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REVIEW

Childhood cancer surgery in low- and middle-income countries

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Abstract

This report summarizes the status of pediatric surgical oncology services in low- and middle-income countries. Factors such as surgical capacity and enablers, and barriers to providing pediatric surgical oncology services are discussed. A review of the literature was conducted to examine the evidence for the capacity of low- and middle-income countries to provide childhood cancer surgery services, focusing on general surgery. Unpublished, ongoing work and initiatives of international organizations are also described.

KEYWORDS
childhood cancer surgery, limited-resource setting, LMIC, pediatric surgical oncology

1 | INTRODUCTION AND CURRENT CHALLENGES

The burden of childhood cancer remains significant globally, with approximately 400,000 new cases diagnosed each year, mostly in low- and middle-income countries (LMICs). Despite healthcare advances, LMICs face challenges in providing adequate childhood cancer surgery due to resource limitations and disparities in healthcare infrastructure, resulting in poorer survival rates.[1]

In recent decades, the importance of capacity and quality metrics to evaluate and improve healthcare systems has grown. Studies since the 1990s have shown that enhancing care processes, strengthening surgical infrastructures, and establishing collaborative initiatives improve patient outcomes and reduce costs.[2,3] Capacity and quality indicators help healthcare teams identify improvement areas and assess overall care quality. Benchmarking against other providers and institutions drives continuous improvement efforts. However, there is a lack of specific tools and indicators tailored to LMICs, especially in pediatric oncology surgery, making it difficult to assess and address care capacity and quality accurately.

Delivering childhood cancer surgery in LMICs faces multiple challenges. Delayed presentation due to fragmented healthcare systems and underdeveloped referral networks leads to advanced disease stages at diagnosis and poorer outcomes. These challenges are compounded by a shortage of multidisciplinary healthcare workforces,

Abbreviations: HIC, high-income country; LMIC, low- and middle-income country; MDT, multidisciplinary team; PrOFILE, Pediatric Oncology Facility Integrated Local Evaluation Tool; PrOFILE-ST, Pediatric Oncology Facility Integrated Local Evaluation—Surgical Tool.

inadequate infrastructure, limited prioritization of pediatric cancer, constrained diagnostic and therapeutic capacities, and financial barriers faced by families.[4–6]

Another common issue in LMICs is that surgeries are frequently performed in less equipped hospitals, instead of referring to tertiary care centers, due to financial models and incentives, and a lack of appropriate referral pathways within the healthcare plan. Clear referral pathways for complex and/or oncology surgeries to tertiary care centers should be prioritized in national cancer care plans.

Despite these obstacles, international institutions offer hope for building capacity and improving outcomes in pediatric oncology surgery within resource-limited settings. Increasing awareness of the potential for childhood cancer to be cured through adapted treatment regimens, simple multimodality therapy, and growing global collaborative efforts holds promise for transforming outcomes in LMICs.[4]

2 | CAPACITY MEASUREMENT AND MONITORING TOOLS

The integration of capacity and quality metrics into healthcare programs has substantially changed how healthcare systems are evaluated and improved. Over the years, numerous studies have underscored the importance of enhancing the processes of care, strengthening surgical infrastructure, investing in training programs, and implementing quality improvement methods. These efforts have not only consistently enhanced patient outcomes, but also consistently yielded cost savings in healthcare delivery.

Capacity and quality indicators play a pivotal role in this process by serving as invaluable tools for identifying weaknesses and mapping the quality of care provided. By systematically measuring various aspects of healthcare delivery, teams can use these indicators to gain insight about areas for improvement and help guide resource allocation and decision-making.[7,8]

Moreover, benchmarking has emerged as a powerful method for measuring and analyzing internal and external performance against other providers and institutions. By comparing performance metrics with those of peers, benchmarking enables healthcare organizations to identify best practices, learn from others' successes, and drive continuous improvement efforts. This comparative analysis fosters a culture of accountability and innovation within healthcare systems, ultimately leading to enhanced patient care and outcomes. However, despite the benefits of capacity and quality metrics and benchmarking, there remains a notable gap in the tools specifically tailored to measure healthcare performance and training needs in LMICs. Pediatric surgical oncology lacks adequate indicators to effectively assess capacity and quality of care. This gap poses substantial challenges for accurately evaluating and addressing healthcare needs in LMICs, where resources are often limited, and healthcare infrastructure may be underdeveloped.

