomalies such as anorectal malformations and Hirschsprung's disease are among the most common conditions treated by the local team, and present at a mean age of 11 months, indicating a substantial delay in diagnosis. Thus, a lecture focusing on the early recognition and surgical management of these anomalies was included. Initial recognition and stabilization priorities, referral guidelines, conditions with the highest disease burden, and procedures that could safely be performed in the community were prioritized for inclusion in the curriculum.

The course is delivered over three half days or two full days and covers topics ranging from common congenital anomalies, infections, trauma as well as anesthesia and perioperative care (Table 1). Lectures focus on the identification of surgical emergencies that are unique to the pediatric population. They include decision making algorithms from local content experts that encompass the timing of referral and commonly used operative techniques. Diagnostic and treatment modalities used in high-income settings, in addition to management strategies tailored to local resource limitations are discussed, as previous experience has shown that trainees in this setting wish to be aware of resources available elsewhere.

The course has been delivered three times since its development. The first course was offered in Kampala in February 2018, the second was in Mbarara in December 2018, and the third in Gulu in June 2019. These sites were selected owing to their strategic locations in different regions of the country. All have an associated medical school with infra-

structure available for course delivery. In addition, each location has either a practicing pediatric surgeon, or a general surgeon who treats a high volume of pediatric surgery cases. Local course coordinators recruited participants from surrounding district and regional referral hospitals. The course has been largely delivered by Ugandan faculty, which minimizes costs and promotes sustainability, with visiting HIC faculty assisting when available.

Prior to the course, a baseline needs assessment was administered to all attendees in order to understand their prior training, what resources were available for children's surgery at their hospital, which pediatric surgical conditions they are comfortable managing, what the most significant challenges are to providing pediatric surgical care in their setting, and what priority areas should be for future intervention. Participants in the Mbarara and Gulu courses also completed anonymous pre- and postcourse tests covering the topics discussed in the course. The test was rated in difficulty towards the level of an independent practitioner. The results were analyzed using paired t-tests, with a $p \leq 0.05$ considered to be significant.

2. Results

Thus far, 45 providers have participated in the course — 10 in Kampala, 17 in Mbarara and 18 in Gulu. Ninety percent of attendees participated in the needs assessment and pre- and postcourse tests. Locations of the hospitals where participants practice are shown in Fig. 1. Among the participants, 30% were general surgeons, 53% were medical officers, and 17% were of other cadres, including nurses and anesthesia officers. Mean time since the attendees completed training was 3.4 ± 4.2 years. The average pediatric and infant surgical volumes reported by participants are shown in Fig. 2.

The most common procedures performed in the participants' current practice are hernia and hydrocele repair (17% adjusted rating), exploratory laparotomy for intussusception (10%), and burn debridement (10%) (Fig. 3A). Attendees were least comfortable managing cleft lip and palate (mean Likert score 1.4 ± 0.9) and anorectal malformations (2.1 ± 1.3) (Fig. 3B). Lack of equipment and consumable supplies was identified as the most significant challenge to delivering pediatric surgical care (24% adjusted rating), followed by advanced disease presentation (23% adjusted rating), and lack of appropriate anesthesia (22% adjusted rating). Additional hands on surgical training (25% adjusted rating) and more frequent didactics (22% adjusted rating) were identified as priority areas for future intervention (Fig. 4).

Participants' scores on the knowledge tests improved significantly from pre- ($55.4\% \pm 22.4\%$) to postcourse ($71.9\% \pm 14.0\%$, $p < 0.0001$).

