

Pediatric cancer care in Africa: SIOP Global Mapping Program report on economic and population indicators

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Abstract

Introduction: In alignment with the World Health Organization (WHO) Global Initiative for Childhood Cancer (GICC), the International Society of Pediatric Oncology initiated a program to map global pediatric oncology services. As survival rates in Africa are low and data are scant, this continent was mapped first to identify areas with greatest need.

Methods: Beginning November 2018, an electronic survey was sent to all known stakeholders, followed by email communications and internet searches to verify data. Availability of pediatric oncologists, chemotherapy, surgical expertise, and radiotherapy was correlated with geographic region, World Bank income status, Universal Health Coverage, population < 15 and < 24 years, percentage of gross domestic product spent on healthcare, and Human Development Index (HDI).

Results: Responses were received from 48/54 African countries. All three treatment modalities were reportedly available in 9/48 countries, whereas seven countries

Abbreviations: GC, Gini coefficient; GDP, gross domestic product; GICC, Global Initiative for Childhood Cancer; HDI, Human Development Index; HIC, high-income countries; LMIC, low and middle-income countries; SIOP, International Pediatric Oncology Society; SSA, sub-Saharan Africa; UHC, universal health coverage; WBS, World Bank status; WHO, World Health Organization.

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reported no pediatric oncology services. Negative correlations were detected between provision of all three services and geographic region ($P = 0.01$), younger median population age ($P = 0.002$), low-income country status ($P = 0.045$), and lower HDI ($P < 0.001$).

Conclusion: This study provides a comprehensive overview of pediatric oncology care in Africa, emphasizing marked disparities between countries: some have highly specialized services, whereas others have no services. A long-term strategy to eliminate disparities in African pediatric cancer care should be aligned with the WHO GICC aims and facilitated by SIOP Africa.

Meeting abstracts: SIOP maps pediatric oncology services in Africa to address inequalities in childhood cancer services. Geel J, Ranasinghe N, Davidson A, Challinor J, Howard S, Wollaert S, Myezo K, Renner L, Hessissen L, Bouffet E. 51st Annual Congress of the International Society of Paediatric Oncology (SIOP), Lyon, France, October 2019. *Pediatric Blood and Cancer* Vol 66 S219-S219. Pediatric cancer care in Africa: SIOP Global Mapping Program report on economic and population indicators.

KEYWORDS

Africa, GICC, global mapping, pediatric oncology

1 | INTRODUCTION

The World Health Organization (WHO) Global Initiative for Childhood Cancer (GICC), launched in 2018, aims to double the current estimated survival rate in low- and middle-income countries (LMICs) to 60% by 2030.¹ Aligned with this aim, the International Society of Paediatric Oncology (SIOP) embarked on a program to create a baseline map of pediatric oncology services within each continental region, commencing with Africa. SIOP, a not-for-profit organization, counts over 2000 members from 112 countries, including physicians, nurses, psychologists, nutritionists, and other professionals addressing global childhood cancer. SIOP, one of only three nonstate actors in official relations with the WHO that focus on pediatric oncology, is a key stakeholder in delivering the GICC.

The GICC's ambitious aims will not be achieved unless pediatric cancer services in Africa are improved. This continent has a population of 1.3 billion with a median age of 19.7 years, and by 2050, it is estimated that one third of global youth will reside in sub-Saharan Africa (SSA) alone.^{2,3} Overall, 27% of the African population in LMICs and 42% of the SSA population are < 15 years, compared with 16% of the population of high-income countries (HICs).⁴ Although African childhood cancer incidence rates appear lower than in HICs, these estimates are based on scant data of variable quality. The larger population (1.3 billion vs 747 million Europeans)^{2,5,6} would suggest a considerably higher burden of disease.