Addressing this gap requires a concerted effort to develop and implement appropriate tools and indicators that are contextually relevant and sensitive to the unique challenges faced by healthcare systems in LMICs. Collaborative initiatives among international organizations, research institutions, and healthcare providers in LMICs[9] are essential to ensure the development of robust measurement frameworks that effectively capture the complexities of pediatric oncology surgery and drive meaningful improvements in care delivery. Yet, maintaining sustainable and meaningful international capacity-building partnerships can be hampered by challenges, such as conflicts in training priorities between high-income countries (HICs) and LMICs, communication and coordination gaps, and lack of clarity about data rights.[10]

Furthermore, capacity-building efforts aimed at strengthening healthcare systems in LMICs should prioritize the development and implementation of comprehensive training programs for healthcare professionals, thereby strengthening the multidisciplinary surgical management of childhood tumors. Specifically, capacity building should incorporate radiologists, radiation oncologists, pediatric oncologists, pathologists, and intensivists, supported by appropriate infrastructure, such as intensive care units, blood banks, and imaging facilities. By investing in healthcare education and training, LMICs can cultivate a skilled workforce equipped with the knowledge and expertise to deliver high-quality care to pediatric patients with cancer.[11]

Although the use of capacity and quality metrics and benchmarking has revolutionized healthcare evaluation and improvement efforts, much work still needs to be done to address the gaps in measuring healthcare performance and training needs, particularly in LMICs and in the context of pediatric oncology surgery. By developing and implementing tailored measurement tools, refining priorities, and investing in actionable capacity-building initiatives, we can work toward ensuring equitable access to high-quality healthcare for all children, regardless of their geographical location or socioeconomic status.[12,13]

The Pediatric Oncology Facility Integrated Local Evaluation Tool (PrOFILE) represents a substantial step forward in the comprehensive evaluation of health-system delivery for pediatric oncology services.[14] Recognizing the critical need for assessing childhood cancer surgery capacity in LMICs, the International Society of Pediatric Surgical Oncology and St. Jude Children's Research Hospital established a partnership.

The PrOFILE-Surgical Tool (PrOFILE-ST) was developed in response to the literature gap in this area. PrOFILE-ST evaluates five essential domains of childhood cancer surgical services: Context, Workforce, Diagnostics, Therapy, and Patient Outcomes. To ensure its relevance and effectiveness, the tool underwent a rigorous development process. Initially, 267 consensus-derived PrOFILE indicators were considered, from which 155 were retained, 77 were adapted, and 35 new surgical questions were incorporated to create PrOFILE-ST. The validation process involved the participation of nine international experts in an alpha-testing phase, followed by finalization by the core development team. Subsequently, the PrOFILE-ST was beta-tested in five countries to assess its practical applicability and refine its usability in diverse settings.

The analysis generated by PrOFILE-ST is expected to provide valuable insights for healthcare systems in LMICs, aiding in the

prioritization of needs, planning of implementation strategies, and monitoring of postintervention outcomes. Although the potential impact of this tool in driving sound prioritization and action is promising, its effectiveness in achieving these goals remains to be determined through further evaluation and assessment.

Overall, PrOFILE-ST represents a significant advance in evaluating and improving childhood cancer surgical services in LMICs. By providing a standardized framework for assessment and analysis, PrOFILE-ST has the potential to drive meaningful improvements in care delivery, ultimately contributing to better outcomes for pediatric oncology patients worldwide. Continued research and evaluation efforts are essential to fully realize the impact and effectiveness of this innovative tool in addressing the complex challenges faced by healthcare systems in LMICs.

3 | EDUCATION AND TRAINING INITIATIVES

The current shortage of a childhood cancer workforce presents a global challenge. In many parts of the world, pediatric oncology surgical procedures are primarily performed by general surgeons or general pediatric surgeons who may lack specific training in surgical oncology.[13] Some pediatric surgeons in LMICs dread performing pediatric oncology procedures because late presentations of advanced disease result in high mortality. Preoperative conditions of patients and access to surgical technical facilities and intensive care units are also poor. Over the years, the lack of specialized training in pediatric oncology, which has impacted the quality of care for pediatric cancer patients, has led to the initiation of targeted training programs, particularly in high-volume centers, to address the limited access to specialized training.[14–17]

To address these workforce limitations, various initiatives have been implemented. For instance, 10 pediatric surgical oncology training programs are now available in six LMICs (i.e., Argentina, Brazil, Egypt, India, Mexico, and South Africa) (Figure 1). These programs, typically training one or two surgeons per year, serve large populations, thus limiting the overall capacity to meet the local demands. Furthermore, in LMICs jobs in pediatric surgical oncology are not guaranteed after training because the subspecialty is not recognized. Pediatric surgical oncology training should be considered an effective, important part of the effort to improve cure rates and survival of children and adolescents with cancer, and should be ideally valued as part of the national plans for children in each country. Until that happens, it is important to train surgeons how to recognize pediatric cancer, what to do, and most important, what not to do in such cases.

