



Perspectives on perioperative management of children's surgical conditions during the COVID-19 pandemic in low-income and middle-income countries: a global survey

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ABSTRACT

Background Many organizations have issued recommendations to limit elective surgery during the coronavirus disease 2019 (COVID-19) pandemic. We surveyed providers of children's surgical care working in low-income and middle-income countries (LMICs) to understand their perspectives on surgical management in the wake of the COVID-19 pandemic and how they were subsequently modifying their surgical care practices.

Methods A survey of children's surgery providers in LMICs was performed. Respondents reported how their perioperative practice had changed in response to COVID-19. They were also presented with 26 specific procedures and asked which of these procedures they were allowed to perform and which they felt they should be allowed to perform. Changes in surgical practice reported by respondents were analyzed thematically.

Results A total of 132 responses were obtained from 120 unique institutions across 30 LMICs. 117/120 institutions (97.5%) had issued formal guidance on delaying or limiting elective children's surgical procedures. Facilities in LICs were less likely to have issued guidance on elective surgery compared with middle-income facilities (82% in LICs vs 99% in lower middle-income countries and 100% in upper middle-income countries, $p=0.036$). Although 122 (97%) providers believed cases should be limited during a global pandemic, there was no procedure where more than 61% of providers agreed cases should be delayed or canceled.

Conclusions There is little consensus on which procedures should be limited or delayed among LMIC providers. Expansion of testing capacity and local, context-specific guidelines may be a better strategy than international consensus, given the disparities in availability of preoperative testing and the lack of consensus towards which procedures should be delayed.

INTRODUCTION

As of May 2020, over 212 countries have reported or confirmed cases of the

Key messages

What is already known about this subject?

► To improve patient and provider safety during urgent and emergent cases, pediatric surgeons are implementing a wide array of changes to surgical practice, but these changes have not been well quantified in low-income and middle-income countries (LMICs). Furthermore, there is little evidence on which pediatric-specific procedures should be canceled or delayed.

What are the new findings?

► Most LMIC institutions have issued formal guidance on elective pediatric surgical care.
► There is wide variation in the adoption of techniques to improve provider and patient safety by pediatric surgeons in LMICs.
► There is little consensus among pediatric surgeons working in LMICs on which elective pediatric surgical procedures should not be performed during a global pandemic.

How might it impact on clinical practice in the foreseeable future?

► This study highlights the need for an increased focus on local, context-specific guidelines and data to guide local measures as opposed to reliance on international consensus guidelines from high-income country organizations.

coronavirus disease 2019 (COVID-19).¹ With over 6 million cases worldwide and 380,000 deaths, the COVID-19 pandemic has resulted in a number of changes to health-care delivery globally.² Healthcare systems around the world have rapidly responded to the pandemic by increasing testing capabilities, expanding intensive care units and developing specialized COVID-19 guidelines.³ In

addition, the Centers for Disease Control and Prevention in the USA and National Health Service (NHS) in the UK have made recommendations to prioritize urgent medical visits, delay elective care and increase telemedicine/telehealth.⁴ Although delaying non-urgent care may reduce spread of disease, delays and cancellations of surgical care are not without consequences. Additionally, the classification of emergent, urgent and elective surgical care is often left to the discretion of individual providers. Optimizing guidelines for children's surgical care during global pandemics requires a thorough understanding of how providers have changed practices and their perspectives of the inherent risks for both providers and patients during global pandemics.

