


Patterns, procedures, and indications for pediatric surgery in a Tanzanian Refugee Camp: a 20-year experience

Sarah Rapaport ¹, Zachary Obinna Enumah,^{1,2} Hilary Ngude,³ Daniel S Rhee,^{1,4} Mohamed Abbas,³ Amber Lekey,⁵ Peter J Winch,² Joseph V Sakran,^{1,6} Kent A Stevens¹

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¹Center for Global Surgery, Johns Hopkins Medicine, Baltimore, Maryland, USA

²Department of International Health, Johns Hopkins University Bloomberg School of Public Health, Baltimore, Maryland, USA

³Tanzania Red Cross Society, Dar es Salaam, Tanzania

⁴Department of Pediatric Surgery, Johns Hopkins Medicine, Baltimore, Maryland, USA

⁵Department of Surgery, Tulane University School of Medicine, New Orleans, Louisiana, USA

⁶Satcher Health Leadership Institute, Morehouse School of Medicine, Atlanta, Georgia, USA

Correspondence to

Dr Kent A Stevens; ksteve14@jhmi.edu

ABSTRACT

Background There are 103 million displaced people worldwide, 41% of whom are children. Data on the provision of surgery in humanitarian settings are limited. Even scarcer is literature on pediatric surgery performed in humanitarian settings, particularly protracted humanitarian settings.

Methods We reviewed patterns, procedures, and indications for pediatric surgery among children in Nyarugusu Refugee Camp using a 20-year retrospective dataset.

Results A total of 1221 pediatric surgical procedures were performed over the study period. Teenagers between the ages of 12 and 17 years were the most common age group undergoing surgery (n=991; 81%). A quarter of the procedures were performed on local Tanzanian children seeking care in the camp (n=301; 25%). The most common procedures performed were cesarean sections (n=858; 70%), herniorrhaphies (n=197; 16%), and exploratory laparotomies (n=55; 5%). Refugees were more likely to undergo exploratory laparotomy (n=47; 5%) than Tanzanian children (n=7; 2%; p=0.032). The most common indications for exploratory laparotomy were acute abdomen (n=24; 44%), intestinal obstruction (n=10; 18%), and peritonitis (n=9; 16%).

Conclusions There is a significant volume of basic pediatric general surgery performed in the Nyarugusu Camp. Services are used by both refugees and local Tanzanians. We hope this research will inspire further advocacy and research on pediatric surgical services in humanitarian settings worldwide and illuminate the need for including pediatric refugee surgery within the growing global surgery movement.

INTRODUCTION

Surgery is an indispensable aspect of health-care for individuals of all ages, yet an estimated 5 billion people worldwide lack access to safe surgery.¹ An estimated 1.7 billion children lack access to surgery.² The overwhelming majority of children who lack access to surgery live in low-income and middle-income countries (LMICs). Less than 3% of children in low-income countries and <8% in middle-income countries have access

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Literature on the provision of pediatric surgical care for refugee children is very sparse.
- ⇒ The few existing studies reveal that there is a large unmet need for surgery among refugee children.

WHAT THIS STUDY ADDS

- ⇒ This study is among the first to assess the provision of pediatric surgical care within a refugee camp.
- ⇒ It is unique in that it assesses a protracted refugee situation and one of the largest refugee camps in the world.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ We hope the results of this study will inform capacity building and aid health planners and policy makers working to improve pediatric surgical care among refugee children in Nyarugusu Camp and others.

to surgery.² Yet, up to 85% of children living in LMICs could have a surgical condition by the age of 15 years.³ Pediatric patients have a unique burden of surgical disease, and if left untreated, these surgically correctable diseases can stymie physical and psychological development and cause a lifetime of preventable morbidity and disability.³ While the growing global surgery movement has galvanized support for improved access to surgery through research, capacity building, and policy engagement, refugees, both adult and pediatric, have only marginally been included in this work.

There are over 103 million displaced people worldwide, 41% of whom are children.⁴ Nearly 32.5 million of all people displaced are classified as refugees and over the past 4 years, 1.5 million children were born as refugees.⁴ Seventy-four per cent of refugees reside in LMICs, which often have under-resourced health systems and decreased access to surgical care.⁴ Data on the provision of surgery in humanitarian

settings are limited but growing.^{5–10} Even sparser are data related to the provision of pediatric surgery among refugee children.^{11,12} There are no identifiable published studies assessing the provision of pediatric surgery within a protracted refugee setting. The aim of this study is to use a 20-year retrospective dataset to provide a descriptive analysis of the patterns, indications, and procedures performed on pediatric surgical patients inside a large, protracted refugee camp in Western Tanzania.

