

# Is Global Pediatric Surgery a Good Investment?

Emily R. Smith<sup>1,2</sup> · Tessa L. Concepcion<sup>1</sup> · Kelli J. Niemeier<sup>2</sup> · Adesoji O. Ademuyiwa<sup>3</sup>

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**Abstract** Investing in surgery has been highlighted as integral to strengthening overall health systems and increasing economic prosperity in low-income and middle-income countries (LMICs). The provision of surgical care in LMICs not only affects economies on a macro-level, but also impacts individual families within communities at a microeconomic level. Given that children represent 50% of the population in LMICs and the burden of unmet surgical needs in these areas is high, investing pediatric-specific components of surgical and anesthesia care is needed. Implementation efforts for pediatric surgical care include incorporating surgery-specific priorities into the global child health initiatives, improving global health financing for scale-up activities for children, increasing financial risk protection mechanisms for families of children with surgical needs, and including comprehensive pediatric surgical models of care into country-level plans.

## The impact of investing in global surgery: a case for children

Investing in surgery increases national health, development, and economic prosperity by strengthening the entire health system with positive repercussions to many aspects of healthcare capacity and delivery. The misconception that surgery is an expensive intervention is a significant barrier to advocating for its essential role in achieving global health goals. However, the value of surgical provision in LMICs has been shown regarding the return on investment, cost-effectiveness of scaling up surgical

services, providing financial risk protection to individuals, and bolstering the economic output of financially strained countries. Given that children represent a significant proportion of the global burden of disease attributable to surgical conditions, particularly in LMICs where over 50% of the population are under the age of 15, and the burden of unmet pediatric surgical conditions is high in these areas, investing in surgical care for children is a priority [1–11].

## Investing is cost-effective

The World Bank first introduced a set of cost-effectiveness thresholds by classifying cost-effectiveness ratios (CERs) as “highly cost-effective” if they fell below \$50 per disability-adjusted life year (DALY) averted in low-income countries or below \$150 per DALY in middle-income countries [12]. The World Health Organization’s (WHO) Choosing Interventions that are Cost-Effective (CHOICE) program defined cost-effectiveness in terms of comparing the CERs to the country’s annual GDP per capita per DALY averted. Both metrics are useful when assessing the

✉ Emily R. Smith  
Emily\_R\_Smith@baylor.edu

<sup>1</sup> Duke Global Health Institute, Duke University, Durham, NC, USA

<sup>2</sup> Department of Public Health, Robbins College of Health and Human Sciences, Baylor University, One Bear Place #97313, Waco, TX 76798, USA

<sup>3</sup> Department of Surgery, College of Medicine, University of Lagos, Lagos, Nigeria

cost-effectiveness of various public health and medical interventions.

The first metric of comparing interventions to the original cost-effectiveness thresholds of \$50 or \$150 per DALY averted can be used when multiple countries are included in CER calculations. The CERs of 11 pediatric surgical specialties are below these thresholds for both low-income and middle-income countries (Fig. 1: Panel a) [12, 13]. According to the low-income threshold of \$50 per DALY averted, general surgery (inguinal hernia repairs) and ophthalmology (trichiasis surgery) are as cost-effective, followed closely by general surgery (various procedures) and ENT (various procedures). According to the middle-income threshold of \$150 per DALY averted, all specialties except for orthopedics (various procedures) are cost-effective.