Africa must be prioritized in all efforts to improve childhood cancer care and survival given the population size, dramatic economic growth, and substantial improvement in infectious disease control. Six of the top 10 fastest-growing economies in the world are in Africa (Rwanda, Ethiopia, Côte d'Ivoire, Ghana, Tanzania, and Benin),⁶ and significant progress has been made in addressing malaria, measles, HIV, and pediatric lower respiratory tract infections.⁷

Unfortunately, although the poverty rate in Africa decreased from 54% in 1990 to 41% in 2015, the actual number of Africans living in poverty increased from 278 to 413 million.⁸ Fundamentally, African health care systems remain fragile and vulnerable. According to the 2020 WHO Report on the Performance of Health Systems in the WHO African Region, "...overall health system performance [index] for the Region is 52.9 out of 100," which addresses actual performance compared with feasible performance.⁹

The incidence and survival rates of children with cancer in Africa are poorly documented. The International Agency for Research on Cancer estimates an age-standardized rate of 8/100 000 cases and a mortality of 4.6/100 000, an incidence rate half as high, and a mortality rate double for countries with a very high Human Development Index (HDI: life expectancy, education, and standard of living).¹⁰ Postulated reasons for low survival rates include misdiagnosis, delayed diagnosis, restricted access to medical care, therapy abandonment, treatment-related toxicity, and higher rates of relapse.¹¹ These challenges are generally related to socioeconomic factors, and economic growth is considered to be a vital health determinant.¹²

The percentage of gross domestic product (GDP) spent on health care is an imperfect measure of health provision, although very low figures do predict poor health outcomes.¹³ The Gini coefficient (GC) measures a country's economic inequality: 0 = perfect equality and 100 = highest inequality. The HDI emphasizes that people and their capabilities, not economic growth alone, should be the ultimate criteria for assessing a country's development.¹⁴ Emphasis has been placed on universal health care (UHC) to increase access to health care and decrease medical treatment financial toxicity.¹⁵ Organizations such as the WHO require high-level data to plan interventions to improve access to adequate pediatric oncology care in underserved areas, and prior to this study, African data were inadequate.

The ongoing SIOG Global Mapping Program documents available global pediatric oncology human resources and services. This report focuses on the availability of trained pediatric oncologists, pediatric chemotherapy, radiotherapy, and specialized surgery across Africa, with input from the SIOG Africa continental subgroup, and describes the results of an analysis of potential relationships between specific economic indicators and service provision.

2 | METHODS

The survey development process and methodology are detailed elsewhere (Pediatric cancer care in Africa: SIOG Global Mapping process, in press). The electronic survey was launched on the SIOG and cancerPOINTE websites on November 16, 2018. Emails were sent to all African pediatric oncology professionals and stakeholders known to SIOG with three email reminders at monthly intervals, and extensive social media coverage to advertise the process. The links remain open as this mapping process is ongoing and updated regularly. An additional chemotherapy question, requiring individual emails to survey respondents for detailed information, was added in September 2019. Data collection was finalized in October 2020 following verification. The data verification process included email requests for African pediatric oncology leaders in the SIOG network to contact colleagues for clarification of conflicting or incomplete data. Extensive internet searches were also conducted to confirm or supplement data.

This report addresses the availability of trained pediatric oncologists and three childhood cancer treatment modalities: chemotherapy, radiotherapy, and surgery. The term “oncologists” encompasses pediatricians subspecialized in pediatric hematology or oncology or both. For the statistical analysis, pediatric surgeons with highly specialized disease-specific expertise, or limited oncology experience, or general surgeons with limited pediatric experience were all included. For conflicting responses from an institution, the senior respondent’s reply was retained, verified by email or confirmed with an internet search of published articles.

