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Title: Optimal Resources for Children's Surgery 2: Tiered Recommendations for Minimum Essential Children's Surgical Procedures across Health System Levels

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ABSTRACT

Background: In 2015 the World Health Assembly (WHO), based on recommendations by the Lancet Commission on Global Surgery, passed resolution (68:15) on strengthening emergency and essential surgical care and anesthesia as a component of universal health coverage. Children's surgery, however, was not adequately represented and in response, the Global Initiative for Children's Surgery (GICS) published the Optimal Resources for Children's Surgical Care (OReCS) in 2019 providing insight into procedures which should be performed at different facility types. OReCS 2 addresses a gap in both policy and published literature to further define surgical conditions and procedural capabilities by hospital level.

Methods: We performed a review of the literature to identify procedures routinely performed in a variety of settings. We then used an iterative Delphi like approach to identify specialty specific procedures and nursing skills by hospital level. Participation was open to all members of GICS with representation from 21 working groups and more than 50 Low-middle income countries (LMICs) and high-income countries (HICs). Data on essential procedures were collected for twelve specialty groups. Modifications of the recommendations provided by the working groups were made by the executive board based on firsthand knowledge of capabilities at lower-level facilities where subspecialists have less experience. Final recommendations were made based on greater than 75% agreement by respondents and review of the executive board of GICS.

Results: Procedures performed at health centers were limited to those not requiring anesthesia or sedation and were largely identified to help triage and stabilize patients for transfer to higher level care. Similarly, first level hospital procedures focused on stabilization and transfer to referral level hospitals for most specialties. Alternatively, specialties such as ophthalmology and dental surgery identified definitive procedures for lower-level facilities. Procedures performed at the National Children's Hospital level include those requiring specialty providers and equipment such as transplant, repair of congenital heart disease, and reconstructive surgery for complex trauma, congenital anomalies, and burns.

Conclusions: This updated version of OReCS provides specific examples of procedural capabilities for twelve subspecialties at the health center, 1st, 2nd, 3rd, and referral level hospitals

in LMICs. While the list is not meant to be all inclusive, it provides a framework within which to define the minimum essential material resources, equipment, and personnel by hospital level.

KEY WORDS: OReCS, children's surgery, surgical procedures, health facilities

LIST OF ABBREVIATIONS
GICS: Global Initiative for Children's Surgery
OReCS: Optimal Resources for Children's Surgery
HIC: High Income Countries
LMIC: Low to Middle Income Countries
LCoGS: Lancet Commission on Global Surgery
NSOAPs: National Surgical, Obstetric and Anesthesia Plans
DCP: Disease Control Prevention
OR: Operating Room
ACS: American College of Surgeons
SSI: Surgical Site Infection

INTRODUCTION

Surgical care has been considered as an essential component of child health and Universal Health Coverage (UHC), with an estimated 30 percent of the global burden of disease requiring surgical intervention at some point in life [1]. Children in low- and middle-income countries (LMICs) bear a disproportionate burden of surgically correctable conditions including congenital anomalies, trauma and injuries, and infections. Without timely access to care and intervention, many of these conditions result in preventable mortality or lifelong disability [2, 3].

In high-income countries (HICs), surgical systems have advanced within well-defined, tiered health care structures. Procedural capabilities are explicitly aligned with hospital level, supported by regulatory frameworks, standardized training pathways, and functional referral networks [4]. District or first-referral hospitals in these settings are designed to deliver a definitive package of essential surgical procedures, while more complex and high-risk interventions are concentrated at secondary and tertiary facilities. This stratified approach has been shown to improve surgical safety, efficiency, and equity [5]. In LMICs, multiple studies have documented substantial variability in surgical capacity across hospitals of similar designation, particularly at the district level [6, 7]. This difference may reflect disparities in workforce availability, anesthesia services, infrastructure, blood supply, and postoperative care, rather than differences in population health needs. As a result, children frequently experience delays in care, inappropriate referrals, or exposure to unsafe surgical practices [8, 9]. Expecting the same surgical procedures to be performed at every level of the health care system is neither feasible nor desirable. Literature consistently emphasizes that surgical outcomes are highly dependent on system readiness, including provider skill, equipment, perioperative monitoring, and intensive care capacity [1]. Evidence indicates that attempting to deliver complex procedures at lower-level facilities without these enabling conditions is associated with increased perioperative morbidity and mortality [10]. Consequently, international frameworks advocate for a rational distribution of surgical services based on procedure complexity and system capacity.

