CHILDHOOD CANCER CONTROL IN RESOURCE-POOR SETTINGS: A NARRATIVE REVIEW OF CHALLENGES USING THE HEALTH SYSTEMS PLUS FRAMEWORK

Saleh Ahmed[1,4], Taiye T. Ibiyeye[2], Ngozi P. Udechukwu[3], Kaltumi Shuaibu[4], Sikemi T. Oluleye[5], Heather Fosburgh[6], Catherine G. Ham[6]

1- Abubakar Tafawa Balewa University, Bauchi State, Nigeria
2- Paediatric Surgery Unit, Department of Surgery, Federal Teaching Hospital, Lokoja, Kogi State, Nigeria
3- Department of Paediatrics, Alex Ekwueme University Teaching Hospital, Abakaliki, Ebonyi State, Nigeria
4- Department of Paediatrics, Tafawa Balewa University Teaching Hospital, Bauchi State, Nigeria
5- Dorcas Cancer Foundation, Lagos, Nigeria
6- Health Systems Unit, Department of Global Pediatric Medicine, St. Jude Children's Research Hospital, Memphis, USA

Corresponding Author: Saleh Ahmed, Abubakar Tafawa Balewa University, Bauchi State, Nigeria, sahmaad21@gmail.com

Citation: Ahmed S, Ibiyeye TT, Udechukwu NP, Shuaibu K, Oluleye ST, Fosburgh H, Ham CG. Childhood Cancer in Resource-Poor Settings: A Narrative Review of Challenges Using the Health Systems Plus Framework. Niger J Oncol. 2026;2(2): 203- 218

ABSTRACT

Background: Childhood cancer control in resource-poor settings faces multiple barriers across the continuum of care, from delayed diagnosis to treatment abandonment and limited survivorship support. While individual challenges are well-documented, understanding their interactions and self-reinforcing dynamics is essential for designing effective interventions. The Health Systems Plus (HS+) Framework offers a comprehensive model capturing both core health system functions and critical "plus" elements of community engagement, family support, and multisectoral coordination. This narrative review examines childhood cancer control challenges through the HS+ domains, illuminating both discrete barriers and the dynamic interconnections that perpetuate poor outcomes.

Methods: This narrative review synthesizes existing literature on childhood cancer control barriers in low-resource environments, mapping findings onto the HS+ framework. We reviewed peer-reviewed articles, policy reports, and case studies published between 2010 and 2025. Thematic analysis was conducted across framework domains with explicit attention to cross-domain interactions.

Results: Of 750 documents screened, 42 met inclusion criteria for detailed analysis, representing 35 countries across five WHO regions, including 19 low- and middle-income countries. Key challenges identified include inadequate

health workforce training, limited diagnostics and essential medicines, fragmented referral systems, financial toxicity leading to treatment abandonment, and weak health information systems. Critically, these challenges form self-reinforcing cycles: weak governance perpetuates underfinancing, constrains workforce development, compromises service delivery, and erodes community trust—each failure compounding the others.

Conclusion: Improving childhood cancer survival in resource-poor settings requires moving beyond siloed interventions toward integrated health systems strengthening. The HS+ framework provides a valuable structure for identifying leverage points where strategic investments can disrupt negative feedback loops and catalyze systemic improvement. Future efforts must prioritize context-aware, evidence-informed strategies addressing dynamic interactions across all health system dimensions.

Keywords: Childhood Cancer Control, Low- And Middle-Income Countries, HS+ Framework

INTRODUCTION

Childhood cancer represents one of the most profound and avoidable inequities in global health. Each year, approximately 300,000 children and adolescents under 19 years are diagnosed with cancer worldwide, with leukemia as both the most common malignancy and the leading cause of cancer-related death in this age group.[1] While often perceived as rare, childhood cancer has emerged as a leading cause of non-communicable disease mortality in children globally, demanding urgent public health attention—particularly in low- and middle-income countries (LMICs) where the burden is greatest and resources fewest.[1-4] The epidemiological transition in LMICs, marked by declining infectious disease mortality, has unmasked childhood cancer as a major contributor to child deaths that health systems remain ill-equipped to address.[5]

The stark disparity in survival outcomes between high-income countries (HICs) and LMICs constitutes a moral failure of global health equity. In HICs, advances in multimodal therapy, supportive care, and health system infrastructure have propelled overall survival rates above 80%. In tragic contrast, survival in many resource-poor settings languishes at 10–30%—a gap translating into hundreds of thousands of preventable deaths annually.[1-4] This "survival gap" persists not primarily from a lack of clinical knowledge about how to treat childhood cancer, but from systemic failure of care delivery.[5-8] The treatments and protocols proven effective in HICs are well-known; their implementation in LMICs is thwarted by interconnected systemic barriers: late diagnosis, absent essential medicines, severe workforce shortages, and catastrophic financial costs for families.[9–11]

The World Health Organization (WHO) and global partners have responded with initiatives like the Global Initiative for Childhood Cancer (GICC), aiming to double survival rates to at least 60% globally by 2030.[2,3,6-11] Yet achieving this ambition requires more than target-setting—it demands a fundamental reorientation in how we conceptualize and address barriers to childhood cancer care. Fragmented, siloed interventions have proven insufficient: investing in chemotherapy access without parallel investment in trained nurses to administer it safely, or in diagnostic laboratories to confirm disease, yields limited returns.[11-12] What is needed is a systematic

analytical framework that captures not only discrete challenges but also their dynamic interactions. This review advances a central thesis: The childhood cancer survival gap in resource-poor settings is a systems failure, a web of self-reinforcing weaknesses across governance, financing, workforce, service delivery, information systems, and community engagement.