A number of organizations from various income settings have issued guidelines on how to handle emergent and elective surgical care during the COVID-19 pandemic, including the WHO,⁵ College of Surgeons of East, Central and Southern Africa,⁶ the UK NHS⁷ and the American College of Surgeons (ACS).⁸ Initially, The COVID-19 crisis required hospitals and ambulatory surgery centers throughout the country to defer non-essential surgery to preserve personal protective equipment (PPE), protect the safety of healthcare professionals, and allocate potentially scarce resources for the care of the patient with COVID-19.⁹ The American Pediatric Surgical Association (APSA) endorsed the ACS guidelines and added additional guiding principles specifically for children's surgical care during the COVID-19 pandemic. Surgery was recommended to be performed 'only if delaying the procedure is likely to prolong hospital stay, increase the likelihood of later hospital admission or cause harm to the patient'.¹⁰ As the pandemic spread worldwide, many other countries and regions followed suit by canceling elective surgeries and issuing guidelines. On 18 April, the WHO released two technical guidance reports, recommending health systems 'progressively postpone all but the most urgent elective surgery and internally repurpose space and staff to COVID-19'.^{5 11} Given the recognition that 'there is no substitute for sound surgical judgement', there is a need to study both surgeon and administrative decisions during this pandemic and their impact on children's surgical care. It is essential that we try to optimize child health outcomes during times of stress on healthcare infrastructure. Institutions providing children's surgery in high-income countries have begun to report

changes in practice in response to COVID-19, but this has yet to be evaluated in lower-resource settings.¹²

This study aimed to understand how providers of children's surgery in low-income and middle-income countries (LMICs) were modifying their perioperative practice in response to the COVID-19 pandemic, including their attitudes towards triage guidelines for elective and urgent procedures.

METHODS

Design and data collection

To understand how the COVID-19 pandemic had affected delivery of children's surgical care in LMICs, we conducted a survey of providers of children's surgery. A 13-question survey was distributed via email through the Global Initiative for Children's Surgery (GICS) email list-serve and through social media postings between 30 April 2020 and 10 May 2020.

Survey questions were created after two rounds, with panels that included global health and children's surgery experts, using a modified Delphi method. Countries were defined as LMICs based on the 2019–2020 World Bank Income Status.¹³ Responses from high-income countries were excluded.

Respondents were asked basic demographic information, information about the primary hospital/facility in which they operated and changes they had made to their practice during the COVID-19 pandemic. They were also asked to report if their institution had issued children-specific guidelines on surgical care and if they agreed with/or were using those guidelines. A set of urgent and elective procedures, based on the ACS guidelines for pediatric surgical procedures, has been previously developed by consensus.¹⁰ For each of these procedures, respondents were asked whether they felt they would be allowed to perform that procedure at their institution and whether they felt they should be allowed to perform that procedure. The aim was to capture which procedures were being limited through both explicit and implicit decisions at LMIC hospitals, as well as whether surgeons agreed with these practices. See [tables 1 and 2](#) for a complete list of procedures.

Open-ended responses and survey responses were grouped thematically based on predefined themes: 'diagnostics and operative triage', 'intraoperative precautions',

Table 1 Responses by facility

Institutions	Total	Low income (n=85)	Lower middle income (n=29)	Upper middle income (n=12)
Facility cared for a patient positive for COVID-19	77 (64%)	5 (46%)	15 (50%)	57 (72%)
Facility cared for a child positive for COVID-19	51 (43%)	3 (27%)	6 (20%)	42 (53%)
Operation performed on a child positive for COVID-19 at facility	26 (22%)	1 (9%)	5 (17%)	20 (25%)

Values presented as absolute numbers and the percentage, n (%). COVID-19, the coronavirus disease 2019.

Table 2 Changes in children's surgical care practice by individual surgeons

Variables	Total (n=126)	Low income (n=12)	Lower middle income (n=29)	Upper middle income (n=85)
More imaging use	24 (19%)	3 (25%)	3 (10%)	18 (21%)
Earlier attending involvement	16 (13%)	2 (17%)	2 (7%)	12 (14%)
Use a negative pressure operating room	4 (3%)	0 (0%)	0 (0%)	4 (5%)
More watchful waiting	33 (26%)	3 (25%)	9 (31%)	21 (25%)
Use a viral filter during aerosolizing procedures	37 (29%)	0 (0%)	4 (14%)	33 (39%)
Use of an N95, controlled air purifying respirator or powered air purifying respirator in the operating room	93 (74%)	4 (33%)	20 (69%)	69 (81%)
Limiting staff in the room	79 (63%)	4 (33%)	17 (59%)	58 (68%)
Excluding trainees from care	37 (29%)	2 (17%)	4 (14%)	31 (36%)
Special post anesthesia precaution time	39 (31%)	0 (0%)	7 (24%)	32 (38%)
Decreased use of laparoscopy	2 (1%)	2 (17%)	3 (10%)	24 (28%)
Use of a laparoscopic viral filter	13 (10%)	0 (0%)	0 (0%)	13 (15%)
Increased use of open procedures	17 (14%)	0 (0%)	2 (7%)	15 (18%)

