

Review Article

Beyond the operating room: a narrative review of paediatric surgical diseases as a neglected child health priority in low and middle-income countries

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ABSTRACT

Paediatric surgical diseases contribute substantially to childhood morbidity, disability, and mortality worldwide, yet they continue to receive limited attention within public health policies and child health programs, particularly in Low and middle-income countries (LMICs). While remarkable progress has been achieved in reducing deaths from infectious diseases and malnutrition, surgically treatable conditions remain a significant but under-recognized cause of adverse health outcomes among children. Congenital anomalies, acute appendicitis, intestinal obstruction, inguinal hernia, trauma, and surgical infections collectively account for a considerable burden of preventable morbidity and mortality. Delayed recognition, inadequate referral systems, shortage of trained personnel, financial constraints, and geographical barriers often impede timely access to surgical care. Consequently, many children present with advanced disease, resulting in increased complications, prolonged hospitalization, disability, and avoidable deaths. This narrative review examines the burden of paediatric surgical diseases in LMICs, explores major health-system barriers affecting access to care, and highlights their implications for child health outcomes. The review further discusses opportunities for integrating paediatric surgical conditions into existing child health programs and proposes public health strategies aimed at improving access to safe, timely, and affordable surgical care. Recognizing paediatric surgical diseases as a public health priority is essential for strengthening health systems, reducing preventable childhood morbidity and mortality, and advancing progress toward universal health coverage and Sustainable Development Goals.

Keywords: Paediatric surgery, Child health, Global surgery, Health systems, Access to care, Low and middle-income countries

INTRODUCTION

Over the past three decades, significant reductions in childhood mortality have been achieved through improvements in immunization coverage, nutrition programs, maternal healthcare services, and control of communicable diseases. Despite these advances, surgically treatable conditions continue to contribute substantially to childhood morbidity and mortality,

particularly in resource-constrained settings. Paediatric surgical diseases represent an important but frequently overlooked component of the global burden of disease among children.¹

Paediatric surgical diseases encompass a broad spectrum of congenital and acquired conditions that require surgical intervention for optimal outcomes. These include congenital anomalies such as anorectal malformations,

Hirschsprung disease, esophageal atresia, congenital diaphragmatic hernia, neural tube defects, as well as acquired conditions including acute appendicitis, intussusception, intestinal obstruction, incarcerated hernias, trauma-related injuries, and surgical infections.² Many of these conditions are readily treatable when diagnosed early and managed appropriately. However, delays in diagnosis, referral, and definitive management remain common in low and middle-income countries (LMICs).³

The growing field of global surgery has drawn attention to disparities in access to surgical care worldwide. The Lancet Commission on Global Surgery estimated that nearly five billion people lack access to safe, affordable, and timely surgical services.⁴ Children represent a particularly vulnerable population within this unmet need. In many LMICs, specialist paediatric surgical services are concentrated in urban tertiary-care centres, leaving large rural populations dependent on under-resourced healthcare facilities with limited surgical expertise.⁵

Congenital anomalies have emerged as an increasingly important cause of neonatal and under-five mortality as deaths from infectious diseases continue to decline. Similarly, common paediatric surgical emergencies such as appendicitis, intussusception, and intestinal obstruction frequently result in preventable complications because of delayed presentation and inadequate referral systems.⁶ The burden extends beyond mortality, contributing to long-term disability, impaired growth and development, educational disruption, and significant financial hardship for affected families.

Despite their substantial contribution to childhood disease burden, paediatric surgical conditions remain inadequately represented within many national child health programs. Existing initiatives often focus on nutrition, immunization, infectious disease control, and developmental disorders, with comparatively limited emphasis on surgically treatable diseases.⁷ Consequently, opportunities for early detection, referral, and intervention may be missed, particularly at primary healthcare and community levels.

From a public health perspective, paediatric surgical care should be viewed as an essential component of comprehensive child healthcare rather than a highly specialized clinical service available only at tertiary institutions. Strengthening healthcare systems to ensure equitable access to surgical services is critical for improving child survival and achieving universal health coverage.⁸

This narrative review aims to examine the burden of paediatric surgical diseases in LMICs, identify major barriers affecting access to surgical care, evaluate their implications for child health outcomes, and discuss public health strategies that may facilitate timely diagnosis,

referral, and management of surgically treatable conditions among children.