In contrast, 11 pediatric surgical oncology training programs are available in eight HICs (i.e., Australia, Chile, France, Netherlands, Singapore, Spain, the United Kingdom, the United States) (Figure 2). These programs often have more resources and can support a higher number of trainees annually, contributing to a more sustainable workforce. Although these HIC programs may offer opportunities for a limited number of candidates from LMICs, those graduates are often attracted by open positions in the HIC job market. This trend contributes to cause a "brain drain" effect in which skilled professionals from LMICs migrate to HICs in search of better opportunities, further widening the workforce gap in their home countries. However, opportunities for international fellowships are still limited, because few centers offer fellowships to pediatric surgeons from LMICs, and those hospitals usually have a slot for only one candidate per year.[18] In a recent article, Paul D. Losty described mentorship and training in pediatric surgical oncology[19]; such opportunities are almost nonexistent in many LMICs. The capacity-building potential in LMICs is significantly affected by the limited number of training slots available. For instance, a program in a high-population LMIC like India, even if it trains one or two surgeons per year, must cater to the needs of a vastly larger pediatric population compared to a program in a smaller HIC. This imbalance underscores the urgent need for more training programs and greater support for existing ones in LMICs to enhance their capacity to meet the local demands. Regarding the remaining HICs and LMICs without specialized pediatric surgical oncology training programs, it is important to note that oncology care in these regions is often managed through general surgical training programs. In many LMICs, general pediatric surgeons may receive informal or on-the-job training in oncology surgery due to the absence of formal programs. While this approach can help mitigate the immediate shortage of specialized surgeons, it does not provide the comprehensive and focused training necessary for optimal patient outcomes.

In some HICs, oncology care might be integrated into broader surgical training programs, which can be effective due to the advanced healthcare infrastructure and resources available. However, this integration is less feasible in LMICs where healthcare resources and infrastructures are significantly constrained.

The role of international societies in LMICs' surgical programs, by enhancing virtual learning and improving local fellowship programs, has been described by the American Surgical Association Working Group on Global Surgery, according to the World Health Organization's (WHO) resolution and *The Lancet Commission on Global Surgery*.[8,20] Two years ago, a global pediatric oncology surgery 2-year fellowship program was launched, by leveraging shared resources from local and regional hubs and global organizations to train candidates from LMICs. This program was piloted by St. Jude Research Children's Hospital and the International Society of Paediatric Surgical Oncology (IPSO) in two regions, and is currently establishing a larger network of regional hubs to improve accessibility for many LMICs.

Overall, efforts to address workforce limitations in pediatric surgical oncology are ongoing, but face challenges related to access, distribution of training opportunities, and the retention of skilled professionals within LMICs.[21,22] Collaborations between LMICs and HICs and the development of sustainable training programs are essential to improve the situation and ensure equitable access to quality care for pediatric patients with cancer worldwide. In a broader context beyond the collaboration between international societies and LMICs–HICs, the WHO launched a global initiative in 2018 to increase survival rates for children with cancer, considering the implementation of workforce training.as one of the principal actions of this project framework.[23]