To illuminate these dynamics, we employ the Health Systems Plus (HS+) Framework—an evolution of the WHO's classic "Building Blocks" model offering a more dynamic, patient-centered perspective.[12-17] The HS+ framework examines six core health system dimensions—Service Delivery, Health Workforce, Health Information Systems, Access to Essential Medicines and Technologies, Financing, and Leadership and Governance—while critically incorporating cross-cutting elements of population needs, values, preferences, and the overarching goal of system performance. This "plus" component is vital for childhood cancer control, as it forces consideration of community awareness, cultural beliefs, family financial burden, and the imperative of delivering high-quality, patient-centered care.[18]

This narrative review employs the HS+ framework as its analytical lens to synthesize the multifaceted challenges of childhood cancer control in resource-poor settings. Our objectives are to: (1) delineate specific barriers within each health system dimension; (2) illuminate critical interconnections and feedback loops between these challenges; (3) highlight the central role of population-specific factors such as health literacy, cultural stigma, and catastrophic out-of-pocket expenditures; and (4) synthesize existing literature into a coherent narrative that moves beyond listing problems toward a systems-level understanding of why the survival gap persists. Ultimately, we contend that achieving meaningful progress requires a paradigm shift from isolated interventions to integrated health systems strengthening—designing strategies that acknowledge and address complexity rather than simplifying it away.

MATERIALS AND METHODS

Study Design and Rationale

We conducted a narrative review to provide a comprehensive, critical synthesis of the broad and complex literature on childhood cancer control barriers in resource-poor settings. This design was chosen because the research question is multifaceted, involving multiple health system dimensions and contextual factors requiring integration of diverse study types (qualitative, quantitative, mixed-methods, policy analyses) to build a coherent "big picture." The goal is to map the landscape of challenges, identify conceptual themes, and analyze them through a structured framework—strengths of the narrative review format. A detailed description of our search strategy, selection process, and analytical approach is provided in Supplementary Appendix A.

Analytical Framework: Health Systems Plus Model

To structure our analysis, we employed an adapted Health Systems Plus framework, which expands on the classic WHO building blocks to include critical cross-cutting and contextual elements.[12-17] The framework encompasses:

Core Health System Building Blocks:

1. **Service Delivery:** Diagnosis, treatment (chemotherapy, surgery, radiotherapy), supportive care, palliative care, survivorship care
2. **Health Workforce:** Pediatric oncologists, nurses, surgeons, pathologists, radiographers, psychosocial workers; training and retention
3. **Health Information Systems:** Cancer registries, patient records, data for monitoring and evaluation
4. **Access to Essential Medicines & Technologies:** Reliable supply of chemotherapeutics, antibiotics, blood products; imaging, pathology, radiotherapy. Service Delivery treats the *person*, while Access to Medicines treats the *supply chain*. The moment a drug leaves the pharmacy shelf, it transfers from the Access framework into the Service Delivery framework, where the clinician takes legal and ethical responsibility for its use.
5. **Financing:** Out-of-pocket costs, health insurance, government funding, donor support; financial toxicity
6. **Leadership & Governance:** National cancer control plans, policies, regulations; stakeholder coordination

"Plus" Elements (Cross-Cutting and Contextual Factors):

7. **Community & Household Factors:** Awareness, beliefs, stigma, health-seeking behavior; family capacity (financial, social); transportation
8. **Socioeconomic & Political Context:** Poverty, education, infrastructure (roads, electricity); political stability; health system fragility
9. **Cross-Cutting Themes:** Equity (gender, rural/urban, poverty); quality of care; resilience; partnerships (international NGOs, twinning programs)

Service Delivery treats the *person* and encompasses the clinical encounter, patient-provider interaction, and the continuum of care. **Access to Medicines** treats the *supply chain*—encompassing procurement, distribution, pricing, and availability of pharmaceuticals. The critical distinction is that the moment a drug leaves the pharmacy shelf, it transfers from the **Access** framework into the **Service Delivery** framework, where the clinician takes legal and ethical responsibility for its use. While eight addresses the broader structural environment (policy frameworks, economic conditions, political will), nine focuses on cross-cutting enablers (health information systems, community engagement, multisectoral coordination) that operate across all other building blocks.

The socioeconomic and political context represents the broad societal environment that creates health inequalities, while cross-cutting themes like equity are internal mechanisms that health systems can use to actively respond to and mitigate those inequalities.

RESULTS

Overview of Included Studies

Of 750 documents screened, 42 were included in the narrative review (these counts are descriptive and supplementary to the qualitative synthesis). These represented 35 countries across five WHO regions, with 19 LMICs included. Geographic distribution reflected literature's concentration in Sub-

Saharan Africa, South Asia, and Latin America, with fewer studies from Eastern Europe and Central Asia. Study types included qualitative studies (n=14), quantitative surveys (n=12), mixed methods (n=8), policy analyses (n=6), and case studies (n=2).