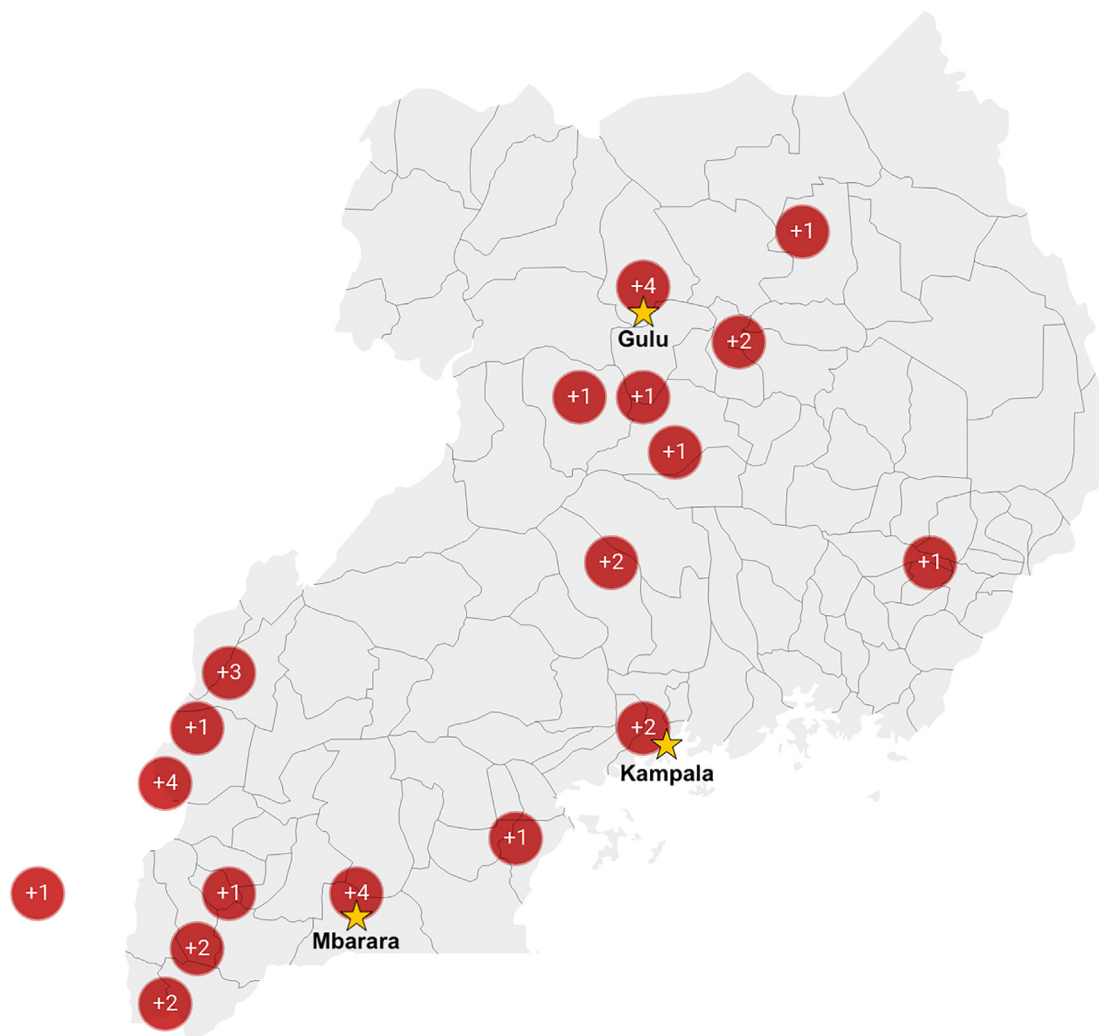
3. Discussion

In recent years, the Lancet Commission on Global Surgery Report, the third edition of the Disease Control Priorities Project and the World Health Assembly Resolution on Essential Surgery have led to increasing recognition that surgery is an essential component of global health. Despite these advances, children's surgery has been underemphasized. The Global Initiative for Children's Surgery, formed in 2016, has created a space for LMIC and HIC providers to work together and develop priorities for children's surgery moving forward and identify the resources necessary for the implementation of programs to improve children's surgical care worldwide [19]. Increased training opportunities, especially for providers in rural hospitals, have been recognized as a priority area for intervention.

Short-term training courses implemented in LMICs can have measurable effects on clinician practice patterns. Helping Babies Breathe, which was implemented beginning in 2010, has led to increased use of bag-valve mask ventilation; and the Safer Anesthesia From Education Course has led to behavior changes in preparation, perioperative care, resuscitation, management of the sick child, communication, and teaching [9,20].

Table 1
Sample curriculum for the pediatric emergency surgical care course.

Day 1	Day 2	Day 3
Abdominal emergencies & incarcerated hernia	Hirschsprung's & anorectal malformations	Fracture management & osteomyelitis
Anesthesia & perioperative care	Abdominal wall defects	Infectious emergencies
Neonatal bowel obstruction	Urologic emergencies	Trauma & burns



Created with Datawrapper

Fig. 1. Locations of providers' home institutions throughout Uganda and east Africa. Training centers are indicated by stars.

Given the high perioperative risk of children in LMICs and the severe shortage of pediatric surgeons, there is a clear role for a short-term course that focuses on teaching the fundamentals of pediatric surgical emergencies to providers in rural settings. The development of such courses presents an exceptional opportunity to create and strengthen international collaborations. Through organizations such as GICS, members of pediatric surgical associations such as APSA, BAPS and PAPS can collaborate with colleagues in LMICs to develop and refine contextually appropriate courses for pediatric surgical emergencies courses. Such courses have already been delivered in Vietnam and India [21,22]. Though provider education initiatives are considered a priority by

both HIC and LMIC stakeholders, the PESC course is the first such course described in the literature.