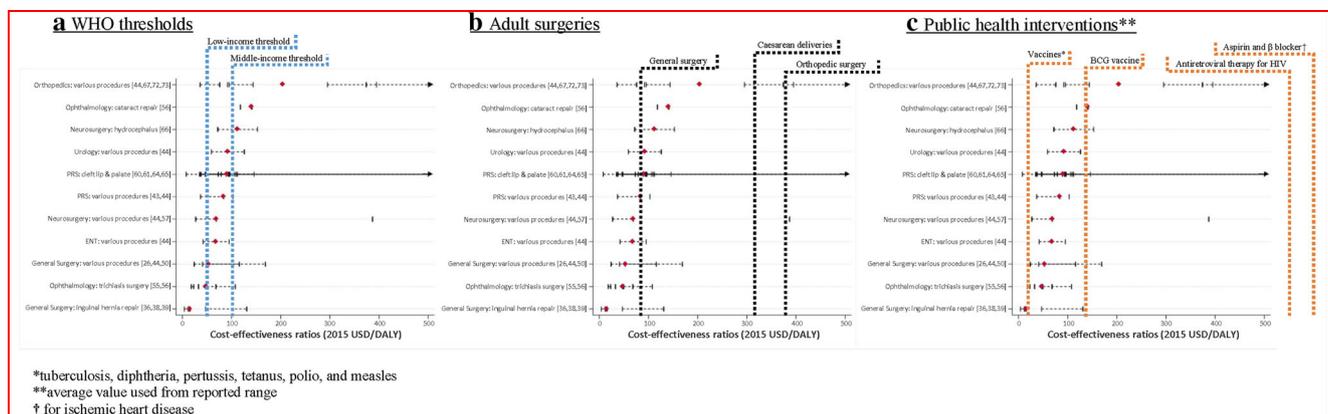
The second metric used to assess the cost-effectiveness of interventions is comparing the CERs to a country’s annual GDP per capita. In a recent systematic review, many essential surgical interventions were as cost-effective as other traditional public health interventions, such as multidrug antiretroviral therapy for HIV, bed nets for malaria prevention, and vaccination programs [14]. The economic impact of investing surgical care for children has also been shown to be cost-effective in resource-poor settings [13]. Of 11 pediatric surgical intervention specialties, the majority of the pediatric-specific surgeries were as cost-effective or more cost-effective than the procedures identified in the cost-effectiveness review by Chao et al. (Fig. 1: Panel b). Of the pediatric-specific interventions, six were more cost-effective than the adult general surgery procedures and all were more cost-effective than the overall orthopedic surgery or Caesarean deliveries. When compared to traditional public health interventions, nine classes of surgical procedures were as cost-effective as BCG vaccine for tuberculosis prevention, and all were as cost-effective as antiretroviral therapy for HIV or treatment for ischemic heart disease

(Fig. 1: Panel c). Using a human capital approach, nine pediatric surgical intervention categories provided significant economic value, with a median benefit of greater than \$10,000 per procedure, namely neurosurgical procedures, general surgery procedures, and plastic and reconstructive surgery. These findings are especially relevant given life-long morbidity and high rates of mortality associated with several pediatric surgical conditions in LMICs.

### Investing promotes economic growth

On a macroeconomic level, expansion of surgical care results in substantial returns on investment with a 1:10 cost-benefit ratio which remains among the most cost-effective global health interventions [15]. A threshold of 5000 surgical procedures per 100,000 population across LMICs by 2030 has been estimated to meet present surgical demands and projected needs [16]. These rates translate to an estimated \$350 billion of required investment needed to increase essential surgical and anesthesia care. Although this required outlay is substantial, without investment in surgical scale-up, the loss of economic productivity in LMICs is estimated at 35 times higher (\$12.3 billion) by 2030, translated to a cumulative loss of 1–3% of the projected global economic output, clearly illustrating the macroeconomic benefits of investment in surgical care.

Although the association between economic growth and surgical care specifically for children has not been evaluated, there are strong links between child health in LMICs with improvements in GDP. An estimated loss of 6% of Africa’s non-health GDP has been attributed directly to child mortality [17]. In a study of 180 countries, under-five mortality has a direct impact on GDP in 93% of the countries [18]. The same study indicated that the average efficiency rate, or the magnitude of association between



**Fig. 1** Cost-effectiveness of selected pediatric surgical procedures against WHO thresholds, selected adult surgical procedures, and selected traditional public health interventions

child mortality and GDP, of these countries was 92%, confirming strong relationship between GDP and child mortality. In LMICs, the directionality indicates that improved GDP reduces child mortality [18, 19] and marginal health investments have greater health outcomes at low levels of GDP. In recognition of the profound impact of child health on GDP, the World Bank hosted the first human capital summit on “investing in the early years for growth and productivity [20].” Although surgical care for children is not distinctly incorporated into these global health initiatives, the link between economic loss and overall child mortality *with* the economic losses associated with child mortality from the lack of surgical care provision is likely substantial.

### Investing protects individuals

The provision of surgical care in LMICs not only affects economies on a macro-level, but also impacts individual families within communities at a microeconomic level. The most prominent barrier to receiving surgical care in LMICs is the large financial burden of direct medical costs [4, 5], with an estimated 81 million people at risk of falling into poverty due to costs associated with surgical care [16]. An additional 48 million people face catastrophic expenditures to indirect costs of lodging, transportation, food, and lost wages. Although a few recent studies evaluated catastrophic expenditures and impoverishment due to surgery in LMICs, none have specifically assessed the financial burden of pediatric surgical patients [21]. Recently, an analysis on poverty related to pediatric surgery in Somaliland found that the presence of a surgical condition in a child increased the chance of the family’s descent into poverty, regardless of whether surgical care was provided. In addition, the single stressor of a pediatric surgical condition on a family’s movement toward poverty remained significant even in the presence of other demographic factors, including household income and rurality. These findings highlight the need for policy recommendations which recognize the importance of financial risk protection for families of children with surgical needs.