Values presented as absolute numbers and the percentage, n(%).

'postoperative management' and 'personal protective equipment and sterilization'.

Study data were collected and managed using REDCap electronic data capture tools hosted at Boston Children's Hospital.^{14 15} A complete copy of the survey instrument was included (see online supplemental file).

Statistical analyses

Statistical analysis was performed using R V.3.6.2.¹⁶ Comparisons were made between type of facility, size of facility and World Bank Income Group Status using χ^2 tests and Fisher's exact tests. Two-sided significance tests were used for all analyses, and statistical significance was determined at the type I error rate of $\alpha=0.05$.

RESULTS

Responses from 132 providers of children's surgery working in LMICs were obtained representing 120 unique institutions across 30 different countries. In total, 117 responses were from pediatric surgeons and pediatric anesthesiologists. See [table 3](#) for specialties represented and online supplemental appendix 1 for all countries represented.

Of the 120 LMIC institutions represented, 79 were upper middle income; 30 were lower middle income; and 11 were low income. Thirteen were first-level hospitals, 63 were second-level/third-level hospitals and 42 were national children's centers. Eighty-one were publicly funded; 19 were privately funded, 16 were a mix of public and private funding; and 4 were faith based. Seventy-seven (64.2%) have cared for a patient positive for COVID-19; 51 (42.5%) have cared for a child positive for COVID-19; and 26 (21.7%) have performed an operation on a child positive for COVID-19. See [table 1](#) for stratification by income level.

One hundred and sixteen (97.5%) of respondents reported their hospital had issued some form of formal guidance on delaying or limiting elective children's surgical procedures. Only 59 (50.9%) were specifically provided a list of what surgical procedures should be delayed. Thirty-seven (31.9%) required approval by the chief of surgery for elective cases and 25 (21.6%) required approval by hospital administration. Facilities in low-income countries (LICs) were less likely to have issued guidance on elective surgery compared with facilities in lower middle-income countries and upper middle-income countries (81.8% in low income countries vs 98% in lower middle-income countries and 100% in upper middle-income countries, $p=0.036$). Other free-text

Table 3 Survey respondents by role and specialty

Respondents	Number
Role	(n=132)
Trainee/resident/registrar	10 (7.6%)
Pediatric surgeon	98 (74.2%)
Anesthesiologist	9 (6.8%)
Other	15 (11.4%)
Specialty (among surgeon respondents)	(n=113)
General and horacic	89 (78.8%)
Urological	10 (8.8%)
Cardiac	1 (0.9%)
Oromaxillofacial	2 (1.8%)
Orthopedic	1 (0.9%)
Otolaryngological	2 (1.8%)
Plastic	8 (7.1%)

Values presented as absolute numbers and the percentage, n (%).

institutional responses included canceling/delaying all elective surgeries with allowance of only emergency surgeries or emergent and urgent surgeries (often with oncology surgeries as an exception) (n=12), allowance of surgeon, specialist or head of department to make decisions on allowed cases (n=4), addition of information about surgery during COVID-19 to consent process (n=1) and shared institutional guidelines (n=1).

In this study, 70 (58.8%) of hospitals had testing capability. Among hospitals with testing, 17 (24.3%) required patients to undergo testing prior to undergoing a surgical procedure. Forty-nine (62%) of upper middle-income facilities had testing capability vs 17 (58.6%) in lower middle income and 4 (36.4%) in low income (p=0.297).