Countries were grouped into geographic regions (Northern Africa or SSA), World Bank income status (WBS),¹⁶ GC,¹⁷ provision of UHC,¹⁸ percentage of population < 15 and < 24 years,² percentage of GDP spent on healthcare¹⁹ and HDI.¹⁴

2.1 | Statistical design

The analysis makes use of an unpaired population sample of all 54 African countries. To determine the strength and significance of the relationship between the availability of the treatment modalities and economic and demographic characteristics, correlations, and differences in means and variable distributions were assessed. Nonparametric Wilcoxon rank sum tests established the equality of means across the three modalities of care for all continuous variables not satisfying the Student *t* test distributional assumptions. These include percentage of GDP spent on health care, percentage of the population < 15,

and < 24 years of age, and GC. Fisher exact tests were used for binary and categorical data comparisons. Pairwise correlation coefficients and *P* values are reported: the Spearman correlation coefficient for correlation between the ordinal country income classification, and Pearson correlation coefficient measuring linear correlation between combinations of binary and continuous nonordinal variables (representative economic and demographic characteristics are shown). Significance was set at 5%.

3 | RESULTS

A total of 264 responses were received (48/54 African countries). Once duplicates and incomplete responses were removed, 130 individual responses were analyzed. No responses were received from Chad, Comoros, Equatorial Guinea, Guinea-Bissau, Seychelles, or South Sudan requiring extensive internet searches for data on these countries. Respondents included heads of division (pediatric oncologist/hematologist; *n* = 79), consultants (pediatric oncologist/hematologist; *n* = 97), junior faculty (registrar, medical officer, student; *n* = 19), nurses (*n* = 27), social workers (*n* = 2), volunteer (*n* = 1), parents (*n* = 3), other (e.g., childlife specialist or undocumented; *n* = 33).

All three treatment modalities (surgery, radiotherapy, and oncology) were provided in 9/48 countries: Algeria, Egypt, Ethiopia, Ghana, Morocco, Nigeria, South Africa, Uganda and Zambia (49.2% of the African population).² Seven countries reported no pediatric oncology services: Cape Verde, Chad, Equatorial Guinea, Eswatini, Guinea-Bissau, Sao Tome and Principe, South Sudan, representing 2.5%² of the African population.

3.1 | Chemotherapy and oncologists

Email responses and survey comments indicated that, in some areas, children with cancer may be treated by an adult hemato-oncologist, pediatrician, general practitioner, or nurse, although these data could not be verified. Trained oncologists are available in 39 countries, whereas 15 have none (see Figure 1). In 25 countries, chemotherapy was available continuously, 6 intermittently, 4 rarely, and 18 never (1 no response) (see Supporting Information Table S1).

3.2 | Radiotherapy and surgery

Radiotherapy was available in 29 countries and unavailable in 25. Four countries had highly specialized pediatric oncology surgical expertise, 7 had pediatric oncology surgeons, 24 had pediatric surgeons, 10 had general surgeons, and 7 had no surgeons (3 countries unknown).

Table 1 indicates associations between geographic, population, and economic factors with provision of essential pediatric oncology services.

SSA countries (90.1%) were less likely to report provision of all three treatment modalities than those in Northern Africa (*P* = 0.01) with the strongest effect size shown by a lack of radiotherapy.