METHODS

Study setting and population

Founded in 1996 primarily for refugees from the Democratic Republic of the Congo (DRC), Nyarugusu Camp is the largest refugee camp in Tanzania and one of the largest humanitarian settings in the world. Nyarugusu Camp is located in Kigoma, Western Tanzania and now additionally houses refugees from Burundi and other neighboring countries such as Kenya and Rwanda. The population of Nyarugusu Camp is 133 000 with 55% of its inhabitants children under the age of 18 years.¹³ At last estimate, 78 713 inhabitants (59%) are from DRC, 53 856 (41%) are from Burundi, and 142 (0.1%) are from other countries.¹⁴

The United Nations High Commissioner for Refugees (UNHCR) and the Tanzania Ministry of Home Affairs provide administrative support to Nyarugusu Camp. Multilateral and non-governmental organizations provide additional support. The Tanzanian Red Cross Society coordinates medical services in the camp. Medical services include a dispensary-level hospital, two health centers, and several health posts, which are accessible to both refugees and local Tanzanians. Differing from local Tanzanian district hospitals which charge a fee for services, the camp dispensary hospital provides care at no cost to refugees and Tanzanians. Complex cases beyond the scope of what can be provided in this humanitarian setting are referred outside the camp per the UNHCR guidelines paper.¹⁵

The camp dispensary hospital contains one minor operating room and two major operating rooms. The procedures performed in the operating rooms are recorded in paper logbooks by camp staff. Those performing surgery include general practitioners who have completed medical school and an additional intern year. Visiting board-certified and resident surgeons on recurrent humanitarian missions also provide services within the camp, including authors ZOE, JVS, and KAS, respectively.

Data collection

A retrospective review of paper logbooks containing entries of surgical procedures performed in Nyarugusu Camp was conducted. Surgical procedures that were performed between November 2000 and September 2020 were included. Day, date, and time of procedure; patient nationality, sex and age; indication for surgery and anesthesia used; and postoperative diagnosis were

abstracted for analysis. Indications that could clinically have similar meanings, such as acute abdomen and peritonitis, were abstracted identical to their appearance in the logbook. Procedures such as ‘repair’ that were performed for a variety of indications were also abstracted identical to their appearance in the logbook, meaning no further specification was made if not present in the procedure category in the logbook. Outcome data were inconsistently recorded and only weakly descriptive (‘good’, ‘fair’), so it was not collected. Only procedures performed on patients under the age of 18 years (not inclusive) were included for analysis.

Statistical analysis

Handwritten logbook pages between November 2000 and September 2020 inclusive were digitized using Microsoft Excel. A second team member verified accuracy by spot checking 10% of entries. If neither reviewer could read a part of an entry, it was classified as illegible. Each entry could be coded with one to three indications, operations, and kinds of anesthesia. These variables were standardized for ease of analysis. As a result of de-identifying data, a single patient could be accounted for in multiple entries if the patient underwent multiple procedures on different days. Descriptive analysis was performed on the following variables: patient nationality, age, sex, indication, operation, and anesthesia type. χ^2 tests were performed to compare the proportion of procedures and indications between refugees and Tanzanians. A significant p value was set at ≤ 0.05 . Procedure time and postoperative diagnosis were not included in the analysis because of inconsistent recording. STATA statistical software was used for performing the analysis (V.16. StataCorp, College Station, Texas, USA).

RESULTS

Demographics

A total of 1221 pediatric surgical procedures were performed over the 20-year period (table 1). This accounts for over 11% of all procedures performed in the camp during this time. A majority of patients were female (n=953; 78%). Most procedures were performed on individuals aged 12–17 years (n=991; 81%), followed by those aged 5–11 (n=122; 10%), 1–4 (n=92; 8%), and those under 1 year of age (n=16; 1%). A quarter of the procedures were performed on local Tanzanians (n=301; 25%) and 72% were performed on those classified as refugees (n=881; 72%). Thirty-nine patients (3%) did not have a recorded or legible nationality. Among refugees, those undergoing procedures were most commonly from the DRC (n=801; 66%) followed by Burundi (n=69; 6%) and ‘other’ (n=11; 1%), which includes the countries of Kenya, Rwanda, and those recorded as ‘refugee’ in the logbook (table 1). The number of procedures performed remained relatively constant over the first 10 years of the 20-year study period, then increased by about 50%