National children's centers were less likely to have cared for a child positive for COVID-19 than non-national centers (23 (54.8%) vs 28 (35.9%)). Eight (19%) national children's hospitals had a patient positive for COVID-19 undergo surgery vs 18 (23.1%) among non-national centers (p=0.762). National children's centers were no more likely than non-national centers to issue guidance on delaying or canceling elective children's surgical procedures (97.4% vs 97.6%, p=0.99).

Among the 117 pediatric general surgeons, specialists and anesthesiologists who responded, 65% had modified their preoperative assessment and 91.4% were taking specific precautions for patients positive for COVID-19 (table 2). Only 6.5% of surgeons reported using non-operative treatment for acute appendicitis (9% at primary/secondary hospitals vs 3.85% at national children's centers).

The majority of providers (97%) believed that the number of elective procedures should be limited due to COVID-19. Only between 10% and 30% of providers agreed with limiting each procedure classified as 'urgent' by the ACS guidelines: 10% for cancer cases, 18% for vascular access insertion and 23% for repair of symptomatic infant inguinal hernia (table 4). For each procedure classified as 'elective', 30%–60% of providers agreed the procedure should be limited. Procedures with the highest promotion of surgeons who believed that the procedure should be delayed included repair of asymptomatic inguinal hernia (61%), anorectal malformation reconstruction following diversion (58%), Hirschsprung disease reconstruction following diversion (59%), branchial cleft cyst/sinus excision (58%) and enterostomy closure (57%) (table 5). The most commonly cited concern regarding delaying these procedures was delay in surgical care, including an increased backlog of elective procedures (n=21, 15.9%).

Examples from survey and free-text responses regarding institutional and provider responses were grouped thematically and presented in table 6.

DISCUSSION

The COVID-19 pandemic has placed enormous stress on surgical systems globally. The decision to cancel or delay

Table 4 Surgeon perception towards limiting specific procedures and institutional guidelines: urgent cases

Procedure	Reporting procedure should be limited* (%)	Reporting institution currently limits* (%)
Cancer surgery	10	19
Portoenterostomy for biliary atresia with jaundice	14	15
Abscess incision and drainage	13	18
Resection or diversion for acute exacerbation of inflammatory bowel disease not responsive to medical management	29	20
Vascular access device insertion	18	19
Repair of symptomatic inguinal hernia	25	35
Gastrostomy if required for discharge	22	26
Repair of symptomatic infant inguinal hernia	23	37
Cholecystectomy for symptomatic cholelithiasis	33	36

*For each procedure, percentages include only facilities that report they perform that procedure.

surgical care during a global pandemic represents an important decision with potential implications for system capacity and patient care.¹⁷ Our survey is among the first to explore the impact of delaying surgical care for children in LMICs and suggest that children's surgical care has been broadly impacted by this pandemic through changes in practice by providers of children's surgery. These changes are seen across income groups and across the various levels of hospitals where children's surgical care is performed. Furthermore, providers overwhelmingly agree that elective and urgent cases need to be delayed or canceled in the setting of a global pandemic and seek guidance on how best to adjust elective and semiurgent case volume. However, institutional guidance varies greatly and there is little consensus from individual providers on which specific procedures should be delayed or canceled. These results reflect the complexities in creating provider-based consensus guidelines and underscore the need for evidence-based guidelines for future pandemics.

Similar to adult surgical procedures, children's surgical procedures have been delayed or canceled across the globe in an effort to conserve resources and decrease potential postoperative complications, but optimization of which procedures, when, and how to minimize health risks for cases that are urgent or emergent have not been well defined. Emerging literature suggests that children

Table 5 Surgeon perception towards limiting specific procedures and institutional guidelines: elective cases

