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Title: Optimal Resources for Children's Surgery 2: Essential Human Resources for Optimal Children's Surgery

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ABSTRACT

Background: Following its inaugural meeting at the Royal College of Surgeons of England, London, United Kingdom, in 2016, the Global Initiative for Children's Surgery (GICS) published the Optimal Resources for Children's Surgery 1 (OReCS) consensus document detailing the facilities and resources required at each level of care. In addition to physical resources needed to provide care for children, the Lancet Commission on Global Surgery (LCoGS) identified the density of surgical providers as a marker of sufficient workforce in capacity. To meet the needs of patients, OReCS 2 details the varying types of providers needed at each level of care to meet the minimum expected capacity to care for children with surgical needs.

Methods: We performed a review of the literature and reviewed LCoGS recommendations that applied solutions in low resource settings. We then used an iterative Delphi-like approach to determine types of providers needed for each of 13 sub-specialties in children's surgical care at the different hospital levels. Participation was opened to all GICS V conference attendees that 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 a greater than 75% agreement by respondents and reviewed by the 20 GICS board of directors.

Results: In the current literature, there is considerable variability in the provider types described for each facility level with an emphasis on the use of non-physician health workers such as clinical officers, nurse anesthetists and community health workers to improve access. Using the modified Delphi from GICS V, it is recommended to have a generalist medical practitioner, followed by non-physician surgical providers at Health Center level. First level hospitals should have generalist medical practitioner, non-physician surgical provider, generalist medical practitioner with pediatric-specific training. At the referring hospital level, which include, 2nd level hospital, third level hospital and children's hospital, recommendations are generalist medical practitioner (GMP), non-physician surgical providers (NPSP), paediatric general and specialty surgeons and some medical specialists such as cardiologist, gastroenterologist and others, for maximum care coverage

Conclusions: To improve access to high quality care and perform the procedures considered essential, different types of providers are needed at different facility levels. Ranging from community health workers to surgical subspecialists to nurses with expertise in pediatric intensive

care units to physiotherapists. OReCS 2 provides detailed examples of the optimal human resources and workforce needed at each facility level.

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

GMP: generalist medical practitioner. NPSP: non-physician surgical providers

GMP-p: generalist medical practitioner with pediatric-specific training,

GS: General surgeon,

PGS: Pediatric general surgeon

ICU: Intensive care unit

DCP: Disease Control Prevention

INTRODUCTION

The United Nations Department of Economic and Social Affairs, Population Division reported an estimated global population of children under age 18 as 2.4 billion in the year 2023 [1]. This estimate represents about 30% of the global population. Consequently, a considerable number of children may be impacted by the 2015 Lancet Commission on Global Surgery's (LCoGS) estimate that over 5 billion people lack access to safe, reasonably priced surgical and anesthetic care when necessary [2]. For instance, a 2019 study revealed that 1.7 billion children worldwide lack access to the basic, life-saving surgical treatment they require, which translates to 92.3% of children in lower middle-income countries (LMICs) and 97.7% of children in low-income countries (LICs) [3]. Although researchers report that by age 15, about 85% of children will suffer from surgically treatable conditions in LMICs, less than 8% of them currently have access to even the very basic level of surgical care [4]. A contributing factor to the lack of surgical care is the workforce deficit which is compounded in LMICs by limited resources, associated cost, and low exposure to the surgical and anesthetic fields in medical schools [2].

With the advancement of medical technology and the growing number of surgical procedures, the need for human resource allocation in the operating room to ensure surgical quality and increase labor efficiency has been emphasized [5]. However, with limited human resources, surgical and anesthetic care in most LMIC contexts is offered by general doctors, rather than specialists [6]. This lack of specialized human resource limits care, with implications for quality of care and overall outcome. Though the majority population of most LMICs are children, the pediatric surgical workforce is deplorable [7]. For instance, a 2022 publication by KidsOR indicated that countries like Burundi, Liberia, Guinea Bissau, Cape Verde, Botswana, Lesotho, Eswatini, Seychelles, Comoros, South Sudan, and Gambia had no pediatric surgeon. Similarly, the rest of Africa countries could only count between 1-20 pediatric surgeons with only Nigeria having above 100. Moreso, the majority lack a paediatric anesthesiologist [8].

The general pediatric surgical capacity in LMICs is described as at 0.26 pediatric surgeons and 1 general surgeon per million children and a median 0.17 surgical facility per million children [9]. With the extremely low pediatric workforce, there are no clear structured workforce guidelines in LMICs for optimal management of pediatric surgical conditions per level of care [3]. Addressing a minimum structured human resource guideline that sorts to maximize available human resources is

vital to patient care. Expectations or minimum standards of care must vary by level of health care facilities. In many low resource settings, little thought has been given to optimizing human resources for high quality care management of surgical conditions in children. Just as it is neither feasible nor desirable to provide all types of surgical care at every level of the health care system, optimal surgical management requires a degree of task sharing and task shifting in areas of limited human resources [10]. Based on the surgical procedures performed, the equipment and resources identified, and the staffing available or required, outcomes can match standards at facilities based on the 2017 Disease Control Prevention (DCP) 3 classification system [11].