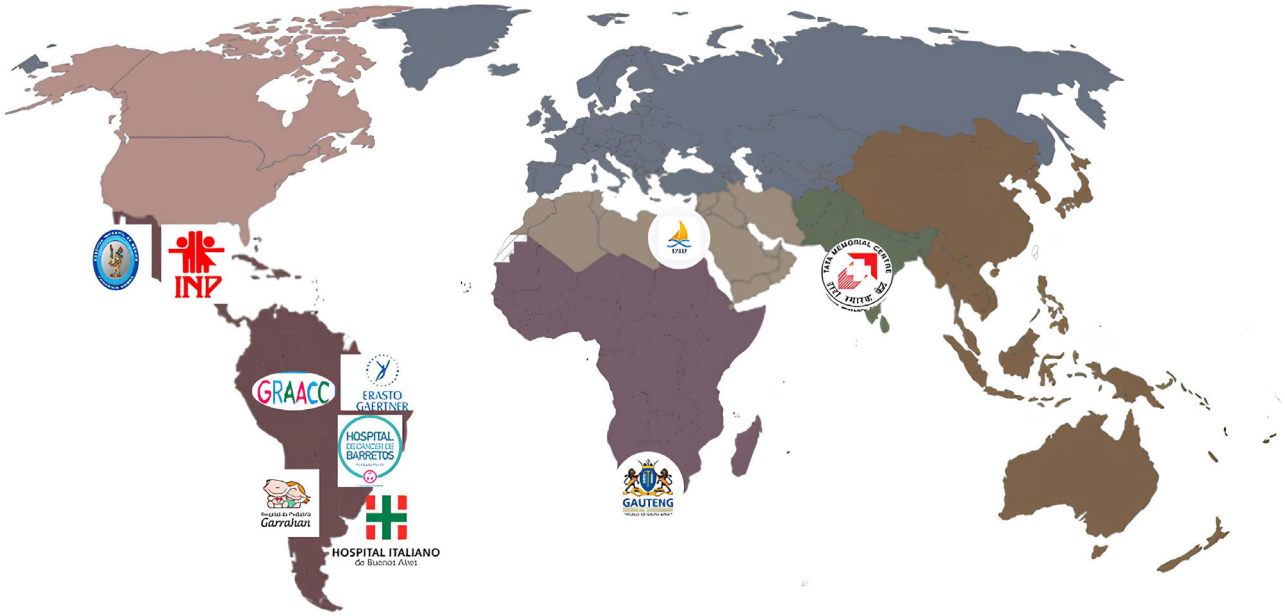

FIGURE 1 Current pediatric surgical oncology fellowship programs in low- and middle-income countries.

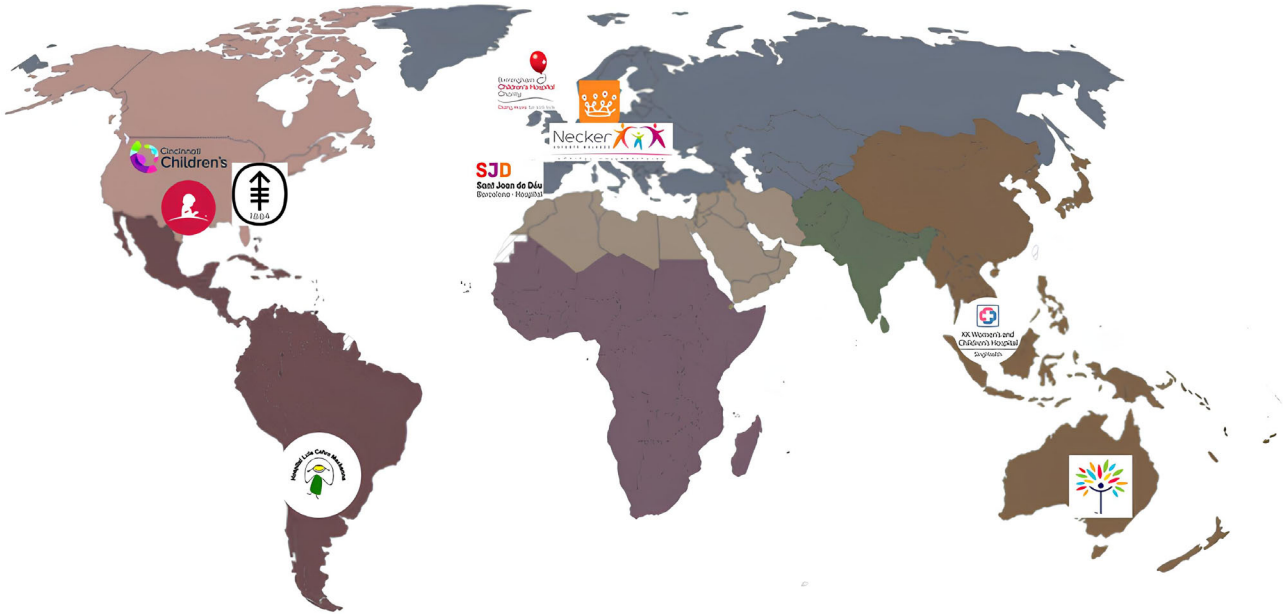

FIGURE 2 Current pediatric surgical oncology fellowship programs in high-income countries.