The regional distribution of included studies is illustrated in Figure 1.

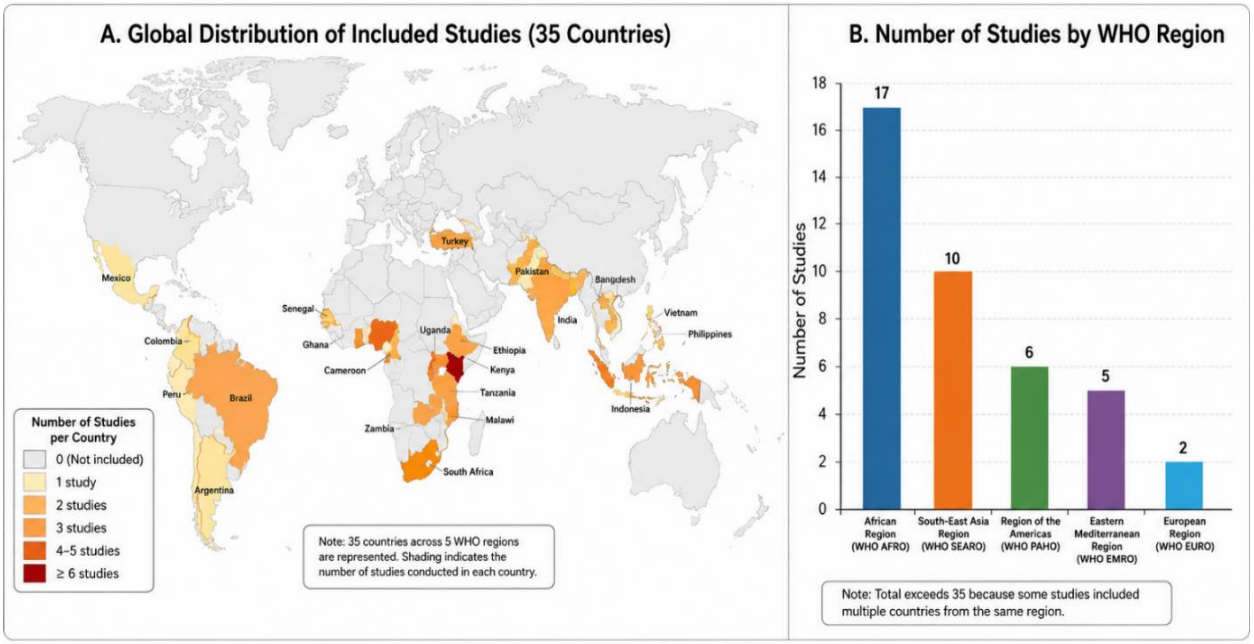

Figure 1. Geographic Distribution of Included Studies.
Panel A shows the global distribution of the 35 countries included in this review, with shading representing the number of studies per country.
Panel B presents the number of studies included from each WHO region.

Figure 1: Geographic Distribution of Included Studies. Panel A shows the global distribution of the 35 countries included, with shading representing the number of studies per country. Panel B presents the number of studies included from each WHO region.

Challenges by Health System Dimension

Table 1 summarizes key challenges identified within each HS+ dimension. Detailed findings are presented below, with particular attention to how challenges in one domain propagate through the system.

Table 1: Summary of Childhood Cancer Control Challenges by HS+ Dimension

Dimension	Key Challenges Identified
Leadership & Governance	Weak political prioritization; fragmented stakeholder coordination; absence of dedicated childhood cancer policies; poor integration into UHC packages
Health Financing	High out-of-pocket expenditures (>40% of health spending); limited insurance coverage; catastrophic financial toxicity; <5% of global pediatric cancer funds reaching LMICs
Health Workforce	Severe specialist shortages; nurse:patient ratios exceeding 1:10; 48% of nurses lacking oncology training; high attrition and migration; limited training institutions
Essential Medicines & Technologies	<30% LMICs have reliable access to essential cancer medicines; supply chain disruptions; stock-outs lasting up to 70 days; outdated national medicine lists
Service Delivery	Fragmented referral systems; delayed diagnosis; absence of multidisciplinary teams; poor integration of palliative care; centralized services inaccessible to rural populations
Health Information Systems	Absent or incomplete cancer registries; weak digital infrastructure; poor data integration; limited capacity for monitoring and evaluation
Community & Family Factors	Low cancer awareness; stigma and traditional healer preference; catastrophic indirect costs (transport, lodging, lost income); weak family support structures

The Heart of The Matter: Cross-Cutting Themes and System Interactions

Childhood cancer care is a "tracer condition" that exposes and tests the strength, equity, and resilience of an entire health system. Our analysis reveals that the most significant barriers are not the individual challenges listed in Table 1, but rather the dynamic interactions and feedback loops that connect them.