GICS believes that there is an important opportunity to prevent death and reduce disability in children by scaling up surgical care in low- and middle-income countries which accounts for the initial publication titled "The Optimal Resources for Children's Surgery" (OReCS 1), which provides a strategy for integrating surgical care for children into National Surgical, Obstetric and Anesthesia Plans (NSOAPs). This current project fits into the OReCS 2 and aims at responding particularly to the human resource requirements for children's surgical care at various levels of care.

METHODS:

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 [12]. As in the first publication of the 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 [13]. The World Health Organization (WHO) uses three level to categorize healthcare facilities; level 1 (Primary), level 2 (Secondary), and level 3 (Tertiary) [14]. 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.

Although human 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 [4, 15].The desired HR for optimal pediatric surgical care as recommended for inclusion at each level of care were determined from an iterative Delphi-like approach. This process involved a qualitative or open-ended assessment, a ranking evaluation, and a consensus assessment [4, 16]. Participation was open to GICS members attending the GICS V conference at Manila Philippines (Figure 1).

- Initial assessment was conducted at the GICS V meeting with representation from multiple surgical, nursing, and advocacy working groups.
- The responses were reviewed by the core group of authors, and a comprehensive list of desired human resources per level of care generated.
- The list was then distributed to all working group leaders and they were required to review which personnel was appropriate per level of care.
- Agreement amongst respondents was then reviewed and recommendations with greater than 75% concordance were included for the third stage, consensus assessment.
- The final stage leading to the provided recommendations involved review of recommendations by GICS board members and some committee members with representation from HICs and mostly LMICs.

Definition of provider types

Terminology follows the WHO occupational classification [17], with study-specific descriptors retained for additional training and clinical roles. Non-physician anesthetist (NPA) denotes a non-doctor providing anesthesia within an authorized scope; nurse anesthetists map to nursing professionals (ISCO-08 2221), while other cadres require role-specific classification.

Generalist medical practitioner (GMP; ISCO-08 2211) denotes a medical doctor providing general medical care [17].

Non-physician surgical provider (NPSP) is a study-specific functional descriptor, not a separate WHO occupation. Classification depends on duties; appropriately trained clinical officers undertaking surgical procedures may map to paramedical practitioners (ISCO-08 2240) [17].

Generalist medical practitioner with pediatric-specific training (GMP-p) is a study-specific training descriptor, not synonymous with a specialist pediatrician. Pediatricians and other medical and surgical specialists map to specialist medical practitioners (ISCO-08 2212) [17].

Community health worker (CHW; ISCO-08 3253) supports community health through education, basic preventive care, referral and follow-up [17].

Clinical officer (CO) maps to paramedical practitioners (ISCO-08 2240) when duties meet that category's definition [17]. National titles alone do not establish occupational classification or clinical scope.

RESULTS:

Socio-demographic information.

The initial assessment done during the GICS V conference at Manila Philippines included 441 participants from over 50 countries. *Figure 2*

Participants were mostly physicians from LMICs (54.9%), and trainees from LMICs (13.5%), followed by nurses and public health specialists from both HICs and LMICs. This accounted for majority participants being from LMICs (78.9%). *Figure 3*

Recommendations

The recommended human resources are at the three healthcare levels: health centers, first-level hospitals, and referral hospitals. The concerned personnel are those required to offer optimal surgical care to the pediatric population across the aforementioned institutions in fields that cut across Anesthesia, Cardiac Surgery, Critical Care, General Surgery, Neurosurgery, OMFS/Dental,

Orthopedic Surgery, ENT/Otolaryngology, Plastic Surgery, Urology, Nursing, and Oncology. Of the 13 targeted specialties, we had respondents for the above 12 except for Ophthalmology.

1. Personnel Recommendation by Specialty at Health Center.

At the Health Center level, most health personnel recommended generalist medical practitioner (GMP), followed by non-physician surgical providers (NPSP) to attend to cases that concern as seen in table 2.

2. Personnel Recommendations by Specialty at First Level Hospital

At first level hospitals, generalist medical practitioner, non-physician surgical provider, generalist medical practitioner with pediatric-specific training are the major personnel that were suggested to address the human resource gap per sub-specialty as illustrated (Table 3).

3. Personnel Recommendations by Specialty at Referral Hospitals.

With regards to the referral level of care: 2nd, 3rd levels and national children's hospital, recommendations are based on the different levels of hospital (Table 4).