Procedure	Reporting procedure should be limited* (%)	Reporting institution currently limits* (%)
Vascular access device removal	54	48
Chest wall reconstruction	51	41
Asymptomatic inguinal hernia	61	68
Asymptomatic infant inguinal hernia	51	60
Anorectal malformation reconstruction following diversion	58	54
Hirschsprung disease reconstruction following diversion	59	59
Inflammatory bowel disease reconstruction following diversion	55	56
Enterostomy closure	57	51
Breast lesion excision (ie, fibroadenoma)	43	40
Branchial cleft cyst/sinus excision	58	58
Thyroglossal duct cyst excision	54	57
Fundoplication	54	45
Orchiopexy	54	58
Bariatric surgery	38	54
Splenectomy for hematological disease	30	50
Cholecystectomy for biliary colic	41	52
Repair of asymptomatic choledochal cyst	45	53

*For each procedure, percentages include only facilities that report they perform that procedure.

generally experience less severe symptoms but do develop respiratory symptoms which can increase the potential for postoperative complications.^{18 19} This demonstrates the need to minimize procedures on children with active COVID-19 infection as well as the need to limit surgical care in order to conserve healthcare system resources. A number of organizations have offered consensus-based guidelines designed to advise surgeons on when and how to cancel or delay elective cases. For example, while APSA has endorsed the ACS guidelines, a number of additional US pediatric subspecialty societies have created their own guidelines to guide subspecialty elective surgery.^{20–22} Our survey suggests the majority of children's surgery providers in LMICs (97%) agree with limiting elective cases due to the COVID-19 pandemic. However, there

was no single procedure where more than 60% of respondents agreed it should be delayed. Among procedures given as examples in the *American College of Surgeons Triage for Pediatric Patients* during COVID-19, only 10%–30% of surgeons agree with limiting each urgent case, and only 30%–60% of surgeons agree with limiting each elective case. In fact, no individual procedure outlined by the ACS as urgent or elective, had more than 65% of respondents agree that it should be canceled. Given the variability in perspectives among providers, it is clear that international guidelines alone are not enough to guide selection of surgical triage, and that institutional buy-in and decisions from local health leaders are needed to develop and enforce children's surgical triage in LMICs. This highlights the need for local, context-based triage guidelines based on local case mix, resources and patient population.

Our survey found that physicians practicing in LICs were less likely to have received guidance on children's elective surgery compared with lower and upper middle-income countries. While we expected that national children's centers in LMICs might have adapted institutional policies more rapidly in response to COVID-19, we did not find significant differences among the responses at large centers and small referral hospitals where children's surgical care was provided. The adoption of perioperative testing for COVID-19 is also of particular interest. Preoperative COVID-19 testing of children has become a dominant strategy in high-income countries.²³ While the reported incidence of COVID-19 among children in the USA undergoing surgery is 0.93%, in the low-income setting this is unknown.²⁴ Part of the challenge in determining burden in LMICs is the lack of testing available in many LMICs. Our survey found physicians in LICs reported much lower rates of adoption of preoperative testing capabilities (36%) when compared with upper middle-income (63%) or lower middle-income countries (59%). Preoperative testing allows surgeons to minimize operations on patients positive for COVID-19, which limits exposure of providers and minimizes the potential complications of undergoing surgery with a concomitant COVID-19 infection. This strategy has allowed high-income countries to resume surgical care while avoiding operating on these patients. Given the lack of testing in LMICs, there is a greater need to rely on institutional, national or international guidelines to avoid unnecessary and potentially hazardous operations from both a provider and patient standpoints. Expansion of preoperative testing is critical to ensure safe surgical care in these settings. While increasing testing availability must remain a priority, the lack of consensus by providers of children's surgery in LMICs suggests the need for more local, context-based decisions.

