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Optimal Resources for Children's Surgery 2: Updates on training and education recommendations

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ABSTRACT

Objective: The practice of pediatric surgery, and surgery in general, in low- and middle-income countries (LMICs) presents multiple challenges. Beyond limitations in physical and human resources, there is a great disparity in the quality and accessibility of training programs in LMICs. In response to input from high-income countries (HICs) and a desire to standardize training, regional associations have formed with the aim of facilitating knowledge sharing and enhancing surgical education around the world. Despite this, no clear guidelines exist regarding the types of initial training programs and Continuing Professional Development (CPD) needed at various levels of health care delivery.

Methods: We performed a PRISMA literature review to identify types of training programs needed at the health center, first level hospital, second level hospital, third level hospital, and national children's referral hospital. We then used an iterative Delphi like approach to identify and rank specific educational needs by hospital level. Participation was opened to all GICS V conference attendees held in Manila Philippines February 2024. This represents 441 participants from 50 countries (79% low to middle income countries). Final recommendations were made based on greater than 75% agreement by respondents and reviewed by the GICS OReCS 2 core working group.

Results: There was agreement amongst respondents that some education program should be offered at every facility level. For health centers and first level hospitals, programs were limited to initial training and continuing education for community health workers and nurses. General medical provider training should start at the first level hospital while medical schools should be at the third level and national children's referral hospital. Specialty training for medical and surgical specialties was recommended only at the third level and national children's referral hospital.

Conclusion: Providing safe and high-quality surgical care for children requires a standardized approach to training not only for surgeons but also for all members of the care team. While the Optimal Resources for Children's Surgery update does not seek to dictate how the training is administered, it does provide a framework for fostering local training programs and creating a skilled workforce at standards mirroring that in HICs.

KEYWORDS: Training, Curriculum, Facility Tiers, Resources

Introduction

The Optimal Resources for Children's Surgery (OReCS) program, led by the Global Initiative for Children's Surgery (GICS), promotes standards for delivering appropriate surgical care to children across low- and middle-income countries (LMIC) health systems. OReCS organizes care into three levels: basic, intermediate, and complex/advanced, which are categorized based on the surgical problem complexity and the resources required to treat [1].

Roughly 1.75-2 billion children lack access to safe surgical and anesthesia care. As much as 87% of surgical needs in LMICs are unmet, despite 30% of the global burden of disease requiring surgery to be treated [2,3]. The Essential Surgery Volume of the Disease Control Priorities 3rd Edition (DCP3), Lancet Commission on Global Surgery (LCoGS), and the World Health Assembly resolution have highlighted the need for essential surgical and anesthetic care being available across the world as well as part of the Universal Health Coverage (UHC). However, the specific surgical needs of children and the resources needed to treat the surgical issues have not been explicitly addressed [1,3,4,5].

The OReCS document identified certain domains as essential for safe management of children's surgery: training, quality improvement, hospital assessment, and research. Barriers affecting healthcare providers include lack of training, ineffective teamwork, unclear responsibility, inequity, lack of support, and the shortage of health care supplies and information technology [6]. Training across the various providers needs to be strengthened to minimize morbidity and mortality in children affected by surgical diseases; the providers include community health workers, perioperative nursing staff, anesthesia staff, general doctor, pediatrician, laboratory, operating room personnel, X-ray technicians, rehabilitation specialists, generalist surgeons, and pediatric surgical subspecialists [1].

Recognizing this gap, GICS undertook an iterative Delphi-like approach, multi-working-group process to map and rank specific education needs according to the hospital level (health center, first

level hospital, second level hospital, third level hospital, and national children's referral hospital). Those outputs provide the core data that inform OReCS 2.0 training recommendations.

The consensus highlights the need for explicit, implementable training packages that align with OReCS service expectations at each level. The aim is to give stakeholders actionable guidance to plan progressive workforce development aligned with facility roles, educational interventions, regional training and research hubs to close persistent skill, training, and quality gaps identified by LMIC providers [1].

Methods

We used multiple methods with a realistic approach to update the Optimal Resources for Children's Surgery (OReCS).