### Investment for pediatric surgical scale-up: the way forward

Now that we have built the case that investing in surgical care for children makes economic sense on both micro- and macro-levels, the most pressing needs moving forward include identifying where pediatric surgical and anesthesia care should be targeted for scale-up and what care delivery aspects need to be addressed. Moving forward,

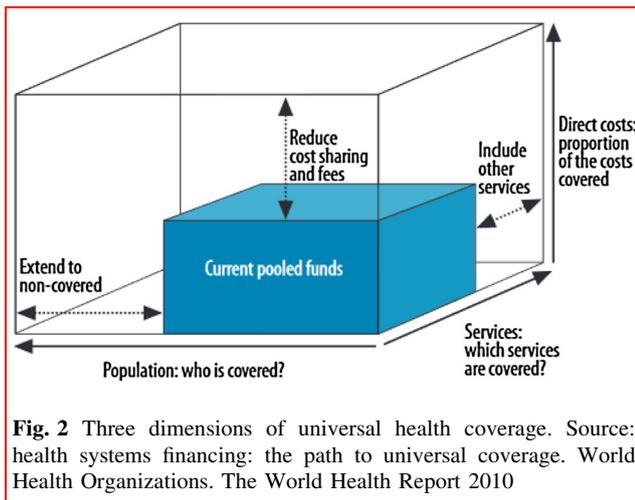
implementation efforts for pediatric surgical care which are allocated strategically and efficiently are needed to meet the immense surgical needs among children in LMICs. These efforts include allocating funding streams into global health funding agendas and incorporating pediatric-specific surgical care into universal healthcare coverage initiatives and country-level surgical plans.

### Allocating funding streams for provision of pediatric surgical care

Global health funding includes three key components: funding sources, funding channels, and implementing institutions. Sources have been defined as the origins of funding and can include government budgets, philanthropic endowments, and non-governmental organizations. These sources are channeled through intermediaries in funding flow, traditionally including bilateral and multilateral agencies, agencies and partnerships (UN agencies, GAVI, etc.), and private foundations to implementing institutions actively working to promote health through prevention and treatment programs in LMICs. Although the global health priorities to receive funding historically included child health, most programs focused on vaccinations, communicable disease prevention, and nutrition. With the emphasis at the latest World Health Assembly on strengthening emergency and essential surgical care and anesthesia, there is potential for greater funding toward surgical care in LMICs. Moving forward, however, incorporating surgery-specific priorities into both the child health priorities and overall health system strengthening movement will ensure children are not excluded from the global surgery agenda.

### Incorporating surgical care into universal healthcare programs

Universal health coverage has emerged as a leading, if not the leading, global health policy goal in the SDG era and is supported by the WHO, the World Bank, the United Nations, and many LMIC governments [22–24]. In a historic resolution at the 68th World Health Assembly, WHO member states unanimously voted to include emergency and essential surgery and anesthesia as vital components of universal health coverage. The current operating plan for universal health coverage is defined by the WHO as a system that maximizes the breadth, depth, and height of coverage (Fig. 2) [25]. The *breadth* of coverage represents who is insured with health protection financing schemes. The *depth* of coverage represents the range of services



**Fig. 2** Three dimensions of universal health coverage. Source: health systems financing: the path to universal coverage. World Health Organizations. The World Health Report 2010

covered. The *height* of coverage represents the proportion of costs associated with healthcare needs covered.

For surgical care, the *breadth* of coverage should include financial risk protection for families with surgical needs. Financial risk protection from out-of-pocket spending associated with surgical care is a key indicator advocated for by the Lancet Commission of Global Surgery, the SDGs, and the World Bank [26, 27]. These financial risks could be addressed through financing schemes, appropriate and adequate insurance provisions, and, most notably, universal health coverage. The *depth* of coverage, or range of essential services, in surgical care should include basic emergency and essential procedure coverage. However, a recent systematic review found a lack of coverage depth in terms of service delivery, workforce, and care provided at district-level hospitals in many LMICs. The least amount of coverage depth in terms of depth of coverage in these countries was for congenital anomalies, highlighting the even greater need to advocate specifically for pediatric surgical care provision. The *height* of coverage, or the proportion of healthcare costs covered, for surgical conditions remains a significant predictor to catastrophic expenditure and impoverishment for families in LMICs. As previously discussed, this greatly affects families with a child with surgical needs. Although the intricacies of UHC are beyond the scope of this paper, a basic level of pediatric, surgical, and anesthetic care should be included.