To address the potential for spread of COVID-19 and the need to reduce resource use during the pandemic, the majority of survey respondents reported that they had modified their preoperative surgical assessments in the face of COVID-19. These include changes across four

Table 6 Strategies for children's surgical care during COVID-19

Theme	Key examples
Diagnosics and operative triage	<ul style="list-style-type: none"> Facility triage Preoperative screening Assumption that every patient is an asymptomatic carrier until proven otherwise Increased imaging use Cancellation of all surgery More use of watchful waiting Use of multi-institutional guidelines
Intraoperative precautions	<ul style="list-style-type: none"> Use of a laparoscopic viral filter Use of the 'Taiwan box' intraoperatively Increased use of laparoscopy/videoendoscopy Increased use of open procedures. Special post anesthesia precaution time Limiting staff in the operating room Limiting resident/trainee involvement
Postoperative management	<ul style="list-style-type: none"> Use of telemedicine for follow-up visits Dedicated spaces or reserved isolation rooms for patients suspected of having or positive for COVID-19 COVID-19 ward for postoperative care Expedited discharge Longer follow-up care
Personal protective equipment and sterilization	<ul style="list-style-type: none"> Required use of masks in the hospital Dedicated operating room for children positive for COVID-19 Disinfecting all ORs with UV light Reserving PPE like new N95 for surgeries or intubation for patients suspected of having COVID-19 or positive for COVID-19 Use of an N95, controlled air purifying respirator or powered air purifying respirator in the operating room

COVID-19, the coronavirus disease 2019; OR, oral rehydration; PPE, personal protective equipment; UV, ultraviolet.

broad themes: diagnostics and operative triage, intraoperative precautions, postoperative management, PPE and sterilization. The variability seen in the use of these measures among different income groups and different hospital types highlights the lack of formal context-specific guidelines on modification of perioperative practice. Interestingly, although case reports of non-operative management of appendicitis have been reported, and the American College of Surgeons has advocated for increased non-operative management, few surgeons in our study are reporting increasing nonoperative management of appendicitis.²⁵⁻²⁷ Given the increased postoperative mortality seen in adult postoperative patients with COVID-19, further study of the effectiveness of these interventions is needed to create formal guidelines towards perioperative management of children during pandemics.¹⁷ Pragmatic clinical trials, especially in low-resource settings, would help to optimize decisions about elective and urgent surgical cancellations and inform the impact of delays in surgical care on clinical outcomes.

Our results raise a number of important questions for future research. Although providers of children's surgery

are generally in agreement that there needs to be cancellation or delay of elective surgical cases, there appears to be minimal consensus on which procedures should fall under this umbrella. Future international multicenter studies evaluating the consequences of postponing surgeries due to COVID-19 are needed. For example, monitoring for potential increases in rates of incarcerated hernias, cancer mortality or advanced progression of surgically amenable disease is needed to guide future guidelines. These studies will be imperative to better guide the list of surgical priorities in the current and future pandemics. Policy work and consensus statements by children's surgical societies or international organizations like the WHO and GICS may help to standardize efforts to limit elective cases and provide a framework for regional or institutional context-specific guidelines. Additionally, future outcomes research may be able to identify which procedures are safe to continue to perform and which should be avoided.

Our study has several limitations. The total number of survey recipients is unknown due to the sampling methodology, which include the GIC network email, which

has 812 members which can represent a response rate of 16%. Our survey represents only a sample of providers of children's surgical care and may not represent surgeons who work in the most remote settings or are not GIC members or social media users. We were not powered to detect differences among certain subgroups given our sample size. Additionally, non-response bias is present for respondents who do not answer specific questions in the survey due to survey fatigue. Additionally, a large number of responses are obtained from Brazilian surgeons who make up the majority of responses from middle-income countries. The results are evaluated with and without the results from Brazil, and we find minimal difference in the results. Therefore, we chose to include all children's surgical providers from LMICs who respond to the study.

In conclusion, most children's surgical providers working in LMICs have modified perioperative practices in the wake of the COVID-19 pandemic. Although the majority believe that urgent and elective cases should be limited during global pandemics, there is no consensus on which specific cases should be limited. While some level of institutional guidance is common in LMICs, there is a similar lack of consensus on which procedures are limited across institutions. Given the lack of both provider and institutional consensus, expansion of preoperative testing is critical to minimize risk of providers and patients. Furthermore, a focus on local, context-specific guidelines may be a better strategy than international consensus, given the disparities in availability of preoperative testing and the lack of consensus towards which procedures should be delayed among LMICs providers.

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