Part 1: An iterative Delphi-style consensus process with multidisciplinary working groups to define methodology components, inclusion criteria, consensus thresholds. Core program documents and prior OReCS material were used as the foundational framework for methods and for mapping recommended training at each level. All members of GICS were invited to participate. The first round included sending a list of identified training programs to the working groups and requesting ranking of which programs should be included at each level. Open-ended questions were also used to allow respondents to make suggestions. Participation was then opened to all GICS V conference attendees held from 24-26 February 2024 in Manila Philippines. This represents 441 participants from 50 countries (79% low to middle income countries). Final recommendations were made based on greater than 75% agreement by respondents and reviewed by the GICS OReCS 2 core working group.

The results were summarized and distributed to participants at the GICS 2024 meeting in Manila. Within working groups, the recommendations were reviewed and ranked by the OReCS working group.

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 [7]. As in the first publication of 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 according to LMIC providers [8]. The World Health Organization (WHO) uses three levels to categorize healthcare facilities; level 1 (Primary), level 2 (Secondary), and level 3 (Tertiary) [9]. 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.

Part 2: PRISMA Literature review - Study and curriculum elements [1,10,11,12] as well as recent updates to training and curriculum guidance (national curricula, specialty milestone/supplemental guides and high-value teaching modules) were reviewed [10, 11,12,13,14].

The literature was reviewed by mapping existing guidance on children's surgical curricula, training milestones, end-of-rotation competencies, and educational resources to inform scope and candidate items for the consensus process. Databases and resources were searched for terms such as 'pediatric surgery curriculum', 'milestones', 'surgical education' and 'competencies' from core OReCS document, relevant society curricula (American Pediatric Surgical Association (APSA), pediatric surgery teaching modules, Pediatric Surgery Library), national curricula (Saudi Commission for Health Specialties (SCFHS) pediatric surgery curriculum) and competency

supplements (Accreditation Council for Graduate Medical Education (ACGME) pediatric surgery supplemental guide). These sources were prioritized because they reflect accepted specialty standards and program-level curricula [1,10,11,12,13,14,15].

Inclusion criteria for curriculum/evidence items were documents describing curricula or competency frameworks for pediatric surgery or closely related perioperative disciplines, educational modules designed for point-of-care or program-level teaching, studies that inform where to locate training or service delivery, published studies or authoritative guidance on Delphi/consensus methods for curricula development. The exclusion criteria were documents or sections not related to pediatric surgical training, and irrelevant literature articles. The literature review is independent of the Delphi process and does not involve review by the GICS members.

Results

Part 1: We synthesized evidence from the original published OReCS document [1], a curated set of specialty curricula, teaching modules and recent literature listed by working groups. Delphi input and working-group discussions (GICS membership across 21 specialty groups; LMIC and HIC representation) provided the primary consensus data for item prioritization and level-allocation. In addition to input from all GICS V conference attendees held from 24-26 February 2024 in Manila Philippines. This represented 441 participants from 50 countries (79% low to middle income countries). Recent literature informed the feasibility and modality choices.

Delphi-derived consensus (≥75% agreement where reported) produced a stratified set of education packages tied to different facility levels [1] [Tables 2,3]:

- Health center: Community health worker initial training and ongoing refresher education modules such as screening, triage, basic wound/burn care, referral triggers. The consensus is reflected in working-group scoring.

- First-level hospital: Community health worker programs plus formalized nursing initial training and continuing education; a general medical provider initial training package emphasizing acute resuscitation, pediatric basic surgical assessment and safe pediatric anesthesia referral criteria.
- Second-level hospital: Consolidation of first-level hospital training plus pediatric-specific medical provider training, structured general-surgery provider training appropriate for emergency and essential pediatric procedures, and mandatory Continuing Professional Development and recertification for all medical providers.
- Third-level hospital: Full medical school-level training environment plus specialist training pathways (pediatric surgery, anesthesiology with pediatric focus), advanced perioperative nursing education, and unanimous agreement that pediatric surgeon initial training and ongoing recertification are delivered at this level.
- National children's referral hospital: Consolidation of third-level hospital training and advanced training in pediatric surgery subspecialties and research.

Consensus percentages and item distributions from the working-group survey are summarized in Table 1 of the training update and were used to set the ≥75% inclusion rule for core items.