The PESC was developed in response to a need for improved training in pediatric surgical emergencies among medical officers and general surgeons that was identified by local stakeholders [14]. Most notably, specialist pediatric surgeons noted delayed presentation of children with congenital anomalies, inadequate temporizing measures for those patients who were referred, and at times inappropriate referrals [17,18,23]. The curriculum was tailored to address these gaps and specifically covers topics tailored to local epidemiology and resource limitations, such as temporizing measures for Hirschsprung's Disease and the

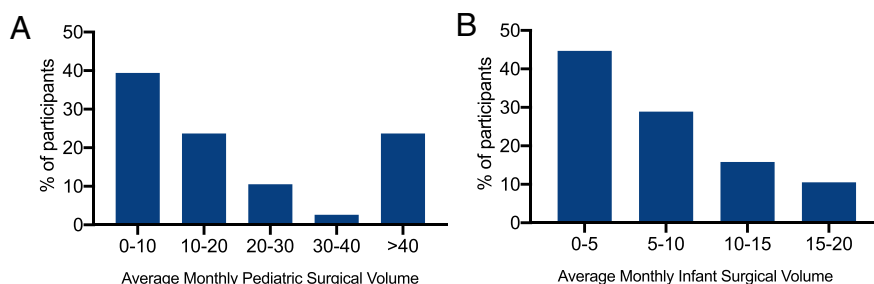


Fig. 2. Participants' reports of average monthly (A) pediatric and (B) infant surgical volumes at their usual practice location.

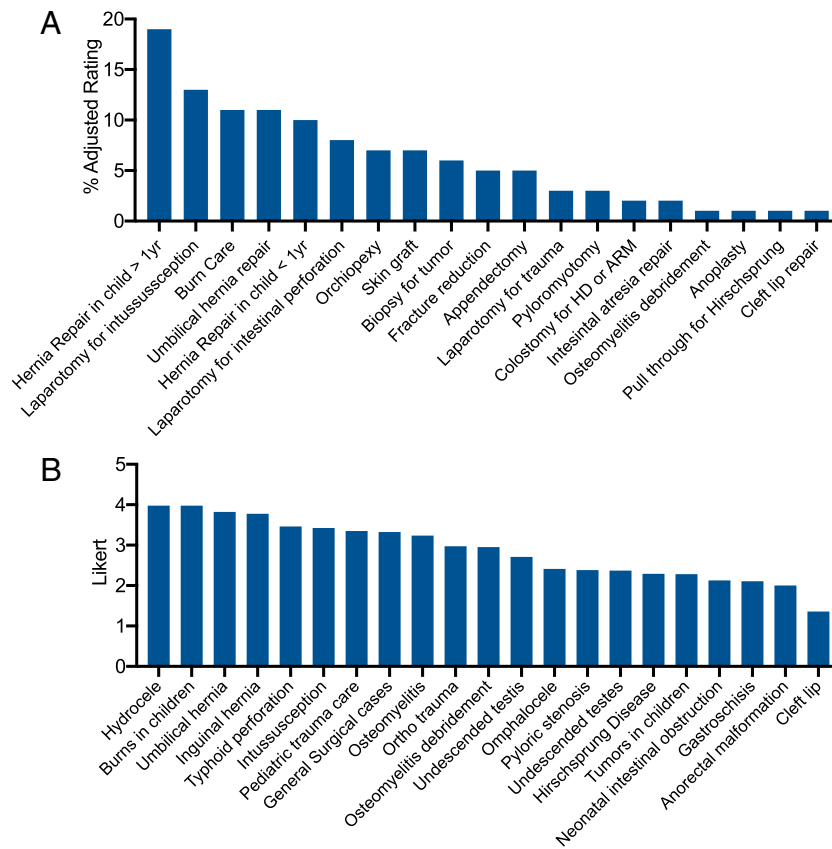


Fig. 3. Participants' reports of (A) the most common surgical procedures performed at their institutions and (B) their comfort level managing common pediatric surgical conditions.

management of intestinal failure in the absence of total parenteral nutrition. Evidence based resuscitation protocols that require minimal resources, for conditions such as gastroschisis, are also taught in the course [24].