Table 1 Demographics

Variable, n (%)	Surgical procedures (n=1221)
Female sex	953 (78.1%)
Age (years)	
<1	16 (1.3%)
1–4	92 (7.5%)
5–11	122 (10.0%)
12–17	991 (81.2%)
Refugee status	
Tanzanian	301 (24.7%)
Refugee*	881 (72.2%)
Missing†	39 (3.2%)
Nationality	
DRC	801 (65.6%)
Burundi	69 (5.7%)
Tanzanian	301 (24.7%)
Other	11 (0.9%)
Missing†	39 (3.2%)

*Refugees are patients from DRC, Burundi, and 'other' (Kenya, Rwanda, 'refugee').
 †Patients in the missing category had a nationality that was illegible or not recorded.
 DRC, Democratic Republic of the Congo.

between 2010 and 2015, before returning to the baseline amount for the 2016–2020 period (figure 1).

Common procedures performed

Cesarean sections were the most common procedure performed (n=858; 70%), followed by herniorrhaphies (n=197; 16%) and exploratory laparotomies (n=55; 5%) (table 2). Among those under 1 year of age, the most common operations were herniorrhaphies (n=13; 81%) and exploratory laparotomy and repair (each with n=1;

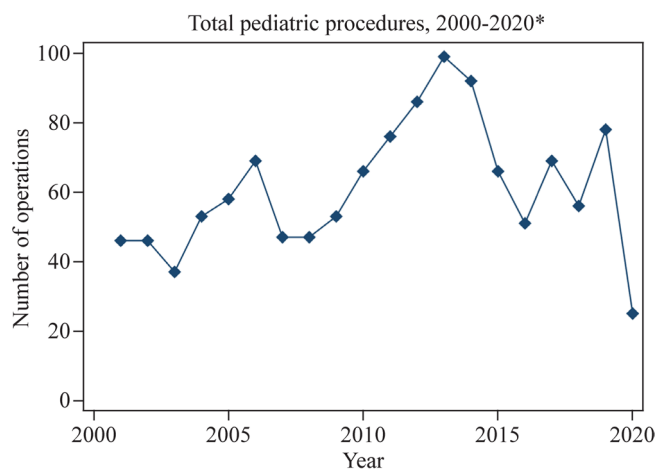


Figure 1 Pediatric procedures over time. *The stark drop at the end of 2020 represents not having a full year of data for the 2020 year, not necessarily an actual drop in procedure numbers.

6%). Herniorrhaphies were also the most common operation for those aged 1–4 years (n=65; 71%), followed by hydrocelectomies (n=11; 12%). Herniorrhaphies were again the most common operation for those aged 5–11 years (n=76; 62%) followed by exploratory laparotomies (n=21; 17%). Cesarean sections were the most common operation for those aged 12–17 years (n=858; 87%) followed by herniorrhaphies (n=43; 4%) (table 2).

When stratifying the most common procedures by refugee status, refugees and Tanzanians have the same most common two procedures of cesarean sections and herniorrhaphies (table 3). Exploratory laparotomy was the third most common procedure for refugees, while hydrocelectomy was the third most common procedure for Tanzanians. Refugees (n=47; 5%) were more likely to undergo exploratory laparotomy than Tanzanians (n=7; 2%; p=0.032) (table 3).

Common indications for exploratory laparotomy

Acute abdomen was the most common indication for exploratory laparotomy (n=24; 44%), followed by intestinal obstruction (n=10; 18%) and peritonitis (n=9; 16%) (table 4). When comparing by age group, there was one patient under 1 year of age who underwent exploratory laparotomy because of intestinal obstruction. Among those aged 1–4 years, all patients who underwent exploratory laparotomy had an indication of acute abdomen (n=3), while one patient also had an indication of peritonitis. Acute abdomen was also the most common indication for exploratory laparotomy in those aged 5–11 years (n=9) followed by intestinal obstruction (n=6). Acute abdomen was again the most common indication for exploratory laparotomy in those aged 12–17 years (n=12) followed by perforation (n=6) (table 4).

When comparing by refugee status, the indications for exploratory laparotomy among refugees (n=47) were acute abdomen (n=23), followed by peritonitis (n=8), intestinal obstruction (n=7) and perforation (n=7) (table 5). In the Tanzanian group (n=7), the most common indication for exploratory laparotomy was intestinal obstruction (n=2). The remaining indications each had one patient represented.