Part 2: We mapped consensus learning objectives and procedural competencies to established curricula and milestone guides to improve adoptability and assessment alignment:

- APST and APSA pediatric surgery resources propose/demonstrate curriculum, primary skills objectives (trauma, surgical skills, endoscopy) and competency-based objectives (professionalism, medical knowledge, patient care) for advanced levels [12,14].
- ACGME pediatric surgery supplemental milestones inform the selection of entrustable professional activities (EPAs) and assessment methods for trainees at third-level and national referral hospitals [11].
- National/regulatory curricula such as SCFHS pediatric surgery curriculum supports contextualized recommendations for postgraduate training elements at third-level and national children's facilities [14].

- GICS specialty teaching modules (Neonatal skills course, minimally invasive course, colorectal course, etc.) can be used for short-course content in first- and second-level hospitals.

Level-specific minimum procedural competence lists include:

- Basic laceration repair, wound care and fracture splinting at health centers
- Common emergency laparotomy, appendectomy, chest tube placement and basic burn management at first-level hospitals
- Neonatal surgical stabilization, pediatric oncology resections, congenital anomaly repairs and neonatal anesthesia competence at referral levels.

A mixed-modality training strategy graded by facility level and resource context:

- Short modular courses and competency-based workshops at first- and second-level hospitals.
- On-site simulation recommended for infant/neonatal anesthesia drills and trauma scenarios.
- Regional fellowships and subspecialty rotations at third-level and national centers to build advanced skills and local teaching capacity.
- Formal CPD and recertification frameworks administered by national/regulatory bodies or regional hubs.

These modality choices reflect a balance between evidence for effective adult learning in low-resource settings and operational feasibility.

The results integrate Delphi consensus, existing curricula and grey literature to define level-specific education packages, minimum procedural competencies, assessment methods, and a pragmatic delivery model (modular courses, simulation, mentoring, and recertification) mapped to the OReCS operational priorities.

Table 1. Facility level definitions and levels of care

WHO (2003)	DCP 3 classification (2017)[1]		Level of Care	Typical Infrastructure	Treatment Capability	Examples
	Population Based Community Level					
Primary: Small hospital/ health center	Health Center		Basic	Small number of beds, sparsely equipped procedure space	Emergency stabilization, referral to higher level of care	Screening for surgical disease, resuscitation
Secondary: District/ provincial hospital	First-level Hospital		Intermediate	100-300 beds, major and minor operating room	Short term treatment most major life-threatening conditions	24/7 emergency surgical care (including surgical care for children)[2]
	Referral Hospital	Second-level Hospital	Complex/ advanced			
Tertiary: Referral hospital		Third-level Hospital National Children's Hospital		300-1000 beds, fully equipped operating room, intensive care facilities	Addition of intensive care treatment	Comprehensive surgical care for children including multidisciplinary and chronic care

[1] Definitions used throughout OReCS reference the DCP 3 classification with corresponding WHO classification implied

[2] Comprehensive surgical care for children at 2nd level hospital with variability based on local resources

Table 2. Recommendations for education program by facility level

Health Center
● Community health worker initial training ● Community health worker ongoing training
First Level Hospital
● Community health worker initial training ● Community health worker ongoing training ● Nursing Initial training program ● Nursing ongoing education/re-certification ● General medical provider initial training program
Second Level Hospital
● Nursing ongoing education/re-certification ● General medical provider initial training program ● Pediatric specific medical provider training program ● Ongoing education/recertification for medical providers ● General surgery provider initial training
Third Level Hospital
● Nursing ongoing education/re-certification ● Medical school ● General medical provider initial training program ● Pediatric specific medical provider training program ● Ongoing education/recertification for medical providers ● Ongoing education/recertification for medical providers with pediatric training ● General surgery provider initial training ● Ongoing education/recertification for general surgeon ● Pediatric surgeon initial training ● Ongoing education/recertification for pediatric surgeon

● Other surgical specialty initial training ● Ongoing education/recertification for other surgical specialties
National Children's Referral Hospital
● Nursing ongoing education/re-certification ● Medical school ● Pediatric specific medical provider training program ● Ongoing education/recertification for medical providers ● Ongoing education/recertification for medical providers with pediatric training ● Ongoing education/recertification for general surgeon ● Pediatric surgeon initial training ● Ongoing education/recertification for pediatric surgeon ● Other surgical specialty initial training ● Ongoing education/recertification for other surgical specialties