Critical Interaction Pathways

Our analysis identified five interaction pathways particularly consequential for childhood cancer outcomes:

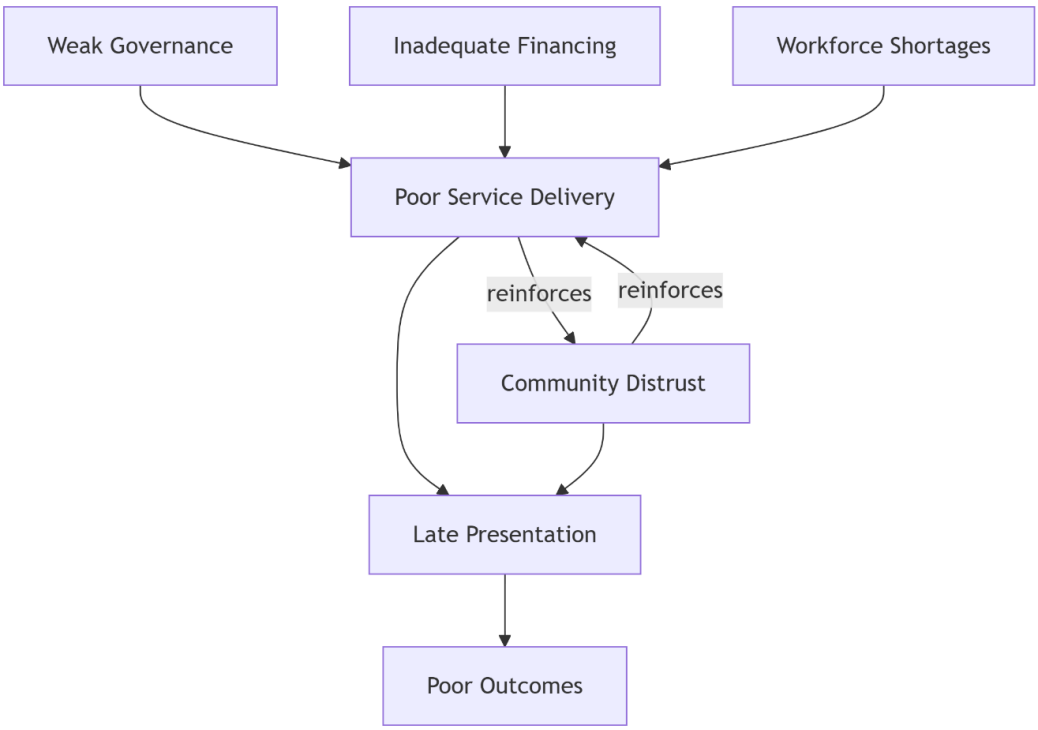

Figure 2: Self-reinforcing cycle of systemic failure. The Vicious Cycle of Systemic Failure

Pathway 1: Governance → Financing → Workforce → Service Delivery

Weak political commitment to childhood cancer (Governance) manifests as absent or inadequate budget allocation (Financing).[18-20] In Ghana, fragmented governance and donor focus on infectious diseases have left childhood cancer programs reliant on unsustainable external funding.[18] This financial neglect directly constrains workforce development: low salaries, unsafe working conditions, and limited career progression drive attrition and migration, with nurse-to-patient ratios exceeding 1:10 versus the recommended 1:5.[19-21] Workforce shortages compromise service delivery through delayed diagnoses, misdiagnosis by undertrained providers, and absence of multidisciplinary teams.[21,31]

Feedback: Poor service delivery outcomes (high mortality, treatment abandonment) reinforce policymakers' perception that childhood cancer is "too difficult" or "too expensive" to prioritize, perpetuating governance neglect.

Pathway 2: Financing → Community → Service Delivery

Inadequate public financing shifts costs to families, with out-of-pocket payments often exceeding 40% of total health spending in

LMICs.[21] Even when chemotherapy is nominally "free," families face catastrophic indirect costs for diagnostics, supportive medications, transportation, and lodging during treatment. In Ghana's National Health Insurance Scheme, incomplete coverage for common cancers like Burkitt's lymphoma leaves families bearing substantial costs.[22]

Financial toxicity directly impacts service delivery through treatment abandonment—families simply cannot afford to continue care.[23] Studies from Sub-Saharan Africa document that financial barriers are among the strongest predictors of treatment abandonment, affecting 30–50% of children in some centers.[22-24]

Feedback: High abandonment rates depress survival statistics, which are then used to argue that childhood cancer treatment is "not cost-effective" in resource-poor settings—a circular logic justifying continued underinvestment.

Pathway 3: Information Systems → Governance → Financing

Weak Health Information Systems—absent or incomplete cancer registries, poor outcome data—cripple effective governance. Without reliable data on incidence, burden, and treatment outcomes, policymakers cannot make evidence-informed decisions about resource allocation. In many LMICs, the scarcity of rigorous childhood cancer data means the true burden remains invisible, allowing childhood cancer to remain deprioritized relative to better-measured conditions.[25]

Feedback: The absence of data perpetuates the absence of resources, which perpetuates the absence of data—a cycle of invisibility.

Pathway 4: Medicines & Technologies → Service Delivery → Community

Supply chain failures for essential medicines—with stock-outs lasting up to 70 days in some settings—directly compromise service delivery.[26,32-36] When a child's chemotherapy is interrupted due to drug unavailability, survival is jeopardized and community trust erodes.[27-29] Families who have sacrificed enormously to bring their child to a treatment center, only to find essential medicines unavailable, become reluctant to seek care for other children or encourage neighbors to do so.[21,30,38]

Feedback: Community distrust reinforces traditional healer preference and delays future presentations, ensuring children arrive with more advanced diseases requiring more complex and expensive treatment—perpetuating the cycle.