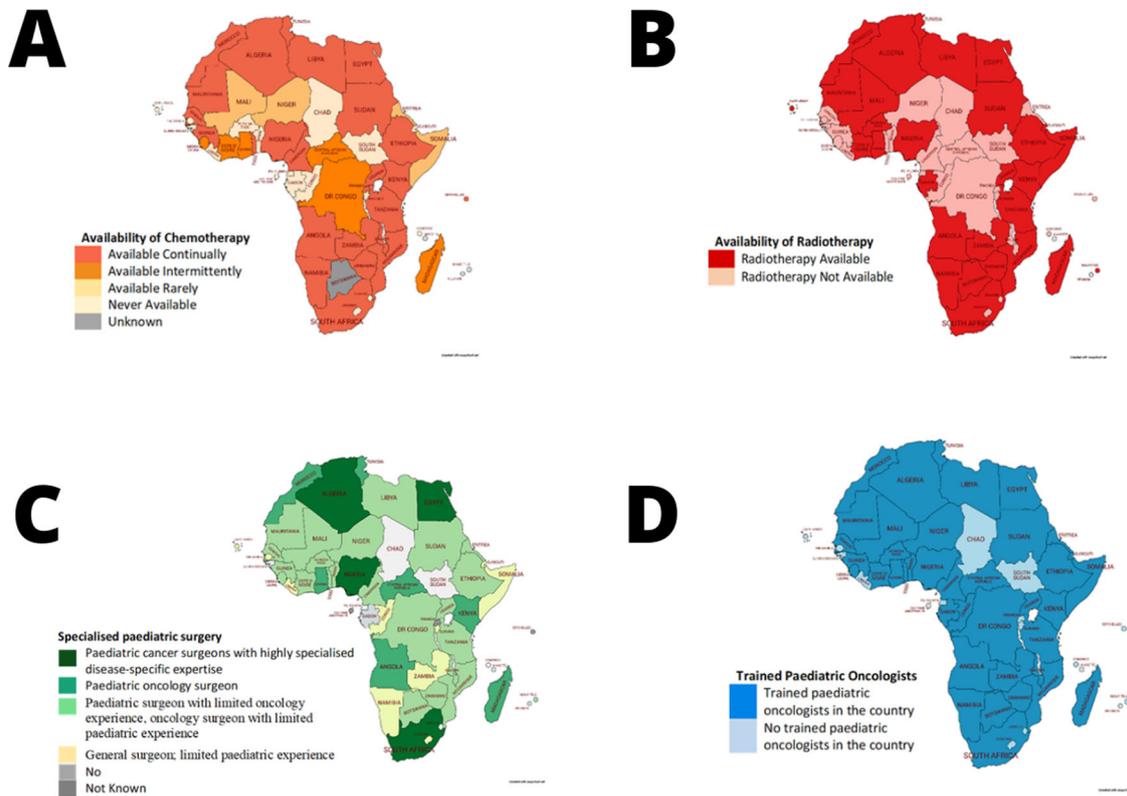


FIGURE 1 Graphic representation of reported availability of radiotherapy, pediatric surgery and trained pediatric oncologists from all sources (survey, emails, and internet searches)

The proportion of the population < 15 and < 24 years was negatively correlated with the reported provision of all three modalities ($P = 0.002$) and radiotherapy alone ($P = 0.002$ and 0.004 , respectively). The higher the proportion of the population < 15 and < 24, the less likely that all three modalities were provided: a 1% increase in population < 24 years decreased the probability of having all three modalities by 2% ($P = 0.026$).

The availability of all three services is significantly and positively correlated with income category ($P = 0.023$); low-income countries were significantly less likely to report provision of all three services. This result is driven by a strong correlation with radiotherapy ($P = 0.024$), (no significant correlation for surgery or chemotherapy).

The average country GC is 46.1; most unequal is South Africa (63), and least unequal is Egypt (31.8). No association was found between GC and any or all of the three treatment modalities or the presence of trained pediatric oncologists. The higher the GC, the higher the spend on healthcare, but a 1% of GDP increase spent on healthcare correlated with a 10% decreased probability of providing radiotherapy and a 6% decreased probability of providing all three modalities (significance at the 5% level). The average percentage of GDP spent on healthcare is 5.6% (range, 2.8% Angola and Gabon, 13.4% Sierra Leone). No association was found between percentage GDP spent on health and provision of any or all three treatment modalities.