4 | MULTIDISCIPLINARY DISCUSSION

Establishing institutional tumor boards plays a crucial role in ensuring comprehensive and coordinated care for children with cancer. It is imperative that all hospitals caring for pediatric patients with cancer have multidisciplinary team (MDT) meetings. These MDT meetings serve as a platform for discussing the clinical management of each case and ensuring that no child receives care without proper deliberation among experts from various specialties. Furthermore, MDT audits are crucial to ensure standards of pediatric surgical care, as described by the Global Initiative for Children's Surgery in 2019, with the *Optimal Resources for Children's Surgical Care* document.[24]

However, the care of children with cancer often involves multiple institutions. For example, although oncology units may be located in one hospital, surgeries might take place in another. This decentralized approach can lead to logistical challenges, particularly regarding MDT communication. Coordination among institutions becomes essential to ensure seamless care delivery and optimal treatment outcomes for pediatric patients with cancer.

To address these challenges, virtual regional tumor boards have been established. These tumor boards serve as a bridge to overcoming the limitations of traditional hospital-based MDT meetings. By leveraging technology, experts from various institutions can discuss complex cases and formulate comprehensive treatment plans. The establishment of virtual regional tumor boards has been instrumental in improving the overall and event-free survival of pediatric patients with cancer in LMICs.[25–31]

By facilitating collaboration and information sharing among healthcare professionals across regions, these virtual platforms enable timely decision-making and access to specialized expertise. Furthermore, they promote standardized approaches to diagnosis, treatment, and follow-up care, thereby ensuring that every child receives high-quality evidence-based care, regardless of their geographic location.

The high clinical workload on both oncologists and surgeons, and lack of incentives for surgeons, pathologists, and radiologists to take time away from their busy clinical services to prepare for and attend MDTs is a significant barrier. This can be addressed by institutional commitments to MDTs as part of expected standard care, perhaps as a recognized benchmark, to incentivize clinicians to take the time to participate.

Thus, establishing institutional and regional tumor boards is essential for optimizing the care of children with cancer. By fostering multidisciplinary collaboration and leveraging technology, these tumor boards play a crucial role in improving treatment outcomes and enhancing the quality of life for pediatric patients with cancer and their families.

5 | STANDARDIZATION OF CARE AND ADAPTED GUIDELINES

Developing adapted guidelines in pediatric oncology is paramount to addressing the disparities in childhood cancer outcomes, which often arise due to variability in care practices. By establishing standardized guidelines for diagnosis, treatment, and follow-up care, healthcare providers can ensure consistency in care delivery across settings. These guidelines serve as a framework for healthcare professionals to follow, thereby helping to improve outcomes and facilitate meaningful comparisons of treatment results across institutions and regions.[32]

Adapted guidelines account for the unique needs and challenges of pediatric oncology, considering factors such as age, disease type, and available resources. They provide evidence-based recommendations for various aspects of cancer care, including screening, diagnosis, treatment modalities, supportive care, and survivorship.[33] By adhering to these guidelines, healthcare providers can optimize the quality of care delivered to pediatric patients with cancer, ultimately leading to better outcomes and improved survival.

In addition to adapted guidelines, the role of synoptic operative reports is equally crucial to enhancing communication and ensuring accurate staging and therapy planning for pediatric patients with cancer. Unlike narrative operative reports, which may lack key findings and comprehensive details, synoptic operative reports provide a structured format for documenting operative findings. These reports include specific key findings that are essential for therapy planning, such as tumor size, surgical margins, lymph node involvement, and presence of metastasis.

Using synoptic operative reports helps to standardize the reporting process and ensures that important information is captured accurately and consistently. This, in turn, facilitates effective communication among surgical teams, oncologists, and other healthcare providers involved in the care of pediatric patients with cancer. By providing a clear and concise summary of operative findings, synoptic reports enable healthcare providers to make informed decisions about treatment strategies and adjustments, thereby improving overall patient care and outcomes.[34]

In summary, developing adapted guidelines and using synoptic operative reports play vital roles in standardizing care practices and optimizing outcomes in pediatric oncology. By promoting consistency, accuracy, and effective communication, these tools contribute to the delivery of high-quality, evidence-based care to children with cancer, ultimately improving their survival and long-term well-being.