LITERATURE SEARCH (NARRATIVE)

A narrative literature search was conducted using electronic databases including PubMed, Scopus, Web of Science, and Google Scholar. Articles published between January 2000 and June 2026 were searched using combinations of the keywords “paediatric surgery,” “child health,” “congenital anomalies,” “appendicitis,” “intestinal obstruction,” “intussusception,” “global surgery,” “access to surgical care,” “health systems,” “referral pathways,” “universal health coverage,” and “Low and middle-income countries.”

Additional information was obtained from reports and policy documents published by the World Health Organization (WHO), United Nations Children's Fund (UNICEF), Lancet Commission on Global Surgery, Global Initiative for Children's Surgery (GICS), and national child health programs. Reference lists of selected articles were also manually screened to identify additional relevant studies.

Studies were included based on their relevance to the epidemiology of paediatric surgical diseases, barriers to healthcare access, referral systems, workforce challenges, health-system limitations, and public health implications. Emphasis was placed on literature originating from LMICs and studies examining healthcare delivery and equity in child health services.

As this manuscript is a narrative review, formal risk-of-bias assessment and quantitative meta-analysis were not performed. The objective was to synthesize current evidence and provide a comprehensive overview of paediatric surgical diseases as an emerging public health priority in resource-constrained settings.

BURDEN OF PAEDIATRIC SURGICAL DISEASES

Paediatric surgical diseases constitute a significant yet frequently underestimated component of the global burden of disease. While substantial attention has historically been directed toward communicable diseases, malnutrition, and maternal-child health interventions, surgically treatable conditions continue to account for considerable morbidity, disability, and mortality among children worldwide.⁹ Recent estimates suggest that nearly one-third of the global burden of disease may require surgical care at some stage of management, with children representing a substantial proportion of affected individuals.¹⁰

The burden is particularly pronounced in Low and middle-income countries (LMICs), where healthcare infrastructure, specialist workforce availability, and referral systems remain inadequate. It has been estimated that approximately 1.7 billion children globally lack

access to safe, timely, and affordable surgical care.¹¹ Consequently, many children present with advanced disease stages, resulting in poorer outcomes compared to those observed in high-income countries.

Congenital anomalies represent one of the most important contributors to paediatric surgical disease burden. According to the World Health Organization, congenital anomalies account for a substantial proportion of neonatal and under-five mortality worldwide.¹² Conditions such as anorectal malformations, esophageal atresia, congenital diaphragmatic hernia, and Hirschsprung disease require specialized surgical intervention shortly after birth. Delayed diagnosis or lack of access to surgical services often results in avoidable mortality and long-term disability. Acquired surgical conditions further contribute significantly to disease burden. Acute appendicitis remains one of the most common paediatric surgical emergencies globally. In many LMICs, delayed presentation and diagnostic uncertainty increase the risk of perforation, generalized peritonitis, and sepsis.¹³ Similarly, intussusception continues to be an important cause of intestinal obstruction among infants and young children. Delayed intervention may necessitate bowel resection and increase mortality risk.

Paediatric trauma also constitutes a major public health challenge. Road traffic injuries, falls, burns, drowning incidents, and interpersonal violence contribute substantially to childhood injury-related morbidity and mortality. Trauma-related deaths account for a significant proportion of preventable childhood mortality, particularly among older children and adolescents.¹⁴

The true burden of paediatric surgical disease is likely underestimated because many countries lack robust surveillance systems, surgical registries, and comprehensive reporting mechanisms. Furthermore, children residing in rural and underserved communities may never reach healthcare facilities capable of providing definitive surgical treatment, resulting in underrepresentation within official statistics.¹⁵

Beyond mortality, paediatric surgical diseases contribute significantly to disability-adjusted life years (DALYs) through chronic disability, impaired physical development, psychosocial consequences, and reduced educational attainment. The cumulative impact extends beyond affected children to families, communities, and healthcare systems, reinforcing the need to recognize paediatric surgical care as an essential component of child health policy and healthcare planning.¹⁶

COMMON PAEDIATRIC SURGICAL CONDITIONS

Congenital anomalies

Congenital anomalies constitute a substantial proportion of paediatric surgical admissions worldwide. Advances in

prenatal screening, neonatal intensive care, and paediatric surgical techniques have significantly improved outcomes in high-income countries. However, disparities remain profound in LMICs, where delayed diagnosis, inadequate referral systems, and limited specialist availability continue to adversely affect survival.¹⁷

Common surgically correctable congenital anomalies include anorectal malformations, Hirschsprung disease, esophageal atresia, tracheoesophageal fistula, congenital diaphragmatic hernia, abdominal wall defects, and neural tube defects. Early diagnosis and timely intervention are critical determinants of outcome. In many resource-limited settings, delayed presentation contributes to severe complications including sepsis, malnutrition, and organ dysfunction.¹⁸