- At the 2nd level hospital, GMP, NPGP, GMP-p, and general surgeons (GS) amongst others were most recommended. Most of these were specialists whose primary field wasn't concerned with pediatrics.
- Meanwhile at the 3rd level, although GMP, NPGP, GMP-p might still have limited intervention, there is a need for the latter to have pediatric specific trainings and for more pediatric specialized physicians such as pediatric anesthesiologist, pediatric cardiac surgeon, Pediatric critical care physician, pediatric orthopedic surgeon, nurse with pediatric experience, nurse with pediatric surgical experience.
- For National Children's Hospital, the appropriate human resource should include pediatric trained specialist and advance specialist in precise domains that cut across the pediatric population such as pediatric anesthesiologist, pediatric critical care physician, cardiac perfusionist, cardiologist with and without interventional capability, pediatric cardiologist, cardiac surgeon, pediatric cardiac surgeon

DISCUSSION

The delivery of safe, timely and accessible surgical care to children in LMICs has for decades been constrained by severe shortages and maldistribution of the required workforce at all levels of healthcare [18]. Although previous efforts have attempted to define the infrastructure and workforce required for the delivery of safe and quality surgical care at different levels of healthcare, recommendations for children's surgery are often fragmented and often focused on siloed programs [19]. This has contributed to inconsistent workforce planning and less than optimal service delivery. While OReCS1 provided some guidance on the workforce, further clarity is required. The current study addresses this need by providing consensus-based recommendations on the types of providers required across different healthcare facility levels.

Healthcare centers are at the primary levels offering basic health services and usually situated within communities, with easy accessibility. The findings of the present report show that workforce requirements for children's surgery must be aligned with the level of care and the complexity of services provided. At the health center level, care should necessarily be limited to basic and emergency interventions, with an emphasis on early recognition, resuscitation and stabilization, and prompt referral [20]. The reliance on non-physician providers at this level of care aligns with the realities in LMICs. However, it is important to clearly define the scope of practice at this level to avoid inappropriate task shifting and sharing that may compromise quality of care. Community health workers and non-physician providers play an important role in access, but primarily in triage and referral rather than definitive surgical management [21] [22].

The first-level hospitals are critical for the treatment of common surgical conditions and emergencies in children. The workforce at this level is intermediate or middle level, where non-specialist physicians, with or without some pediatric specific training provide emergency and essential surgical care such as appendicitis, hernia, colostomy and burn management for children [23][24][25]. The presence of general surgeons and appropriately trained non-physician providers can significantly improve access. However, expectations must remain realistic, and routine inclusion of specialized personnel at this level is not feasible and is unnecessary. Strengthening the competencies and skills of available providers through targeted pediatric specific training should be a key priority.

At referral hospitals, including second- and third-level facilities and national children's hospitals, there is a clear need for specialized and multidisciplinary teams. The management of complex pediatric surgical conditions requires specialists across all specialties as well as specialized nursing staff [26]. These facilities also serve as centers for training, research, and leadership in children's surgical care. Concentrating specialized human resources at this level is essential to ensure quality and improve outcomes.

The recommendations in this report are particularly relevant in the context of LMICs, given the large proportion of children in the population, as well as the high burden of untreated surgical conditions in this age group [27][7]. Workforce deficits in LMICs are well documented, with very low ratios of pediatric surgeons and pediatric anesthesiologists density [7]. In practice, much of the surgical and anesthesia in the setting is often delivered by non-specialist physicians and non-physician providers. While task sharing has been shown to improve access, it should be seen as a complementary, stop gap strategy rather than a substitute for the development of a trained specialist workforce [28].

For policymakers, healthcare planners and healthcare administrators, these recommendations provide a practical and realistic framework for integrating children's surgical workforce planning into National Surgical, Obstetric and Anesthesia Plans (NSOAPs). Effective implementation of these recommendations will require both short-term and long-term strategies, including training, retention, and equitable distribution of workforce. Particular attention should be given to strengthening nursing and perioperative care, which are critical components of safe surgical systems but often under-resourced in LMICs [29].

CONCLUSION

The pediatric population in LMICs is growing rapidly. Improving access to surgical care for this growing population requires a deliberate and structured approach to human resource planning. Different levels of care require different cadres of providers, and this must be reflected in national policies and implementation strategies. While task sharing can improve access in the short term,

long-term progress will depend on the development of a trained and sustainable children's surgical workforce.

AUTHORS CONTRIBUTION

NEK: search, writing, review, final approval

SC, EA,MS: critical review, literature search, final approval

KL: conception, writing, critical review, final approval and supervision.

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GICS membership

CONFLICT OF INTEREST

None

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