Table 3. Education programs required by facility level (displayed as percentage of respondents in agreement)[1]

	Health Center	1st Level Hospital	2nd Level Hospital	3rd Level Hospital	National Children's Hospital
None	11.1	11.1	0.0	0.0	0.0
Community Health Worker Initial Training	88.9	77.8	22.2	33.3	22.2
Community Health Worker Ongoing Education	88.9	77.8	44.4	44.4	33.3
Nursing Initial Training Program	66.7	88.9	66.7	55.6	55.6
Nursing Ongoing Education/re-certification	55.6	77.8	77.8	88.9	88.9
Medical School	22.2	33.3	55.6	88.9	88.9
General Medical Provider Initial Training Program	44.4	77.8	77.8	77.8	44.4
Pediatric Specific Medical Provider Training Program	11.1	33.3	77.8	88.9	88.9
Ongoing education/recertification for Medical Providers	22.2	33.3	100.0	88.9	88.9
Ongoing education/recertification for Medical Providers w Pediatric Training	11.1	22.2	55.6	88.9	88.9
General Surgery Provider Initial Training	11.1	33.3	88.9	88.9	33.3
Ongoing education/recertification for General Surgeon	11.1	33.3	66.7	88.9	77.8
Pediatric Surgeon Initial Training	11.1	11.1	22.2	100.0	88.9
Ongoing education/recertification for pediatric surgeon	11.1	11.1	22.2	100.0	100.0
Other surgical specialty initial training (please comment below for specifics)	11.1	11.1	33.3	77.8	77.8
Ongoing education/recertification for other surgical specialties	11.1	11.1	11.1	77.8	77.8

[1] Participating working groups: Plastic surgery, Urology, General Surgery, Oral and Maxillofacial, ENT, Neurosurgery, Oncology, Orthopedic Surgery, Cardiac Surgery

Discussion

OReCS 2 integrates the iterative Delphi consensus and literature review, where the facility-level educational needs were identified and evidence-based curricula were mapped, respectively.

OReCS 2 advances a model where level-specific training packages support safe task-sharing and decentralization of children's surgical care by specifying which competencies, procedures, and supervision structures belong at each facility tier. Structured, competency-based short courses and supervised practice improve provider confidence and decision-making in low-resource settings, and that decentralization paired with clear referral and mentorship reduces delays to definitive care. Integrating defined professional activities and minimum procedure lists into level-based curricula helps preserve safety while expanding access. The recommendations can be operationalized by the health systems by implementing competency checklists and strict assessment protocols, managing local burden and resources according to context with relevant content from international/regional/national regulatory bodies, as well as aligning curricula with the respective facility tier.

A sustainable workforce requires clear role definitions and career pathways. Community health workers and non-physician clinical healthcare providers can help with screening and basic procedures at health centers. Specialist training such as pediatric surgery and pediatric anesthesia should be delivered at third-level and national referral centers. Delphi-derived consensus endorses progressive upskilling and recertification across levels. Matching international curricula and milestone frameworks to local scope of practice helps with providing appropriate care for the pediatric population. Resource hubs backed by competency checklists and supervision improve quality metrics [1,3,10,11,12,13,14].

This manuscript emphasizes competency-based modules with measurable outcomes such as skill checklists, OSCE stations, and workplace-based assessments, so that training is comparable across contexts [13]. Mapping curricula to established resources, including APST/APSA curriculum or SCFHS and ACGME milestones, ensures learners acquire internationally recognized competencies while permitting contextual adaptation of content, contact hours, and assessment thresholds [11,12,13,14]. At health centers and first-level hospitals, educational initiatives focus on direct observation and checklist-based assessment as limited tools are available. Second-level hospitals can focus on OSCE and workplace-based assessments for a handful of skills (eg: emergency laparotomy, chest tube placement) within the context of recommended medical

provider training. National Children's and third-level hospitals can host comprehensive professional activities, OSCEs, competency-based assessments, etc., as they are sites of collaboration for medical schools and specialist training.