At the same time, decentralization of selected essential surgical procedures to district hospitals has been shown to improve access and reduce delays when supported by clear standards and referral

pathways [11]. It has been suggested that district hospitals can be strengthened to provide a core set of low-risk, high-impact procedures, while referral-level facilities focus on specialized and resource-intensive care [12]. This model is particularly critical for children's surgery, where early intervention is time-sensitive and delays can result in irreversible harm.

Despite increasing global attention to surgical system strengthening and the creation of National Surgical, Obstetric, and Anesthesia Plans (NSOAPs), there remains limited published guidance specifying essential children's surgical procedures by facility level in LMICs [13]. Prior OReCS documentation and available literature highlight an urgent need to define minimum, level-appropriate procedural recommendations that are realistic, safe, and aligned with existing resources [14]. Establishing such standards is a necessary step toward strengthening district hospitals, improving referral efficiency, and advancing equitable access to high-quality surgical care for children in LMICs. The aim of this work is to make recommendations for minimum children's surgical procedure packages for different levels of healthcare facilities.

METHODS:

According to the literature search and previous OReCS document, there is urgent need for setting up minimum standards for children's surgical care by different levels of health care system. Understanding the minimum standards at each hospital level is critical to defining what initiatives, specifically from the perspective of surgical procedures should be expected and required. Although the importance of procedural capabilities aligns with the existing resources and workforce, there is little published in terms of recommendations for essential surgical procedures at each health facility level in LMICs. As it is neither feasible nor desirable to provide all types of surgical care at every level of the health care system, the recommendations for improved procedural capacities should vary by level of care.

Facility levels are defined using a modification of the Disease Control Priorities (DCP) 3rd edition. In brief, the DCP classifies platforms of delivery of care into five categories including population based, community level, health center, first-level hospital, and referral hospital [15]. As in the first publication of the Optimal Resources in Children's Surgical Care (OReCS) version

1, we focus here on the delivery of surgical care which is performed at the highest three levels. Based on the experience of children's surgery providers from LMICs, the referral hospital level was divided into second and third level facilities and National Children's Hospitals. This distinction of National Children's Hospitals as a component of tertiary care was important because of the substantially different complexity of care and therefore requirements for policy makers. While physical resources and equipment may be similar between facilities, the children's hospital category is found to have a large impact on training, research, and advocacy at the national and international level , and thus will impact procedural capabilities [16]. The World Health Organization (WHO) uses three level to categorize healthcare facilities; level 1 (Primary), level 2 (Secondary), and level 3 (Tertiary) [17]. GICS employed the DCP3 definitions throughout the delphi process but in order to allow broader application of the results, the association between the classification systems is outlined in Table 1. Henceforth, "Health Center" corresponds with WHO Primary or Level 1 Facility; "First Level Hospital" and "Second Level Hospital" correspond with WHO Secondary or Level 2 Facility; and "Third Level Hospital" and "National Children's Hospital" correspond with WHO Tertiary or Level 3 Facility.

The recommendations for procedures to be performed at each level of care were developed through an iterative, Delphi-like process. This process involved multiple stages of expert panel review. It was initiated by a qualitative or open-ended assessment of essential procedures across specialties allowing respondents to rank procedures which should be prioritized at each facility level (Appendix 2). Responses were sought from all members of the GICS through email and survey format. A consensus assessment was then conducted [18, 19]. Participation was opened to all members of the GICS at the GICS V International meeting held in Manila, Philippines in 2025 including representatives from multiple surgical, nursing, and advocacy working groups. A survey with previously identified procedures and facility levels was distributed and included open ended response option for participants to include procedures that were felt to be needed at various facility levels. The responses were reviewed by the core group of authors, and a primary list of procedures was generated. This list was then distributed to all working group leads via email who were asked to specify which procedures should be required at each level of care. Data on essential procedures were collected from twelve specialty groups. Modifications of the recommendations provided by

the working groups were made by the executive board based on firsthand knowledge of capabilities at lower-level facilities where subspecialists have less experience. Agreement amongst respondents was then reviewed and recommendations with greater than 75% concordance were included for the third stage, consensus assessment. The final stage involved review of recommendation by a core group of board and committee members with representation from HICs and LMICs.