DISCUSSION

We sought to elucidate the patterns, most common procedures, and indications for pediatric surgery in this protracted refugee setting using a 20-year retrospective dataset. Our data show that the pediatric surgery occurring in this humanitarian setting is reflective of basic general surgery need and that a quarter of those using services are Tanzanian. The most common procedures were cesarean sections, herniorrhaphies, exploratory laparotomies, hydrocelectomies, and appendectomies. There was a significant difference in proportion of exploratory laparotomies between the Tanzanian and refugee groups, with it being performed more commonly in the refugee population. The most common indications for

Table 2 Most common procedures by age group

Variables, n (%)	Total (n=1221)	Under 1 year of age (n=16)	Aged 1–4 years (n=92)	Aged 5–11 years (n=122)	Aged 12–17 years (n=991)
Cesarean section	858 (70.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	858 (86.6%)
Herniorrhaphy	197 (16.1%)	13 (81.3%)	65 (70.7%)	76 (62.3%)	43 (4.3%)
Exploratory laparotomy	55 (4.5%)	1 (6.3%)	3 (3.3%)	21 (17.2%)	30 (3.0%)
Hydrocelectomy	40 (3.3%)	0 (0.0%)	11 (12.0%)	13 (10.7%)	16 (1.6%)
Appendectomy	8 (0.7%)	0 (0.0%)	0 (0.0%)	2 (1.6%)	6 (0.6%)
Mayes	7 (0.6%)	0 (0.0%)	6 (6.5%)	1 (0.8%)	0 (0.0%)
Repair	7 (0.6%)	1 (6.3%)	0 (0.0%)	0 (0.0%)	6 (0.6%)
Bilateral tubal ligation	5 (0.4%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	4 (0.4%)
Others	44 (3.6%)	1 (6.3%)	6 (6.5%)	9 (7.4%)	28 (2.8%)

Percentages add up to 100 for age group.

exploratory laparotomies were acute abdomen, intestinal obstruction, peritonitis, and perforation. In essence, this study describes the current capacity of the camp to treat pediatric surgical disease. It is not an attempt to characterize the pediatric surgical burden of disease within the camp, treated and/or untreated.¹⁶

Pediatric refugee surgery provision

There are few studies elucidating the provision of pediatric surgery among refugees. One such study by Wu *et al* assessed surgery among pediatric refugees referred to a tertiary hospital with a dedicated pediatric ward.¹¹ This study, which assessed surgically correctable disabilities among children in Dadaab Camp in Kenya, a chronic refugee setting, found during a 6.25-year period (March 2006–June 2011), 640 procedures were performed; 43% of which were for congenital anomalies and 57% of which were for acquired conditions. Only 13.5% of the need for common congenital conditions was met. Unlike the results of our study, which show a surgical output reflective of basic, general, more emergent surgery, the surgical

care in the study by Wu *et al* more closely resembles the capacity of a non-humanitarian tertiary hospital that can complete complicated congenital cases.¹¹ The lack of complicated congenital cases in our dataset is reflective of the current capacity of the camp, in that these complex surgeries often require advanced infrastructure such as operative and postoperative monitoring, medical management (including availability of medications), and a specially trained surgical and non-surgical workforce that is not available at the camp-level hospital. Children in Nyarugusu Camp with complex diagnostic or therapeutic needs, similar to those receiving care in the study by Wu *et al* would need to be referred outside the camp health center to tertiary hospitals.¹¹ Yet, this referral process is fraught with bureaucratic and political challenges, so unfortunately, some who require referral may experience delays or inadequate care.^{17,18}

Studying pediatric surgery performed among 20 different Médecins Sans Frontières Operational Centre Paris (MSF-OCP) programs in various humanitarian settings and conflict locations, Trudeau *et al* found that

Table 3 Most common procedures by refugee status

	Total (n=1182)†	Refugee (n=881)	Tanzanian (n=301)	P value
Cesarean section	838 (70.9%)	635 (72.1%)	203 (67.4%)	0.14
Herniorrhaphy	184 (15.6%)	127 (14.4%)	57 (18.9%)	0.059
Exploratory laparotomy	54 (4.6%)	47 (5.3%)	7 (2.3%)	0.032*
Hydrocelectomy	38 (3.2%)	28 (3.2%)	10 (3.3%)	0.90
Appendectomy	8 (0.7%)	7 (0.8%)	1 (0.3%)	0.40
Mayes	7 (0.6%)	5 (0.6%)	2 (0.7%)	0.85
Repair	7 (0.6%)	4 (0.5%)	3 (1.0%)	0.29
Bilateral tubal ligation	5 (0.4%)	4 (0.5%)	1 (0.3%)	0.78
Others	41 (3.5%)	24 (2.7%)	17 (5.6%)	N/A

*Indicates statistically significant p value.