Acute appendicitis

Acute appendicitis remains the most common abdominal surgical emergency in childhood. Although outcomes are generally favorable when treated promptly, diagnostic challenges frequently arise because younger children often present with atypical symptoms. Delayed diagnosis is associated with higher rates of perforation, intra-abdominal abscess formation, prolonged hospitalization, and increased healthcare costs.¹⁹

The incidence of complicated appendicitis is significantly higher in settings where access to emergency surgical services is limited. Factors contributing to delayed presentation include lack of parental awareness, transportation barriers, financial constraints, and inadequate referral pathways.²⁰

Intestinal obstruction

Intestinal obstruction is an important cause of paediatric surgical emergencies and encompasses diverse etiologies including intussusception, congenital bands, malrotation with volvulus, adhesions, incarcerated hernia, and Hirschsprung disease. Prompt recognition is essential because delayed intervention may result in bowel ischemia, necrosis, perforation, and septic shock.²¹

Intussusception represents the leading cause of intestinal obstruction among infants and young children. While non-operative reduction techniques have substantially improved outcomes in well-equipped centres, delayed diagnosis often necessitates surgical intervention in LMICs.²²

Inguinal hernia and hydrocele

Paediatric inguinal hernia is a common surgical condition affecting infants and children. Although elective surgical repair is generally straightforward, delayed treatment increases the risk of incarceration and strangulation. Premature infants are particularly vulnerable to these complications.²³

Despite the availability of effective surgical treatment, socioeconomic barriers and limited access to specialist care frequently result in delayed management in resource-constrained settings.

Paediatric trauma

Trauma is increasingly recognized as a major contributor to childhood mortality and disability. Road traffic accidents, falls, burns, sports-related injuries, and household accidents account for a substantial proportion of emergency surgical admissions among children.²⁴

Children living in LMICs are disproportionately affected because of inadequate road safety measures, unsafe housing conditions, limited injury-prevention programs, and delayed access to trauma care. The long-term consequences of paediatric trauma include physical disability, psychological distress, and reduced quality of life.

Surgical infections

Surgical infections continue to contribute significantly to paediatric morbidity, particularly in resource-limited settings. Conditions such as necrotizing soft tissue infections, complicated abscesses, osteomyelitis, and septic arthritis frequently require combined medical and surgical management. Delayed presentation often results in prolonged hospitalization, increased healthcare expenditure, and poorer functional outcomes.²⁵

HEALTH-SYSTEM GAPS AND BARRIERS TO CARE

Despite growing recognition of paediatric surgical diseases as an important component of child health, substantial barriers continue to limit access to timely and effective surgical care in LMICs. These barriers exist at patient, community, healthcare system, and policy levels and collectively contribute to delayed diagnosis, delayed referral, and poor outcomes.

Delayed recognition and health-seeking behaviour

The initial recognition of surgical disease often occurs at the household level. Parents and caregivers may attribute symptoms such as abdominal pain, vomiting, constipation, fever, or swelling to minor illnesses, delaying healthcare seeking. Cultural beliefs, reliance on traditional healers, and inadequate awareness regarding surgical emergencies further contribute to delayed presentation.²⁶

Referral system deficiencies

Effective referral systems are essential for timely management of paediatric surgical conditions. However, referral pathways remain fragmented in many LMICs. Children frequently undergo multiple consultations at

peripheral healthcare facilities before reaching an appropriate surgical centre. Such delays may significantly worsen clinical outcomes, particularly in conditions such as appendicitis, intussusception, volvulus, and incarcerated hernia.²⁷

Geographical and transportation barriers

Rural populations often face substantial challenges in accessing specialized healthcare facilities. Long travel distances, poor road infrastructure, seasonal disruptions, and limited ambulance services contribute to delayed presentation. Geographic inequities remain a major determinant of paediatric surgical outcomes in resource-limited settings.²⁸

Financial constraints

Direct and indirect healthcare costs remain significant barriers to accessing surgical services. Although government-sponsored health insurance programs have expanded coverage in several countries, families frequently incur expenses related to transportation, accommodation, investigations, medications, and lost wages. Financial hardship may delay or prevent timely treatment.²⁹

Workforce shortages

The shortage of paediatric surgeons represents one of the most significant barriers to paediatric surgical care globally. Many LMICs have an insufficient number of trained paediatric surgeons relative to population needs. Consequently, general surgeons often manage paediatric surgical conditions, particularly in district and rural hospitals. Shortages also extend to anesthesiologists, paediatric intensivists, nurses, and allied healthcare personnel.³⁰