Pathway 5: Workforce → Service Delivery → Information Systems

Workforce shortages compromise not only clinical care but also data systems. Overburdened clinicians with limited training in data management cannot maintain high-quality registries. The absence of dedicated data personnel means that even where registries exist, they are often incomplete or inaccurate.[28,30]

Feedback: Poor data obscures workforce shortages (by failing to document workload, attrition, or outcomes), which then receive no policy attention.

The "Plus" Dimension: Community as both Barrier and Leverage Point

The HS+ framework's explicit inclusion of community and family factors reveals their dual role. Low awareness, stigma, and traditional healer preference serve as powerful barriers delaying presentation and promoting abandonment.[20-23,37,-39] Conversely, community engagement represents one of the most potent leverage points for systemic improvement. Parent support groups, when effectively integrated into care delivery, can reduce abandonment, improve adherence, and advocate for policy change.[40-42]

The challenge is that community engagement cannot be effective when the formal health system is dysfunctional. Families who become informed advocates for early detection cannot act on that knowledge if referral pathways are unclear, diagnostic facilities are absent, or treatment is unaffordable. The "plus" elements are not substitutes for core system strengthening but co-requisites.

Implications for Intervention Design

Understanding these interactions explains why isolated interventions so often fail:

- Donated chemotherapy without investment in cold chain, trained administrators, or diagnostic capacity yields wasted drugs and toxic deaths.
- Workforce training without addressing working conditions, salaries, and career pathways yields trained staff who promptly emigrate.
- Public awareness campaigns without functional referral systems and affordable treatment yield frustrated families and eroded trust.
- Cancer registry development without investment in data personnel, infrastructure, and utilization yields expensive but unused datasets.

Conversely, understanding these interactions reveals potential leverage points where strategic investments might disrupt multiple negative cycles simultaneously:

- Investing in national health insurance coverage for childhood cancer (Financing) simultaneously reduces abandonment (Service Delivery), strengthens political commitment (Governance), and generates demand for data (Information Systems).
- Establishing twinning partnerships with HIC institutions (Governance) can simultaneously train workforce, strengthen protocols (Service Delivery), and build research capacity (Information Systems).
- Integrating childhood cancer into primary care training (Workforce) can improve early detection (Service Delivery), reduce late-stage presentation (Community), and generate data on referral patterns (Information Systems).

Strategies And Recommendations for System Strengthening

Based on our systems-level analysis, we propose prioritized, context-aware recommendations organized by HS+ dimension with emphasis on cross-cutting actions addressing multiple domains simultaneously.

Governance and Leadership

Priority Action: Embed childhood cancer in national health policies with dedicated budgets and accountability mechanisms.

Context-Aware Strategies:

- For countries with no childhood cancer policy: Conduct situational analysis using the C5 tool (Country Collaboration for Childhood Cancer Control) to generate evidence for advocacy and identify immediate priorities.[12,14]
- For countries with nascent policies: Establish multi-stakeholder platforms (ministry of health, professional societies, NGOs, parent groups) to coordinate implementation and monitor progress.
- For countries with established policies but weak implementation: Link policy goals to financing mechanisms (e.g., accreditation requirements, performance-based funding) and establish regular review cycles.

Cross-Cutting Impact: Strong governance enables sustainable financing, coordinates workforce planning, and creates accountability for service delivery.

Health Financing

Priority Action: Remove financial barriers to care through strategic purchasing and expansion of prepayment mechanisms.

Context-Aware Strategies:

- For low-financing settings: Pilot dedicated childhood cancer funds pooling government, NGO, and donor resources; use data on treatment abandonment to advocate for inclusion in UHC benefit packages.
- For settings with insurance schemes: Ensure childhood cancer is explicitly included in benefit packages with coverage for both medical and essential non-medical costs (transport, lodging, nutrition).
- For all settings: Link financing to quality by directing resources to accredited centers using evidence-based protocols and reporting outcomes.

Cross-Cutting Impact: Adequate financing enables workforce retention (salaries), service delivery (drugs, diagnostics), and community engagement (reducing abandonment).

Health Workforce

Priority Action: Build and sustain a competent, motivated multidisciplinary workforce through training, task-sharing, and improved working conditions.

Context-Aware Strategies:

- For severe shortages: Implement task-sharing models where general pediatricians and nurses receive structured training in core oncology care, with specialist supervision via telemedicine.
- For retention challenges: Address root causes through salary supplementation, career development pathways, and safe working environments (e.g., chemotherapy handling protocols).
- For training gaps: Develop national pediatric oncology training curricula; establish regional centers of excellence for specialized training; integrate childhood cancer into pre-service education for all cadres.

Cross-Cutting Impact: A strengthened workforce improves service delivery, generates better data, and builds community trust through competent, compassionate care.

Essential Medicines and Technologies

Priority Action: Ensure reliable, affordable access to essential childhood cancer medicines and diagnostics through strengthened procurement and supply chains.