†Only entries containing both a procedure and nationality are included in this table.

N/A, not available.

Table 4 Most common indications for exploratory laparotomy by age group

Variables, n (%)	Total (n=55)*	Under 1 year of age (n=1)	Aged 1–4 years (n=3)	Aged 5–11 years (n=21)	Aged 12–17 years (n=30)
Acute abdomen	24 (44%)	0 (0%)	3 (100%)	9 (43%)	12 (40%)
Intestinal obstruction	10 (18%)	1 (100%)	0 (0%)	6 (29%)	3 (10%)
Peritonitis	9 (16%)	0 (0%)	1 (33%)	4 (19%)	4 (13%)
Perforation	8 (15%)	0 (0%)	0 (0%)	2 (10%)	6 (20%)

Due to a procedure allowing up to three indication codes, the total indications can add up to more than the number of patients who underwent the procedure. This table shows only the most common indications for exploratory laparotomy, so the indications shown may not add up to the total procedures performed.

*This total represents those who underwent an exploratory laparotomy

one-third of patients were preteen (under 13 years of age) while the remaining patients were classified as teens (aged 13–17 years).¹² The most common indications for surgery in the preteen group were burns, accidental injuries, and infections, while the most common indications for surgery for teens were mainly trauma induced and included burns, traffic accidents, and gunshot wounds.¹² While this study uses slightly different age categorizations than ours, we have similar findings in that a majority of the patients are teens. The indications for procedures largely differ between studies, which can be attributed to a few factors. One reason is that our dataset only included major operations performed at Nyarugusu. Minor operations such as wound management, incision and drainage, dressing changes, and burn care would typically be performed in the minor operating room and not captured in our dataset. The differing contexts of the chronic humanitarian setting in our study versus acute conflict-related settings represented by Trudeau *et al* could also be responsible for the different indications—such as trauma or gunshot wounds—between studies.¹²

Burden of pediatric surgical disease among refugee children

In addition to the limited research on the provision of surgery among refugee children, there are limited data on the burden of pediatric surgical disease among refugees. To our knowledge, our group published the first population-based study assessing the burden of pediatric surgical disease in a refugee camp in sub-Saharan Africa and found that 16% of children in Nyarugusu Camp had a potentially surgically correctable condition.¹⁶ The

most common anatomic location of surgical disease was the face, head, and neck, which differs from the results of our current study regarding the most common indications and procedures performed. This discrepancy could be explained by face, head, and neck conditions requiring referral outside the camp because they are out of the practice of camp surgical care. Other groups, such as Kuwayama *et al*, have described the burden of surgical disease among displaced populations other than refugees, such as those internally displaced in West Darfur, Sudan.¹⁹ Additionally, Al-Hajj *et al* have published on burns among pediatric refugees living in Lebanon. Burn care is not performed in the major operating room at Nyarugusu Camp, therefore our study, which is based on data from the major operating room logbook, does not describe the characteristics of burns among pediatric populations in the camp.²⁰

Pediatric surgery in limited resource settings

Despite sparse literature on pediatric surgery in humanitarian settings, there is a growing body of literature on the burden of pediatric surgical disease in resource-limited settings worldwide. Several studies have used the Surgeons OverSeas Assessment of Surgical need to quantify the pediatric surgery burden of disease in sub-Saharan Africa.^{21–25} One such study conducted in Nigeria found that among the 2.9 million children with surgically correctable diseases, the most common indications for surgery were umbilical hernias, inguinal hernias, wounds and injuries to the extremities, hydroceles, and undescended testes.²⁴ The indications for surgery from this

Table 5 Most common indications for exploratory laparotomy by refugee status

Variables, n (%)	Total (n=54)*	Refugee (n=47)	Tanzanian (n=7)	P value
Acute abdomen	24 (44%)	23 (49%)	1 (14%)	0.22
Intestinal obstruction	9 (17%)	7 (15%)	2 (29%)	0.16
Peritonitis	9 (17%)	8 (17%)	1 (14%)	0.87
Perforation	8 (15%)	7 (15%)	1 (14%)	0.76

Due to a procedure allowing up to three indication codes, the total indications can add up to more than the number of patients who underwent the procedure. This table shows only the most common indications for exploratory laparotomy, so the indications shown may not add up to the total procedures performed.