6 | CONCLUSION

Addressing the challenges facing childhood cancer surgery in LMICs requires a multifaceted approach that involves strengthening healthcare systems, investing in infrastructure and workforce development, improving access to diagnostics and treatments, and enhancing financial support mechanisms (Figure 3).

Strengthening healthcare systems involves improving overall healthcare infrastructure, including hospitals, surgical facilities, and critical care units. Investments in infrastructure are necessary to provide the physical and technological resources required for effective cancer treatment. Enhancing diagnostic and treatment capabilities, such as access to modern imaging technologies, pathology services, and advanced surgical techniques, is essential for accurate diagnosis and effective treatment of pediatric cancers. Additionally, providing financial support mechanisms, such as subsidized care or insurance programs, can help reduce the financial burden on families and improve access to necessary treatments.

We have discussed several critical enablers for improving childhood cancer surgery outcomes in LMICs. Surgical oncology training is crucial for developing a skilled workforce capable of performing complex cancer surgeries. Effective communication and MDTs ensure coordinated care and comprehensive treatment planning. Streamlined and effective documentation helps maintain accurate medical records and facilitates continuity of care. Unified guidelines provide standardized protocols for diagnosis and treatment, ensuring consistency in care delivery. Benchmarking and measurement tools are essential for assessing performance, identifying areas for improvement, and driving continuous quality improvement.

By addressing these challenges and leveraging these enablers, we can deliver quality childhood cancer services that enhance outcomes for pediatric oncology patients in LMICs. A concerted effort involving

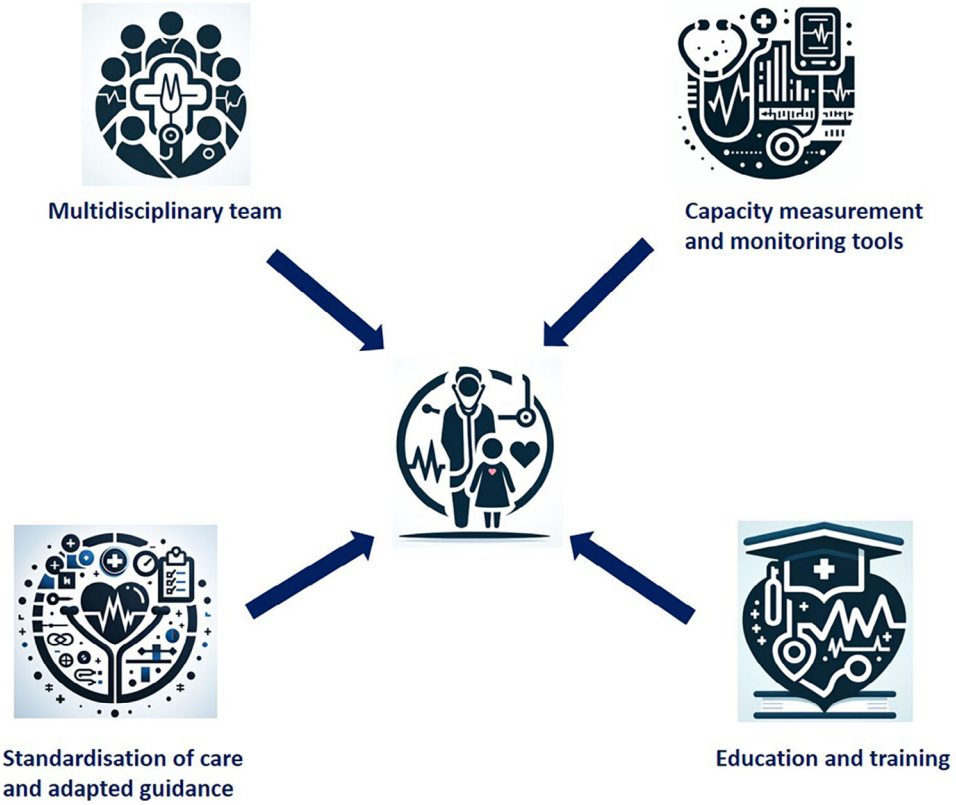

FIGURE 3 Key elements for childhood cancer management in low- and middle-income countries.

healthcare providers, policymakers, and international organizations is required to implement these strategies effectively and sustainably. Continued research and collaboration are necessary to develop innovative solutions and ensure equitable access to high-quality care for all children, regardless of their geographical location or socioeconomic status.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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