RESULTS:

Minimum essential procedures by specialty at Health Centers

A primary health center is the first contact point of health services in rural areas of low-income countries with care often provided by community health workers, nurses, or medical assistants. Minimum essential procedures that are available at this level are focused on the initial diagnosis, primary management, and simple interventions rather than advanced surgeries (Table 2). Nurses and community health workers act as the primary workforce at this level. They should provide essential services like basic life support (BLS), monitoring vital signs, prenatal screening, vaccination, and initial management of common conditions and injuries. No anesthesia or sedation is required at the health centers. Then, further clinical assessment should include basic cardiovascular examination such as- cardiac auscultation to identify any suspected congenital heart disease, as well as electrocardiography (ECG) where available. Moreover, health centers should have the facilities to identify common pediatric emergencies including pneumonia, dehydration, neurotrauma, and other acute illnesses, and initiate appropriate stabilization procedures before referral.

Minor procedures like incision and drainage of superficial abscesses, repair of simple lacerations, splinting of uncomplicated fractures, circumcision, first aid for first-degree burns, and treatment of common eye and skin infections. At this level, all specialties recommended capabilities around early detection, triage, stabilization, and referral rather than definitive surgical treatment.

Procedural capabilities by specialty at first level hospital

In alignment with DCP classification system, the OReCS document classifies facilities as first level hospitals that have twenty-four-hour clinical services for patients with life threatening conditions [14]. Unlike health centers, first level hospitals have more expanded procedural capabilities. As described in the executive summary, the first level hospital will have basic facilities and increased providers thus allowing a higher level of diagnostic and therapeutic, and therefore procedural, capability. Both general and local anesthesia services are provided along with laryngeal mask airways (LMA) and endotracheal tubes for children (>1 year) by the specialty of anesthesia (Table 3). The general medical providers, surgeons, and cardiologists available at the first level hospital should provide more advanced care including medical/conservative treatment of patent ductus arteriosus and echocardiography. In critical care, procedural capabilities go beyond the services of health centers and include advanced stabilizing maneuvers such as venous cut down, recognition and treatment of meningitis and early sepsis, and administration of oxygen. General surgeons at the first level hospital should be supported to perform moderately advanced procedures such as trauma/ emergent laparotomy, amputation, colostomy, thoracostomy, hernia repair, and orchiopexy. Despite not recommending specialty trained neurosurgeons at the first level hospital, procedures such as exploratory burr holes (without CT), ventricular taps, and trauma craniotomy should be available by general surgeons and non-physician surgical providers.

Medical officers without specialized training at the first level hospital should also be trained to manage ophthalmologic and dental/OFMS procedures for management of foreign bodies, corneal scratch, hyphema, and dental extractions. Though not pediatric specific, orthopedic surgeons at this level should perform more advanced procedures including treatment for open fractures, clubfoot with Ponseti technique, and infection drainage. Minimum essential procedures by the general surgeon within the ENT/Otolaryngology specialty again include the removal of foreign body in ear/nose/throat, packing for epistaxis, drainage of superficial skin abscess, and treatment of tonsillitis. Along with the management of 1st degree burn and simple laceration, plastic surgery specialty at this level should include burn escharotomy and stabilization of vascular trauma and wound sepsis. Nursing specialty adds screening procedures for surgical site infections, intravenous access, vascular line care, and advanced wound management at first level hospital.

Procedural Capabilities by Specialty at Referral Hospitals

The procedural differences are due in large part to the range of specialty trained providers available at each level hospital with the greatest number of pediatric trained specialists at the National Children's Referral Hospital. Table 4 highlights the advancement in minimum essential procedures at different referral hospitals. All the referral hospitals have the necessary anesthesia capacity for all ages including general, regional, and local anesthesia, a significant change from the care recommended at first level hospitals which focuses on children greater than 1 year of age. The second-level hospital that serves as a first referral point has wide range of procedural capabilities. As such, resuscitation, airway management, treatment of meningitis and early sepsis, routine surgical procedures, management of traumatic facial injuries, thoracostomy, closed reduction for hip dysplasia, pinning SCFE, fasciotomy, syndactyly release, management of spina bifida, hydrocephalus, cataract surgeries, orchiopexy, preputialplasty, cystostomy, vesicostomy, lap assisted orchiopexy, imperforate hymen, hypospadias, nephrostomy, and urolithiasis management should all be routinely performed by respective specialty at this level hospital.

Having the broadest range of subspecialties, the third level and National Children's Hospitals serve the highest level of care within a country. The capabilities of these hospitals extend up to complex surgeries such as surgical correction of cardiac anomalies, palliative treatment of Tetralogy of Fallot, Extra Corporeal Life Support, simple anoplasty, trauma thoracotomy, repair of gastroschisis and omphalocele, management of complex neurovascular malformations, epilepsy, surgical correction of ophthalmologic conditions (including squint, ptosis, retinopathy, and glaucoma), repair of cleft lip and palate, maxillo-facial reconstruction, definitive management of osteomyelitis/septic arthritis, muscular dystrophy, tympanomastoidectomy. Pediatric urologists at this level should manage all congenital and acquired conditions such as urethral valve, bladder exstrophy, cloacal exstrophy, and epispadias. Multi-disciplinary teams should provide procedural support around kidney transplant and nursing capabilities at these hospitals also increase from basic life support to advanced life support (PALS, ACLS) progressively.