CONSEQUENCES OF DELAYED SURGICAL CARE

The consequences of delayed diagnosis and treatment of paediatric surgical conditions extend far beyond the immediate disease process. Delays may result in disease progression, increased complication rates, prolonged hospitalization, permanent disability, and avoidable mortality. In many LMICs, children frequently present at advanced stages of disease due to a combination of patient-related, socioeconomic, and health-system factors.³¹

Acute appendicitis provides a clear example of the impact of delayed care. While uncomplicated appendicitis is generally associated with excellent outcomes, delayed diagnosis significantly increases the risk of perforation, generalized peritonitis, intra-abdominal abscess formation, and sepsis. Perforated appendicitis is associated with longer hospital stays, greater healthcare expenditure, and increased postoperative morbidity.³²

Similar patterns are observed in intestinal obstruction, where delays in intervention may lead to bowel ischemia, gangrene, perforation, septic shock, and death.

In congenital anomalies, delayed referral often results in nutritional compromise, recurrent infections, and irreversible organ dysfunction. Conditions such as Hirschsprung disease, esophageal atresia, and congenital diaphragmatic hernia demonstrate markedly improved outcomes when managed promptly at specialized centres. Conversely, delayed intervention is associated with significantly higher mortality rates in resource-limited settings.³³

The consequences of delayed surgical care are not limited to physical health. Children who experience prolonged illness or disability may face interruptions in education, reduced social participation, and long-term psychological consequences. Parents and caregivers frequently experience emotional distress, financial hardship, and loss of productivity resulting from repeated healthcare visits and prolonged hospitalizations.³⁴

From a public health perspective, delayed surgical care places additional strain on already burdened healthcare systems. Advanced disease often requires more complex surgical procedures, intensive care support, prolonged hospitalization, and greater resource utilization. Preventing delays through early recognition and timely referral may therefore improve outcomes while simultaneously reducing healthcare expenditure.³⁵

ROLE OF PAEDIATRICIANS AND PRIMARY CARE PROVIDERS

Paediatricians and primary care providers serve as critical gatekeepers within healthcare systems and play an essential role in improving access to paediatric surgical care. Because they frequently represent the first point of contact for children and their families, their ability to recognize surgically treatable conditions can significantly influence outcomes.³⁶

Early recognition of warning signs is particularly important in paediatric surgical emergencies. Symptoms such as persistent vomiting, abdominal distension, bilious vomiting, severe abdominal pain, irreducible groin swelling, failure to pass meconium, and signs of bowel obstruction should prompt immediate referral to higher centres. Timely identification of these clinical features may prevent disease progression and reduce complications.

Paediatricians are also responsible for initial stabilization of children before referral. Appropriate fluid resuscitation, electrolyte correction, antibiotic administration when indicated, and maintenance of airway and circulatory support can substantially improve outcomes during transfer to definitive care facilities.³⁷ In addition to clinical responsibilities, paediatricians play an

important role in parental education and community awareness. Counseling caregivers regarding warning symptoms, emphasizing the importance of timely healthcare seeking, and dispelling misconceptions regarding surgical treatment can contribute to earlier presentation and improved outcomes.³⁸

Primary healthcare providers working in rural and underserved communities represent another critical component of the referral pathway. Training programs aimed at improving recognition of common paediatric surgical conditions may enhance early diagnosis and facilitate timely referral. Strengthening collaboration between paediatricians, surgeons, and primary healthcare providers is essential for creating efficient and responsive referral systems.

INTEGRATION OF PAEDIATRIC SURGICAL CONDITIONS INTO CHILD HEALTH PROGRAMS

Child health initiatives have traditionally focused on reducing mortality from communicable diseases, improving nutritional status, expanding immunization coverage, and addressing developmental disorders. While these priorities remain essential, paediatric surgical diseases have received comparatively limited attention within national and international child health strategies.³⁹

The Integrated Management of Neonatal and Childhood Illness (IMNCI) framework has contributed substantially to reducing childhood mortality through standardized approaches to common childhood illnesses. However, surgically treatable conditions receive relatively limited emphasis within existing algorithms. Incorporating recognition of surgical warning signs and referral triggers into IMNCI training programs could improve early identification of paediatric surgical emergencies.⁴⁰

In India, the Rashtriya Bal Swasthya Karyakram (RBSK) was established to facilitate early detection and management of congenital anomalies, diseases, deficiencies, and developmental delays among children. The program provides an important platform for strengthening paediatric surgical referrals, particularly for congenital anomalies requiring early intervention. However, variations in implementation and specialist availability continue to limit its effectiveness in certain regions.⁴¹