No significant association was found between the provision of UHC and provision of any or all three treatment modalities in countries with UHC: Algeria, Botswana, Burkina Faso, Egypt, Eritrea, Gabon, Ghana,

Guinea-Bissau, Mauritius, Mozambique, Namibia, Seychelles, Tunisia, and Rwanda.¹⁸

The higher the HDI, the less likely the country is to have a younger population. Countries with higher HDI are much more likely to provide UHC ($P = 0.018$), and HDI is much lower in SSA countries ($P < 0.001$). Low-income countries have much lower HDI values ($P < 0.0001$). Countries with higher HDI do not have significantly higher levels of spending on health care, nor do they have significantly higher inequality. The average HDI is 0.557 (Somalia lowest 0.356, Mauritius highest 0.804), and the average HDI ranking is 151 (Niger lowest 189, Mauritius highest 66).¹⁴ The availability of all three services is significantly and positively correlated with income category ($P < 0.001$); countries with higher HDI are much more likely to offer all three services. This result is driven by a high correlation with chemotherapy ($P < 0.001$).

Table 2 offers more insight into specific countries with successful childhood cancer programs. Highlighted countries were selected as authors had in-depth national knowledge of these settings and reported data were easily verified.

4 | DISCUSSION

This study mapped the availability of pediatric oncologists and three fundamental pediatric oncology treatment modalities across Africa, by examining associations between service provision and specific economic indicators. Most respondents were senior faculty members, but

TABLE 1 Pearson pairwise correlation coefficients. Three childhood cancer treatment modalities available in African countries correlated with economic indicators

Variables	All three modalities	Surgery	Chemotherapy	Radiotherapy
Geographic region	−0.344*	−0.133	−0.227	−0.297*
	(0.011)	(0.337)	(0.105)	(0.029)
Percentage of population under 15 years	−0.415**	−0.094	−0.159	−0.418**
	(0.002)	(0.501)	(0.262)	(0.002)
Percentage of population under 24 years	−0.409**	−0.143	−0.114	−0.386**
	(0.002)	(0.302)	(0.420)	(0.004)
World Bank status (Spearman correlation) coefficient)	0.315*	−0.045	0.021	0.313*
	(0.023)	(0.752)	(0.888)	(0.024)
Low-income countries	−0.274*	0.043	0.016	−0.327*
	(0.045)	(0.758)	(0.911)	(0.016)
Lower-middle-income countries	0.102	0.043	−0.067	0.199
	(0.465)	(0.758)	(0.637)	(0.149)
Upper-middle-income countries	0.144	−0.184	−0.005	0.092
	(0.297)	(0.182)	(0.972)	(0.509)
High-income countries	0.211	0.082	0.139	0.182
	(0.125)	(0.557)	(0.324)	(0.188)
Gini coefficient	−0.031	−0.224	−0.196	−0.092
	(0.833)	(0.119)	(0.181)	(0.525)
Percentage of GDP spent on healthcare	−0.084	0.002	0.121	−0.188
	(0.552)	(0.989)	(0.396)	(0.179)
Provision of Universal Health Coverage	0.085	−0.131	0.024	0.002
	(0.540)	(0.345)	(0.868)	(0.991)
Human Development Index	0.504**	−0.039	0.191	0.481**
	(< 0.001)	(0.782)	(0.175)	(< 0.001)

** $P < 0.01$.* $P < 0.05$; P values in parentheses.

gaps or inconsistencies in the data necessitated extensive searches of published reports from various countries and personal contact follow-up by the research team.

4.1 | African context

To address the findings of this study, it is critical to acknowledge the context in which children and adolescents are treated for cancer. There is great poverty across Africa; only 2/54 countries are high-income according to the World Bank (Seychelles and Mauritius), and 6/54 are upper-middle-income (Botswana, Equatorial Guinea, Gabon, Libya, Namibia, and South Africa). The remaining 46 countries are lower-middle-income or low-income countries.¹⁶ Despite abundant natural resources, most African countries have fragmented or vulnerable healthcare systems, wide-scale public health challenges, and poor health literacy. Many countries suffer from significant political unrest, conflict, and the aftermath of wars, and serious consequences of climate change drive internal displacement and international migra-

tion, which further contribute to the inability to prioritize healthcare. Efforts to achieve UHC have been challenging; only Rwanda and Ghana show significant progress to date.²⁰ A strong primary health care (PHC) system is necessary to decrease late presentation in children and adolescents, but less than 40% of PHC funding comes from public sources.¹⁵

Results from this SIOP Global Mapping Program provide a comprehensive overview of what is available for childhood cancer treatment in Africa as of 2020. No pediatric oncology services are available in six countries, but it is encouraging to note that in nine countries (47.2% of the population),² all three treatment modalities exist. Professional specialization, chemotherapy, radiation therapy, and specialized surgery are all critical to childhood cancer survival and are addressed in turn.