Context-Aware Strategies:

- For supply chain fragility: Centralize procurement to achieve economies of scale; improve forecasting using registry data; establish buffer stocks to prevent stock-outs.
- For affordability barriers: Include all essential childhood cancer medicines in national essential medicines lists and UHC formularies; negotiate pooled procurement with neighboring countries.
- For diagnostic access: Prioritize investment in pathology and imaging capacity at referral centers; explore public-private partnerships for equipment maintenance and quality assurance.

Cross-Cutting Impact: Reliable medicines and technologies enable effective service delivery, reduce abandonment (when families don't face unexpected drug costs), and build community trust.[32-36]

Service Delivery

Priority Action: Establish integrated, tiered service networks ensuring timely diagnosis, protocol-based treatment, and comprehensive supportive care.

Context-Aware Strategies:

- For fragmented referral systems: Map and disseminate clear referral pathways; establish communication mechanisms between levels of care; designate and resource referral hubs.
- For delayed diagnosis: Integrate childhood cancer early warning signs into primary care and IMCI training; establish rapid referral mechanisms for suspected cases.
- For limited multidisciplinary care: Build tumor boards (in-person or virtual); integrate nutrition, psychosocial support, and palliative care from diagnosis.

Cross-Cutting Impact: Strengthened service delivery generates demand for workforce development, supplies data for information systems, and builds community trust.

Health Information Systems

Priority Action: Develop and sustain childhood cancer registries that inform policy, track outcomes, and drive quality improvement.

Context-Aware Strategies:

- For no registry: Start with hospital-based registries at referral centers using simple, sustainable tools; link to regional or global platforms (e.g., St. Jude Global Registry).
- For existing registries but limited use: Build local capacity for data analysis and interpretation; establish regular feedback loops to clinicians and policymakers.
- For digital infrastructure constraints: Use offline-capable tools; invest in basic infrastructure (reliable electricity, internet) at registry sites.

Cross-Cutting Impact: Robust information systems enable evidence-based governance, track financing effectiveness, monitor workforce performance, and document service delivery outcomes.[39]

Community and Family Engagement

Priority Action: Integrate families and communities as partners in childhood cancer control across the care continuum.

Context-Aware Strategies:

- For awareness gaps: Develop culturally appropriate awareness campaigns using multiple channels (community health workers, media, schools); engage survivors and families as messengers.
- For stigma and traditional healer preference: Build relationships with traditional healers as potential referral partners; address cultural beliefs through dialogue rather than dismissal.
- For family support: Establish parent support groups; create mechanisms for peer support during treatment; address practical needs (accommodation, school re-entry) through multi-sectoral partnerships.

Cross-Cutting Impact:
Engaged communities drive earlier presentation, support treatment adherence, advocate for policy change, and hold systems accountable.

DISCUSSION

This narrative review used the HS+ framework to synthesize the multifaceted challenges of childhood cancer control in resource-poor settings. Our central contribution is not merely to catalog barriers but to illuminate the dynamic interactions and feedback loops that perpetuate systemic failure. We have shown that weak governance perpetuates underfinancing, constrains workforce development, compromises service delivery, and erodes community trust—each failure compounding the others.

Implications for Policy and Practice

Our findings have several implications for policymakers, program managers, and global health advocates:

First, interventions must be designed with systems in mind. The failure of siloed approaches is not accidental but inevitable given the interconnectedness of health system domains. Donors and implementers should resist narrow, easily measurable interventions and instead invest in bundled strategies addressing multiple domains simultaneously.[25,26]

Second, context matters—but not as an excuse for inaction. While the specific configuration of challenges varies across settings, the underlying dynamic of interacting weaknesses is universal. The HS+ framework provides a structure for context-specific assessment (as in the C5 tool) that can identify local priorities while maintaining systems perspective.[12-17]
Third, data are not an end but a means. The absence of robust childhood cancer data in many LMICs is often cited as a barrier to action. Our analysis suggests the reverse: action generates data. Investing in service delivery, even imperfectly, generates clinical encounters and outcomes that populate registries. The goal should be to build data systems iteratively alongside service delivery, not as a prerequisite.

Fourth, community engagement is not optional. The "plus" in HS+ is not an add-on but a core component. Families and communities are not merely beneficiaries but actors whose knowledge, resources, and advocacy are essential to system functioning.[19] Interventions ignoring community

perspectives will fail regardless of technical merit.

Comparison with Existing Literature

Our findings align with and extend previous reviews. Gizaw et al.'s systematic review of barriers in Sub-Saharan Africa identified many of the same individual challenges we report, including provider knowledge gaps, referral system fragmentation, and community factors.[21] Our contribution is to situate these barriers within a systems framework, explaining their persistence and interaction. Similarly, Cotache-Condor et al.'s work on delayed cancer care identified multiple determinants but called for "comprehensive, multi-level interventions"—precisely what a systems perspective enables.[11]

The HS+ framework itself has been applied in regional collaborations in Latin America and the Caribbean, demonstrating its utility for multi-stakeholder strategic planning.[12,14,40] Our review extends this work by applying the framework to synthesize global literature and explicitly mapping interaction pathways.