While this analysis is mostly based on US curricula such as the APSA and ACGME milestones, other international frameworks such as the UK Intercollegiate Surgical Curriculum Programme (ISCP) also provide detailed information on structured pediatric surgery training. Though not included in this analysis primarily, other regional resources are valuable in contributing to the global pediatric surgery curriculum.

Training outcomes should feed into morbidity and mortality review, preventable-death studies, and routine data collection so that competencies translate into improved patient outcomes. It is best to maintain institutional trainee case-logs and a pediatric surgical database for outcome-tracking and to identify gaps in procedural exposure that inform targeted retraining or referral policies.

Besides the initial training, regular recertification and CPD are required to maintain competence and reduce skill decay. Lack of ongoing training contributes to poor provider-care quality. In regions where specialist providers are geographically isolated and training infrastructure is variable, structured CPD aids in standardizing care across facilities. OReCS 2 emphasizes the need for the CPD component to be equal to the initial training. Some examples of CPD are case-based learning from institutional records, competency reassessment every two to four years, fellowships for emerging subspecialties, and simulation-based training for emergency and high-risk procedures. To overcome barriers in CPD, regional training hubs can serve as CPD centers, leverage technology to review cases/online modules, and establish strict accountability protocols.

To sustain high-quality pediatric surgical care, regular certification and CPD are required, especially in LMIC settings where access to updated clinical guidance is limited. Evidence shows that lack of ongoing training plays a significant role in contributing to poor care quality and provider performance [6]. Continuous skill reinforcement, in addition to initial training, is required to strengthen surgical systems - the Lancet Commission on Global Surgery as well as WHA68.15

emphasize the need for ongoing education for universal health coverage and effective surgical systems [4, 5]. Lower-level facilities should focus on refresher courses in emergency procedures, assessment and safe referral criteria, whereas, third-level and national children's hospitals should focus on review of cases, regular evaluations, feedback along with periodic refresher courses.

The aim of this work was to define expectations for training and education across the different tiers of facilities, nevertheless, the detailed models on training, tools and curricula need to be worked upon. Future works need to focus on how programs should be structured and the mapped curricula from the existing literature need to be evaluated for their effectiveness in LMIC settings. The next phase of work should focus on strengthening the training systems and expanding research within pediatric surgical care and providing the base for the research questions listed below.

A minimal dataset aligned with a GICS proposed pediatric surgical database to track trainee case-exposure, assessment outcomes, patient-level morbidity/mortality, and training impact on service delivery is recommended. The dataset needs to be designed to be mobile-friendly and aligned to regional research hubs for analyses. Embedding training evaluation into routine quality-improvement cycles is proposed as the standard for measuring long-term training effectiveness and safety improvements.

Limitations

This document outlines recommendations for training at each facility tier but deliberately refrains from prescribing training administration, specific curricula implementation and assessment competencies in varying contexts. OReCS 2 does not define minimum caseload/volume for procedures, specify assessment tools, give detailed curricula, and analysis of cost-effectiveness.

OReCS 2 proposes a system-oriented, competency-based approach to children's surgical training that ties level-specific education to measurable assessment and quality improvement (QI); it provides toolkit elements to operationalize training.

Conclusion

A systems-level commitment to children's surgical care grounded in level-specific training packages, practical resource templates, and measurable quality processes is essential to close the global access gap and improve outcomes for children in LMICs. The recommendations listed are the minimum expectations for training at each level and are a steppingstone to laying out a structured framework that health ministries, training institutions and professional societies can adhere to for national strategies.

However, these recommendations do not possess a fully operational roadmap for implementation. They also do not include the international frameworks from different regions across the world and are mostly limited to the US. The document does outline the basic training that needs to occur at every level but purposely does not provide specific tools, curricula and training models that educators and administrators will need to reform programs. Developing context-adaptable materials will need work beyond the scope of this publication. Ongoing efforts within GICS and partner organizations will focus on translating the outlined standards into training resources.

OReCS 2 lays the foundation for future operations and integration of pediatric surgical care/training into National Surgical, Obstetric and Anesthesia Plans (NSOAPs). Continuous investment, research, and collaboration will help build the models needed to make safe, affordable, and timely care for every child, which is a component of universal health coverage.

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