4.2 | Oncologists and chemotherapy

The majority of countries reported the presence of trained pediatric hemato-oncologists, whereas a minority reported continuous

TABLE 2 Case studies of four countries and pediatric oncology services available according to survey results and publications

Country	Tanzania	Morocco	South Africa	Egypt
Population size (2)	60 651 389	36 471 769	58 558 270	100 388 073
% population < 15 (22)	42.7%	27%	29%	34%
Gini coefficient (18)	40.5	39.5	63.0	31.5
%GDP spent on healthcare (23)	3.63%	5.25%	8.11%	5.29%
World Bank income classification (17)	Lower middle	Lower middle	Upper middle	Lower middle
Geographic region	Eastern	Northern	Southern	Northern
Provision of universal health coverage (19)	No	No	No	Yes
Estimated annual childhood cancer incidence (24, 25)	3501	1939	1688	6803
Childhood cancer five-year survival rate	60% (26) (1 year OS)	65% (27)	60% (28)	72% (29)
Chemotherapy availability	For most cancers the majority of the time	For most cancers the majority of the time	For most cancers the majority of the time	For most cancers the majority of the time
Radiotherapy availability	For most cancers the majority of the time	For most childhood cancers the majority of the time ^a	For most cancers the majority of the time ^b	For most cancers the majority of the time ^b
Specialized surgery	Experienced pediatric surgery	Available	Experienced pediatric surgery available ^c	Experienced pediatric surgery available ^c

^aIncludes intensity modulated radiation therapy and proton therapy.

^bIncludes intensity modulated radiotherapy, stereotactic therapy, and brachytherapy.

^cIncludes solid organ transplant surgery and highly specialized neurosurgery.

availability of chemotherapy (Figure 1; Supporting Information Table S1). Responses indicating that nonspecialized practitioners (e.g., general practitioners, pediatricians, adult oncologist, or nurses) providing treatment by necessity may shed light on reasons for low survival rates.

4.3 | Radiotherapy

An absence of radiotherapy was reported by 14/48 countries (and suggested in an additional 11 country internet publications or websites), making the cure of many malignancies, e.g., central nervous system tumors, extremely challenging. Globally, Africa has been reported to have the lowest access to radiotherapy,^{21,22} and our study confirms that 25 countries currently have no access to this essential treatment, negatively impacting survival. Malignancies that require multidisciplinary care teams are more challenging to treat. For example, leukemia may be successfully cured with chemotherapy alone, and has dramatically improved survival rates over the last 50 years, unlike solid tumors such as neuroblastoma, brain tumors, and sarcomas, which require cooperation between oncologists, surgeons, and radiation oncologists. A center that can administer chemotherapy, but does not have access to radiotherapy or specialized surgical services will struggle to improve the survival rates of children with most solid tumors.