Limitations

This review has several limitations. First, as a narrative review, it is subject to selection and interpretive bias, though we mitigated this through transparent, framework-driven methodology. Second, English-language restriction may have excluded relevant studies, particularly from non-Anglophone LMICs. Third, literature itself may over-represent challenges from well-documented programs and under-represent the most resource-poor settings where even basic documentation is absent. Fourth, our focus on barriers may under-emphasize the growing number of successful innovations and adaptations emerging from LMICs; a companion review on solutions and successes would complement this work.

In conceptualizing childhood cancer control, our review adopted a systems lens that recognizes control as emerging not from any single intervention—whether prevention, early detection, or treatment—but from the functional integration of all these elements within a resilient health system. The HS+ framework itself operationalizes this integrated view, where control is the product of governance, financing, workforce, medicines, and service delivery working in concert. Thus, while our search emphasized barriers, our analytical frame encompassed the full spectrum of control by examining how each system domain enables or constrains the prevention, detection, treatment, and survival of childhood cancer. We acknowledge that future reviews could usefully complement our barrier-focused approach with explicit searches for "control," "prevention," and "survivorship" outcomes, which may reveal additional evidence on successful control strategies.

Future Directions

This review suggests several priorities for future research and action:

1. Implementation research testing bundled, system-oriented interventions and documenting how they interact with local contexts.
2. Economic analyses capturing the full costs and benefits of systems strengthening, including avoided downstream costs from treatment abandonment and late presentation.

3. Network analyses mapping stakeholder relationships and identifying opportunities for improved coordination.
4. Community-based participatory research centering family and community perspectives in intervention design.
5. Longitudinal studies tracking how systems evolve over time in response to investments and shocks.

CONCLUSION

The childhood cancer survival gap between high-income countries and resource-poor settings is not a technical problem awaiting a technical solution. It is a systems failure, a web of self-reinforcing weaknesses across governance, financing, workforce, service delivery, information systems, and community engagement. Sustainable progress requires moving beyond isolated interventions toward integrated health systems strengthening that address these interactions explicitly.

REFERENCES

1. Wu Y, Deng Y, Wei B, et al. Global, regional, and national childhood cancer burden, 1990–2019: An analysis based on the Global Burden of Disease Study 2019. J Adv Res. 2022;40:233–47.
2. World Health Organization. CureAll framework: WHO Global Initiative for Childhood Cancer. Geneva: WHO; 2021.
3. Ward ZJ, Yeh JM, Bhakta N, et al. Global childhood cancer survival estimates and priority-setting: a simulation-based analysis. Lancet Oncol. 2019;20(7):972-83.
4. Haileamlak A. The challenge of childhood cancer in developing countries. Ethiop J Health Sci. 2016;26(3):199–200.
5. Bhakta N, Force LM, Allemani C, et al. Childhood cancer burden: a review of global estimates. Lancet Oncol. 2019;20(1):e42-53.
6. Lima RAG, Lopes-Júnior LC, Maia EBS, et al. Global Initiative for Childhood Cancer Control: Increasing access, improving quality, saving lives. Rev Lat Am Enfermagem. 2023;31:e3963.
7. Erdmann F, Feychting M, Mogensen H, et al. Social inequalities along the childhood cancer continuum: an overview of evidence and a conceptual framework. Front Public Health. 2019;7:84.
8. Howard SC, Davidson A, Luna-Fineman S, et al. A framework to develop adapted treatment regimens to manage pediatric cancer in low- and middle-income countries. Pediatr Blood Cancer. 2017;64(S5):e26879.
9. Gizaw AT, Woldie I, Yilma AN, et al. Barriers to timely diagnosis and treatment of childhood cancer in Sub-Saharan Africa: a qualitative systematic review. BMC Cancer. 2025;25(1):1600.
10. Cotache-Condor C, Grimm A, Williamson J, et al. Factors contributing to delayed childhood cancer care in low- and middle-income countries: A systematic review protocol. Pediatr Blood Cancer. 2022;69(5):e29643.
11. Tang B, Bodkyn C, Gupta S, Denburg A. Access to WHO Essential Medicines for childhood cancer care in Trinidad and Tobago: A health system analysis of barriers and enablers. JCO Glob Oncol. 2020;6:67–79.
12. Lam CG, Vasquez L, Loggetto P, et al. Partnering to implement the Global Initiative for Childhood Cancer in the Americas: prioritizing systems