All practicing pediatric surgeons in the country work in either Kampala, Uganda's capital city or Mbarara, a major city in the western region. Children from other regions of the country do not have ready

access to a pediatric surgeon, so recruitment of participants from rural hospitals in these regions was prioritized. Our needs assessment survey found that it is more common for rural providers to manage general surgery conditions in older children at their home institution, and these providers are more likely to refer congenital anomalies that require complex reconstruction to specialized care. Providers identified additional training opportunities as the most essential element needed to

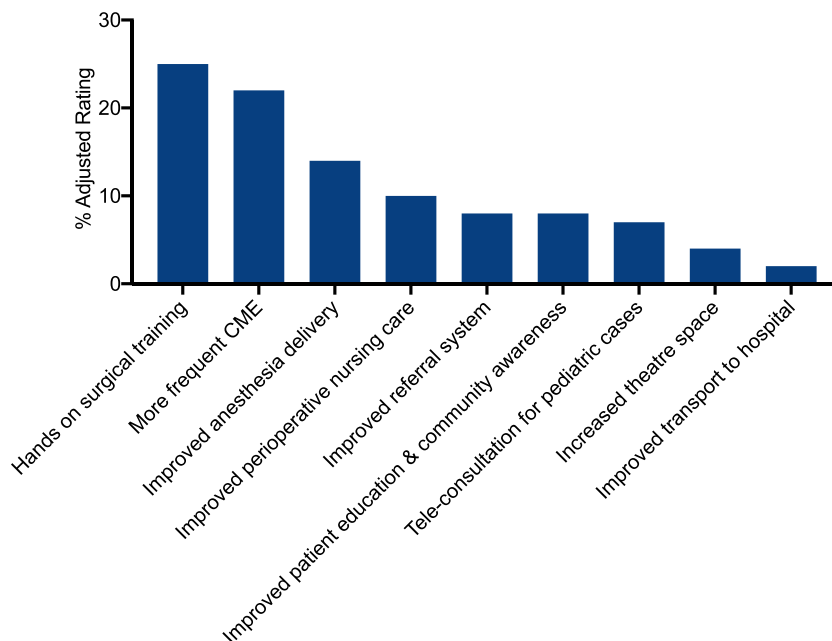


Fig. 4. Interventions needed to improve pediatric surgical care.

improve pediatric surgical care in their setting. It is possible that with minimal training, providers, especially experienced general surgeons, will be more likely to perform more complex, but appropriate procedures, which could help to ease the backlog of cases faced by specialist pediatric surgeons [25]. Providers also cited a need for more frequent didactics. As internet access in such settings expands, it may be possible to deliver didactics remotely, and even create a library that is readily accessible. Course participants cited late presentation and lack of infrastructure or consumables as the most substantial challenges to providing pediatric surgical care in rural Uganda. This is consistent with the themes of previous studies describing contextual challenges of surgery in this setting [16,26].

This needs assessment provides insight into the on the ground needs of rural providers, allowing for the development of targeted interventions to improve access to high quality children's surgical care in Uganda. While not formally reported with this analysis, the implementation of this course has already led to positive change seen by local course organizers. An increase in timely, appropriate referrals, particularly for congenital anomalies such as gastroschisis, omphalocele, anorectal malformations and Hirschsprung's disease has been noted.

In direct response to course feedback four rural outreach initiatives have been organized: two at Fort Portal Regional Referral Hospital, one at St Mary's Hospital Lacor and one at Kabale Regional Referral Hospital. These initiatives are multidisciplinary – visiting instructors include attending pediatric surgeons and pediatric surgery fellows, anesthetists who have experience with pediatric patients and nurses familiar with the perioperative care of children. Each outreach has included at least one CME lecture as well as major ward rounds with the local team. Hands on intraoperative teaching, where specialist pediatric surgeons take medical officers and general surgeons through common cases, was a major focus. Between 15 and 75 operative teaching cases were performed per week. The most common cases during these outreaches were umbilical and inguinal hernia repairs. More complex reconstructive operations, notably posterior sagittal anorectoplasties for anorectal malformations and pull-through procedures for Hirschsprung's disease, were also included. It is our hope that as these outreaches become more regular, and the team returns to the same site repeatedly, these initiatives will allow providers to feel comfortable managing common conditions independently. More formal, mixed-methods follow up of these outreach initiatives is planned.

This course and its evaluation do have limitations. Owing to time constraints, the course does not include any hands on teaching or simulation; however, this may be included in future iterations of the course. Although the course did improve performance on postcourse exams, this study does not examine if the course changes practice patterns of providers or any effects on patient outcomes. Long term, mixed methods follow-up of course participants is planned to more formally evaluate the impact of this course.

4. Conclusions

The PESC is the first short term course focused on improving the management of pediatric surgical emergencies in a resource-limited setting described in the literature. The course evaluations did show an improvement in provider knowledge after the course, and feedback from the course has already led to initiatives to improve care in these settings. Continued delivery of the course is planned to help improve surgical care for children more broadly. The experience from this pilot initiative in Uganda can inform the development of wider reaching international initiatives. This represents an important opportunity for stakeholders such as the WHO and UNICEF to invest in improving access to safe children's surgical care on a global scale.

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