4.4 | Surgery

Only four countries reported the availability of pediatric surgeons with highly specialized disease-specific experience such as pediatric neurosurgeons with experience of tumor surgery (see Supporting Information Table S1). In 35 countries, there was access to either pediatric oncology surgeons (7 countries), pediatric surgeons with limited oncology experience, or oncology surgeons with limited pediatric experience (23 countries). More countries reported having surgical services than adequate access to chemotherapy, possibly explained by practitioners having gained experience in pediatric oncological surgery without formal training or the broad definition of surgical services which may have included nonspecialized surgeons who do not actually operate on children with cancer. Many sophisticated surgical techniques, including solid organ transplantation (e.g., treatment for inoperable hepatoblastoma), are available but are generally financed by out-of-pocket payments by parents in SSA.¹¹ Limited access to surgical skills may delay diagnosis and adversely affect survival¹¹ by limiting access to diagnostic biopsies and definitive surgery. Similar restrictions are reported from both HIC and LMIC, but the proportion of patients for whom this applies is higher in LMIC. Out-of-pocket expenses have the potential to undermine core objectives of health-care systems, including equitable financing, equal access, and improved population health¹¹ and are a well-documented cause of treatment abandonment.²³

4.5 | Economic indicators

The availability of all three services is significantly associated with income category and countries with higher HDI are more likely to offer all three services. The proportion of the population < 15 and < 24 years was negatively correlated with the reported provision of all three services.

UHC has been implemented in several African countries, but was not associated with provision of all three treatment modalities, possibly because of an emphasis on PHC in UHC plans.²⁴ Many African countries with UHC do not include childhood cancer care as an essential service. There are various interpretations of UHC across countries, and most ensure access to PHC but do not include access to specialized services, e.g., cancer care.²⁵ There are major challenges at the PHC level (the bulk of UHC services), including lack of knowledge of signs of childhood cancer and poor referral systems for diagnosis and specialized care.²⁶ Nigeria and Tanzania have not achieved adequate UHC coverage, although Ghana has achieved significant coverage in 10 years.²⁰ In African countries without subsidized cancer care or UHC, and those where UHC does not include adequate cancer care, parents, and caregivers are often unable to pay medical costs.¹¹ Payment for expensive care can further impoverish families already in precarious financial circumstances in their quest to save the lives of their children as shown in India²⁷ and Lebanon.²⁸

In a study of 10 LMIC countries supported by My Child Matters Grants (four in Africa), the postulated childhood cancer survival correlated with per capita government health care expenditure and total health care expenditure, GDP, gross national income, and number of doctors and nurses/1000 population.²⁹ In our study, there were no correlations between availability of pediatric oncologists or surgeons and three treatment modalities with GDP, WBS, or GC. We did not attempt to determine correlation with survival rates, because these are generally unreported in Africa.

Economic inequality represented by GC was not associated with provision of services, e.g., both South Africa and Egypt, the least and most equal, were able to provide similar services (see Table 2). The case studies in Table 2 highlight distinct capacities across the continent: Egypt, a lower-middle-income country, provides more specialized care options than South Africa, which spends more of its GDP on health care. The model pioneered in Egypt of a large central hospital servicing more than 50% of the children with cancer in the country, supported by fundraising and philanthropic donations³⁰ may be worth exploring in other countries. South African services are substantially subsidized by the state, but are often inaccessible to patients, due to distance from treating centers, poor knowledge of early warning signs of cancer, and suboptimal referral systems.³¹

The percentage of GDP spent on health reflects both private and public spending and was associated with provision of pediatric services as has previously been postulated.¹¹ In many countries, there is a disproportionate division of healthcare spend between the state and the private sector: e.g., in Algeria the private sector includes 70% of physicians, whereas the remaining 30% are responsible for 60% of public healthcare delivery.²⁰ The likelihood of providing specialized pediatric

oncology services decreases with an increase in GDP spent on health, a finding that may be explained by differing government priorities such as a decision to invest more state funds in PHC than specialized cancer care²⁴ or multiple other possibilities such as corruption or poor governance.