DISCUSSION

This article aims to propose an equitable distribution of minimum essential children's surgical procedure packages across healthcare facilities levels. It reflects a core principle of effective surgical system design where procedural capability must be aligned with infrastructure, workforce capacity, and training. The findings reinforce global surgery literature that emphasizes that safe surgical care cannot be defined solely by the availability of a procedure, but rather by the system readiness required to deliver that procedure safely and consistently [1].

Building Packages for Safe Surgery by Facility Level

Health Centers

While the results of this study were specific to working group specialties, it is our recommendation that the health center focus on triage, stabilization, and referral with definitive treatment for few conditions. This is consistent with evidence showing that primary-level facilities in low-resource settings are most effective when focused on timely recognition of surgical conditions and prompt referral, rather than attempting operative care without anesthesia capacity, sterile environments, or postoperative monitoring [11, 20]. The absence of anesthesia services at this level is a matter of well-established safety concern, as anesthesia-related morbidity and mortality increase significantly in settings without trained anesthesia providers, oxygen supply, and monitoring equipment [13]. The emphasis on basic life support, wound care, infection management, and burn first aid aligns with WHO recommendations for integrated primary care and underscores the critical gatekeeping role of community health workers and nurses in pediatric surgical pathways [21].

First Level Hospitals

In contrast, first-level hospitals represent a transition point where increased infrastructure and workforce capacity enable a broader range of diagnostic and therapeutic procedures. The availability of general and local anesthesia, airway management for children over one year of age, and basic surgical imaging reflects an incremental strengthening of system inputs that permits expansion of procedural scope. Importantly, the ability of general surgeons, non-specialist physicians and non-physician surgical providers to perform procedures such as laparotomy, thoracostomy, burr holes, and ventricular taps reflects evidence that task-sharing, when supported

by structured training and supervision, can safely expand surgical access in LMICs [18, 22]. Studies consistently demonstrate that surgical outcomes are strongly influenced by provider competence and team-based care, particularly in pediatric populations [23]. This reinforces the need for synchronized investments in infrastructure, workforce development, and continuing professional education, rather than isolated upgrades in facilities or technology.

Referral Level Hospitals

Referral hospitals, particularly third-level and national children's hospitals, represent the apex of the surgical care continuum, where the convergence of advanced infrastructure, specialized workforce, and multidisciplinary teams enables complex and high-risk pediatric procedures. The expansion of anesthesia services to include all age groups, regional techniques, and advanced life support aligns with evidence that complex pediatric surgery requires robust perioperative systems, including intensive care units, blood banks, imaging, and subspecialty collaboration [13, 24]. Concentrating highly specialized procedures such as congenital cardiac repair, neurovascular surgery, and complex urologic reconstruction at referral centers reflects a tertiary-level strategy shown to improve outcomes by maintaining procedural volume, expertise, and quality assurance.

Comparatively, high-income countries have tiered healthcare models validated through formal accreditation systems, scope-of-practice regulations, and referral protocols [25]. It is our recommendation that LMICs adopt similar principles while adapting them to context-specific limitations. Importantly, expanding procedural capability without investments in supplies, infrastructure, and training risks undermine patient safety, whereas coordinated system strengthening enables safe decentralization of essential services and appropriate centralization of complex care.

This comprehensive set of recommendations for a tiered approach to procedural capacity in the LMIC setting is not without limitations. The list of procedures is not meant to be exhaustive or prescriptive, and individual factors, including surgeon and staff familiarity and infrastructure availability, will ultimately dictate the capability of any healthcare facility. The intention is that these findings can be used to support system development and standardization.

Conclusion

Overall, these recommendations support the argument that establishing minimum essential procedures by hospital level is not merely a technical exercise, but a strategic health systems intervention. By aligning infrastructure readiness with workforce training and clearly articulated procedural packages, health systems can strengthen referral efficiency, optimize resource use, and improve equity in access to children's surgical care. This level-specific framework is particularly relevant for National Surgical, Obstetric, and Anesthesia Plans (NSOAPs) and provides an operational roadmap for translating global commitments to UHC and child health into actionable, facility-level standards.

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