### Investing in comprehensive pediatric surgical care models

Implementation efforts scale up pediatric surgical care in regions where the need is greatest, but the least developed healthcare systems should include staff, stuff, space, and systems (the 4Ss) [28]. However, children represent a

population with unique needs, such as essential supplies and resources, which are different than adults and should be evaluated separately [5, 29, 30]. Complicating the surgical care of children are shortages in pediatric-trained personnel, infrastructure, equipment, and supplies, which contribute to delayed presentations and suboptimal delivery of care [31–33]. In LMICs, there is a severe shortage of surgeons with as few as one pediatric surgeon for nearly 6,000,000 children compared with one pediatric surgeon for every 100,000 children in the USA [33]. On top of a lack of pediatric surgical workforce, there is a shortage of adequate facilities in LMICs. Up to 90% of the pediatric workforce are in large tertiary hospitals, rather than in rural areas where 75% of the population live. Among the district and regional hospitals serving the rural populations, laboratory resources and pediatric-specific infrastructure are often lacking [31–33]. Incorporating the 4Ss into a comprehensive model of pediatric surgical care will require a coordinated planning effort of providers, government officials, and funding organizations. Although there are several models of care delivery in LMICs, including faith-based missions, short-term surgical trips, surgical camps, and mobile health, the most common models are short-term [34]. While short-term models address immediate needs and provide vital opportunities for education and training, long-term models of partnership building and incorporating pediatric surgical care into national healthcare plans will increase sustainability and capacity building.

Although many publications address specific components needed for pediatric surgery, studies offering comprehensive solutions are scarce [35]. However, recent progress in developing National Surgical, Obstetric, and Anesthesia Plans (NSOAPs) which are intersectoral, multi-disciplinary, and driven by local stakeholders provides a springboard for comprehensive surgical care delivery models. The NSOAPs are designed to improve surgical care across five domains: service delivery, including infrastructure (number of and access to surgical facilities), workforce (surgical, anesthetic, and obstetric providers), service delivery (surgical volume and quality/safety), financing (budget allocation and health financing), and information management (information systems and research). In several LMICs, these NSOAPs have been pivotal in directing planning, delivery, and management of surgical care at all levels of health delivery systems, with strong partnerships with the Ministry of Health, local government officials, and key stakeholders [36]. In Nigeria, for instance, before the current effort to have a National Surgical Obstetric Anesthetic and Nursing Plan (NSOANP), the National Child Health Policy (NCHP) and National Strategic Health Plans do not have any provision for children surgery except circumcision. To ensure the inclusion of children surgery in the NSOANP and having

no internationally acceptable surgical assessment tool for children, the World Health Organization-Program in Global Surgery and Social Change (WHO-PGSSC) tool was adapted to include items relevant to children. In addition, stakeholders such as the Federal Ministry of Health, Nigeria Medical Association, and the West African College of Surgeons among others had several meetings where the concept of child surgery as a component of the NCHP was advocated and eventually accepted. This advocacy is also being duplicated in other West African countries where NSOAPs are being developed. Given that half of the population in LMICs are children, it is apparent why children and children surgery must be included in such plans if more than half of the population is not to be excluded. A NSOAP without taking account of such huge gap in human capacity will leave a lot to be desired. Therefore, a comprehensive NSOAP will have application among most LMICs and most incorporate children surgery to be relevant for the generation of today and future generations.

## Conclusion

There is great momentum in investing surgical care for the greatest in need, namely the vulnerable population of children, around the globe. Pediatric conditions once considered fatal are now surgically correctable. Pediatric surgical interventions once considered too expensive for LMICs are now a viable, cost-effective strategy to reduce the overall global burden of disease. Armed with this knowledge, advocacy for surgical care for children is needed as a priority on both national and global agendas to improve the economies of resource-limited countries, and most notably, improve the well-being and longevity of billions of children around the world.

We suggest several policy recommendations to improve investment in pediatric surgical care in LMICs:

- Incorporate surgery-specific priorities into the child health priorities and overall health strengthening movements.
- Improve global health financing for pediatric surgery scale-up activities and research.
- Increase and expand financial risk protection mechanisms for families of children with surgical needs.
- Integrate pediatric surgery-specific care into universal healthcare plans.
- Include comprehensive pediatric surgical models into country-level NSOAP

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