*This total represents those who had a recorded nationality and underwent an exploratory laparotomy



study closely resemble our data's most common surgical procedures which besides cesarean sections, include herniorrhaphy, exploratory laparotomy, and hydrocelectomy.

Global pediatric surgery capacity building

While refugee children have largely been neglected from global pediatric surgery conversations, efforts to improve access to pediatric surgery, particularly in sub-Saharan Africa, are underway. Consortia such as the Global Initiative for Children's Surgery (GICS) have brought together stakeholders in the field from around the world to conduct research and work with WHO and Lancet Commission on Global Surgery to increase surgical capacity in under-resourced settings. They identify four pillars of areas that will increase capacity: infrastructure building, service delivery, training, and research.²⁶ However, a study by GICS assessing the inclusion of pediatric surgery in National Health Policies, Strategies, and Plans (NHPSP) reveals that only 7% of NHPSPs included pediatric surgery compared with 45% that included surgery, highlighting how pediatric surgery is perhaps undervalued among health leadership and policy makers.²⁷ Our study shows that there is significant volume of pediatric surgery in this humanitarian setting. This, combined with the research showing that 16% of children in the camp have an untreated surgical disease, necessitates the inclusion of pediatric services in humanitarian setting surgical planning, infrastructure building, and workforce training.¹⁶ Improved buy-in of the importance of pediatric surgery by leaders formulating NHPSPs and those planning surgical systems in humanitarian settings would allow for better scale up of these systems.

Regarding workforce training, studies have shown that programs such as the College of Surgeons of East, Central and Southern Africa pediatric surgery training program allow graduates to exceed international guidelines for caseloads in general surgery training, but that there is little subspecialty experience.²⁸ In another program, LMIC pediatric surgeons who trained in a HIC with a curriculum targeting their learning needs gained clinical and teaching skills. On the contrary, an analysis of pediatric surgery fellows who completed American College of Graduate Medical Education lacked sufficient experience treating obstetric and orthopedic conditions.^{29, 30} Our data support the need for adequate training in obstetric surgical conditions for surgeons caring for children in humanitarian settings, as cesarean sections were the most common operation performed. While pediatric refugee surgery has been largely neglected from this field of literature, one recent stride is the building of the first dedicated pediatric operating room in a refugee camp in June 2021 in Kakuma Camp, Kenya.³¹

Future directions

Our study adds to the body of literature suggesting a need for pediatric surgery in LMICs. While refugee children are largely neglected from the growing pediatric global

surgery movement, our data highlight that these children need humanitarian surgical services and that local citizens also benefit, as 25% of the patients undergoing operations at Nyarugusu were Tanzanian children. This emphasizes the importance of including humanitarian settings in global pediatric surgery advocacy and capacity building efforts, as these services may benefit refugees and local communities with demonstrated need. We hope our findings will aid program implementors, health system planners, camp medical organizers, and the larger refugee health community in formulating data-driven policy to support and improve pediatric surgery in this and other protracted refugee settings.

Limitations

Our study is not without limitations. First, there are limitations within the data itself. The nature of short-term workers recording surgical procedures in the logbooks and a lack of standardized recording system in terms of coding and time from procedure entries must be recorded, adds heterogeneity, subjectivity, and possible recall bias. Second, the indications discussed are broad and could be secondary to a variety of disease etiologies. We maintained the level of descriptive granularity found in the original logbooks; thus the broadness of indications is representative of limited documentation within the camp. Additionally, this study does not address the untreated burden of disease in the camp nor the cases referred outside the camp, which typically represent more complicated cases requiring higher levels of expertise and care.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The Tanzanian Commission on Science and Technology (COSTECH) (2020-391-NA-2011-143) and Johns Hopkins Institutional Review Board (IRB00012663) approved this study. Informed consent was waived by The Johns Hopkins Institutional Review Board. Relevant local regulations guided the conduct of this study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. De-identified data available on reasonable request.

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ORCID iD

Sarah Rapaport <http://orcid.org/0000-0001-7890-1018>

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