Universal Health Coverage (UHC) initiatives also offer opportunities for integrating paediatric surgical services into broader healthcare delivery frameworks. Expanding financial protection mechanisms, improving referral networks, and ensuring equitable access to specialist services can reduce disparities in surgical care access.⁴²

Recognition of paediatric surgery as an essential component of child health policy is necessary for achieving Sustainable Development Goal targets related

to child survival, health equity, and universal healthcare access. Greater integration of paediatric surgical services within existing child health programs may facilitate earlier diagnosis, improved referral pathways, and better long-term outcomes.

PUBLIC HEALTH STRATEGIES AND POLICY RECOMMENDATIONS

Addressing the burden of paediatric surgical diseases requires a comprehensive public health approach involving healthcare systems, policymakers, healthcare providers, and communities. Strengthening surgical services alone is insufficient without parallel improvements in awareness, referral systems, financing, and workforce development.⁴³

Community awareness and health education

Community-based awareness programs can improve caregiver recognition of surgical warning signs and encourage timely healthcare seeking. Educational campaigns targeting parents, teachers, community health workers, and local leaders may reduce delays in presentation and improve treatment outcomes.

Strengthening referral networks

Efficient referral systems are fundamental to improving paediatric surgical outcomes. Standardized referral protocols, improved communication between healthcare facilities, and dedicated paediatric transport services can reduce delays and facilitate timely access to specialist care.⁴⁴

Workforce development

Expanding the paediatric surgical workforce remains a priority in many LMICs. Training additional paediatric surgeons, anesthesiologists, paediatric intensivists, and specialized nursing personnel is essential. Simultaneously, enhancing paediatric surgical competencies among general surgeons working in district hospitals may improve access to care in underserved regions.⁴⁵

Telemedicine and digital health

Telemedicine has emerged as a promising tool for improving access to specialist expertise in remote settings. Virtual consultations can assist healthcare providers in triage, diagnosis, stabilization, and referral decisions, potentially reducing delays in care.⁴⁶

Strengthening surgical infrastructure

Investment in paediatric-friendly operating theatres, intensive care facilities, diagnostic services, blood banks, and emergency transportation systems is necessary for delivering safe surgical care. Infrastructure development

should prioritize equitable access across rural and urban populations.

Data systems and surveillance

Robust surveillance systems and national paediatric surgical registries are required to accurately quantify disease burden, monitor outcomes, and guide policy decisions. Improved data collection may facilitate evidence-based planning and resource allocation.⁴⁷

Policy integration

National child health strategies should explicitly recognize paediatric surgical conditions as a public health priority. Integration of surgical indicators into health-system performance monitoring frameworks may help ensure that paediatric surgical care receives appropriate policy attention and resource allocation.⁴⁸

Limitations

This manuscript is a narrative review and therefore does not incorporate formal systematic review methodology, quantitative meta-analysis, or structured risk-of-bias assessment. The literature included was selected based on relevance to paediatric surgical diseases, healthcare access, and public health implications. While every effort was made to include representative and contemporary evidence, some relevant studies may not have been captured. Nevertheless, the review provides a comprehensive overview of current challenges and opportunities related to paediatric surgical care in LMICs.

CONCLUSION

Paediatric surgical diseases represent a substantial but frequently neglected component of the global child health burden. Despite significant advances in child survival, millions of children continue to experience preventable morbidity, disability, and mortality due to inadequate access to timely surgical care. Congenital anomalies, appendicitis, intestinal obstruction, trauma, and other surgically treatable conditions remain important contributors to adverse health outcomes, particularly in Low and middle-income countries.

Multiple barriers—including delayed recognition, ineffective referral systems, workforce shortages, financial constraints, and geographic inequities—continue to limit access to appropriate surgical services. The consequences extend beyond individual patients, affecting families, communities, and healthcare systems through increased morbidity, healthcare expenditure, and socioeconomic burden.

Addressing these challenges requires recognition of paediatric surgical care as an essential component of comprehensive child health services. Strengthening referral pathways, expanding workforce capacity,

integrating paediatric surgical conditions into child health programs, improving healthcare infrastructure, and promoting community awareness are critical steps toward improving outcomes. By moving beyond the traditional perception of surgery as a specialized tertiary-care service and embracing its role within public health, policymakers and healthcare systems can contribute significantly to reducing preventable childhood morbidity and mortality and advancing universal health coverage.

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