A functioning pediatric radiotherapy unit requires costly infrastructure, radiation technicians, nuclear physicists, radiology services, nurses, sedation capacity, and radiation oncologists.³² Radiotherapy was less likely to be provided in low- and lower-middle-income African countries than upper-middle-income and HIC and the percentage of GDP spent on health care correlated with the capacity to provide radiotherapy, thus reflecting global trends.^{32,33} A study in the Arab world found that higher GDP and political stability were important determinants of the availability of radiation therapy.³³

This study focused on three important childhood cancer treatment modalities and provides an updated, detailed snapshot of availability across Africa as reported by health care professionals involved in the field. Preventable childhood cancer deaths in LMIC are associated with underdiagnosis, misdiagnosis, delayed diagnosis, challenges accessing medical care, treatment abandonment, treatment-related toxicity, and higher rates of relapse.³⁴ Mexican data indicate that even when improvements in infrastructure, staffing, and use of standardized protocols have been successfully implemented, a decrease in mortality rate does not necessarily follow, and treatment abandonment rates are highest in regions with low HDI.³⁵ This suggests that improving survival rates may be beyond the reach of practitioners, and will require systemic changes in the government support and widespread policy changes, which are goals of the WHO GICC and partners like SIOP.

4.6 | Limitations

Limited internet access and connectivity challenges may have resulted in a higher representation from better-resourced settings, thus overestimating the capacity of the region. The quality of the responses from the survey varied widely (many incomplete responses); administrators prohibited some practitioners from responding. Most of the respondents were senior faculty members, but there are concerns about the reported availability of radiation, which may not always be accessible for children. The verification process, although extensive, was imperfect and relied on personal contacts, multiple communications, and internet searches. Access to a particular modality within a country does not imply access for all children in that country. This study represents a broad overview, and cannot be regarded as definitive at this point.

4.7 | Recommendations

The lack of an association between provision of UHC and the three main modalities of pediatric cancer care in this study should not detract from the drive to introduce and strengthen UHC across the continent. In UHC planning, it is essential to include pediatric cancer care an increasingly important cause of childhood mortality in countries

undergoing demographic and epidemiologic transitions. Efforts to increase awareness and timely referral of children with cancer should be supported.

Although the need for radiotherapy might seem small, as there is underdiagnosis and lack of referral of patients who require this modality, increased access to radiotherapy may be achieved by working with the International Atomic Energy Agency to increase capacity in Africa. This group has made recommendations in the Global Task Force on Radiotherapy for Cancer Control which analyzed factors precluding access to radiotherapy.³⁶ Economic models have been defined to fund increasing radiotherapy services, and these suggestions should be acted upon.³⁷ The model of centralized children's cancer centers should be interrogated as a solution to lack of access to specialist care in countries that do not yet have adequate PHC or state-subsidized pediatric oncology centers. Continued referral to other countries may continue to be necessary for smaller countries such as Lesotho and Eswatini, which currently have limited scope to increase medical services. Further funding is urgently required to train and retain more surgeons, pediatric and radiation oncologists, and to ensure uninterrupted supplies of chemotherapy. Collaboration is essential between multiple stakeholders at the global, national, and local levels to increase capacity in regions without services. Such stakeholders may include, but are not limited to, the Groupe Franco Africain d'Oncologie Pédiatrique (GFAOP), SIOP Africa, WHO, World Child Cancer, and the various specialty groups such as the Society for Neuro-Oncology Sub-Saharan Africa. Twinning projects in which colleagues from HIC collaborate with those in Africa may be of benefit but should be conducted carefully to ensure that local agendas are not derailed by well-funded foreign interests. Robust studies should be conducted to determine specific needs of each country and recommendations made to Ministries of Health to achieve parity in resource allocation.

5 | CONCLUSION

Although some African countries can provide access to highly specialized childhood cancer multidisciplinary care, this survey highlights countries requiring most attention, and those with no services should be actively supported.

A long-term strategy to eliminate disparities in African pediatric cancer care should be aligned with the WHO GICC aims and facilitated by SIOP Africa (continental subgroup of childhood cancer professionals). The three main modalities of pediatric cancer care are interconnected and cannot function optimally in isolation. If all are strengthened, and childhood cancer care is included in UHC, the hope is that the survival rate of children with cancer in Africa will rise, thus reaching the GICC's goal of 60% global survival of children with cancer.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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