strengthening. Rev Panam Salud Publica. 2023;47:e41.
13. World Health Organization. Monitoring the building blocks of health systems: a handbook of indicators and their measurement strategies. Geneva: WHO; 2010.
14. Ortiz R, Vásquez L, Giri B, et al. Developing and sustaining high-quality care for children with cancer: the WHO Global Initiative for Childhood Cancer. Rev Panam Salud Publica. 2023;47:e50.
15. Pan American Health Organization. Country Collaboration for Childhood Cancer Control (C5): workshop report. Washington, DC: PAHO; 2022.
16. St. Jude Children's Research Hospital. C5: Country Collaboration for Childhood Cancer Control. Memphis: St. Jude Global; 2023.
17. World Health Organization. WHO Global Initiative for Childhood Cancer: an overview. Geneva: WHO; 2020.
18. Denburg AE, Ramirez A, Pavuluri S, et al. Political priority and pathways to scale-up of childhood cancer care in five nations. PLoS One. 2019;14(8):e0221292.
19. Cotache-Condor C, Kantety V, Grimm A, et al. Determinants of delayed childhood cancer care in low- and middle-income countries: A systematic review. Pediatr Blood Cancer. 2023;70(3):e30149.
20. Akinsete AM, Odugbemi BA, Ogundowole GE, et al. Pediatric oncology in Nigeria: A panoramic view. J Glob Oncol. 2019;5:1–7.
21. Gizaw AT, Woldie I, Yilma AN, et al. Barriers to timely diagnosis and treatment of childhood cancer in Sub-Saharan Africa: a qualitative systematic review. BMC Cancer. 2025;25(1):1600.
22. Owusu R, Heupink LF, Gulbi G, et al. Achieving universal coverage of childhood cancers in Ghana via the National Health Insurance Scheme: A stakeholder analysis. PLOS Glob Public Health. 2025;5(7):e0004871.
23. Cotache-Condor C, Rice HE, Schroeder K, et al. Delays in cancer care for children in low-income and middle-income countries: development of a composite vulnerability index. Lancet Glob Health. 2023;11(4):e505–15.
24. Ritter J, de Bragança J, Auste C, et al. Novel framework of financial hardship in childhood cancer: Incorporating stakeholder perspectives. JCO Glob Oncol. 2024;10:e2300345.
25. Farmer P, Frenk J, Knaul FM, et al. Expansion of cancer care and control in countries of low and middle income: a call to action. Lancet. 2010;376(9747):1186-93.
26. Gupta S, Rivera-Luna R, Ribeiro RC, Howard SC. Pediatric oncology as the next global child health priority: The need for national childhood cancer strategies in low- and middle-income countries. PLoS Med. 2014;11(6):e1001656.
27. Radhakrishnan V, Gunasekera S, Lam CG, et al. Florence Nightingale needs your attention: A framework for improving pediatric oncology nursing in low- and middle-income countries. Indian J Med Paediatr Oncol. 2022;43(03):280–4.
28. Cayrol J, Ilbawi A, Sullivan M, Gray A. The development and education of a workforce in childhood cancer services in low- and middle-income countries: a scoping review protocol. Syst Rev. 2022;11(1):167.

29. Day S, Hollis R, Challinor J, et al. Baseline standards for paediatric oncology nursing care in low to middle-income countries: position statement of the SIOP PODC Nursing Working Group. Lancet Oncol. 2014;15(7):681-2.
30. Adejumo PO, Oluwasanu MM, Ntekim A, et al. Oncology training needs assessment among health care professionals in Nigeria. JCO Glob Oncol. 2022;8:e2100344.
31. Klootwijk L, Apadet L, Njuguna F, et al. Delays in access to paediatric oncology care: Perspectives from eight partner hospitals. S Afr J Child Health. 2024;18(3):144–51.
32. Denburg AE, Fundytus A, Khan MS, et al. Defining essential childhood cancer medicines to inform prioritization and access: Results from an international, cross-sectional survey. JCO Glob Oncol. 2022;8:e2100359.
33. Robertson J, Magrini N, Barr R, et al. Medicines for cancers in children: the WHO model for selection of essential medicines. Pediatr Blood Cancer. 2015;62(10):1689-93.
34. Chukwu OA, Adewole IF, Denburg A, Essue BM. Improving childhood cancer medicines access in developing countries: Towards an implementation framework for the Global Platform for Access to Childhood Cancer Medicines for Nigeria. PLOS Glob Public Health. 2024;4(9):e0003275.
35. Petricca K, Carson L, Kambugu J, Denburg A. Strengthening access to cancer medicines for children in East Africa: policy options to enhance medicine procurement, forecasting, and regulations. Glob Health Res Policy. 2024;9(1):24.
36. Boateng R, Renner L, Petricca K, et al. Health system determinants of access to essential medicines for children with cancer in Ghana. BMJ Glob Health. 2020;5(9):e002906.
37. Oluwasanu MM, Adejumo PO, Sun Y, et al. Challenges and recommendations for improving cancer research and practice in Nigeria: A qualitative study with multi-stakeholders in oncology research and practice. Cancer Control. 2024;31:10732748241241542.
38. Mahajan H, Reddy N, Devi NGM, et al. Projected cancer burden, challenges, and barriers to cancer prevention and control activities in the state of Telangana. PLoS One. 2023;18(7):e0278357.
39. Nyarko EN, Santa S, Diaba-Nuhoho P. AI and digital health for childhood cancer care in Ghana. Commun Med. 2025;5(1):344.
40. Loggetto P, Jarquin-Pardo M, Fuentes-Alabi S, et al. Regional collaboration for the development of national childhood cancer plans in Latin America and the Caribbean. Rev Panam Salud Publica. 2023;47:e98.
41. Akinyemiju T, Ogunsina K, Gupta A, et al. A socio-ecological framework for cancer prevention in low and middle-income countries. Front Public Health. 2022;10:884678.
42. Morgan GW, Foster K, Healy B, et al. Improving health and cancer services in low-resource countries to attain the Sustainable Development Goals target 3.4 for noncommunicable diseases. J Glob Oncol. 2018;4:1–11