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Current Realities of Wilms Tumor Burden and Therapy in Ghana

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ABSTRACT

Background: Between 2005 and 2014, Ghana's Wilms tumor (WT) 2-year disease-free survival of 44% trailed behind that of high-income countries. This study aimed to uncover social determinants of health leading to preventable WT death in Ghana.
Methods: WT patient records (2014–2022) at Korle-Bu Teaching Hospital (KBTH; Ghana) were reviewed retrospectively. Demographics, clinical course, tumor characteristics, and survival were evaluated using t-tests, Pearson Chi-square, and multivariate Cox logistic regression.
Results: Of 127 patients identified, 65 were female. Median age was 44 months [IQR 25–66]. Forty-eight patients (38%) presented with distant metastasis (75% lung, 25% liver), which associated with hypoalbuminemia ($p = 0.009$), caregiver informal employment ($p = 0.04$), and larger tumors ($p = 0.002$). Despite neoadjuvant chemotherapy shrinking 84% of tumors, larger initial size associated with incomplete resection ($p = 0.046$). Of 110 nephrectomies, 31 patients had residual disease, negatively impacting survival ($p = 2.7 \times 10^{-5}$). Twenty-two patients (17%) abandoned treatment (45% before nephrectomy; 55% after nephrectomy), with seven patients ultimately lost to follow-up (LTFU). Decedents represented 43% of stage IV patients compared to 28% in other stages. Event-free survival (EFS) was 60% at 4 years with overall survival (OS) at 67%.
Conclusions: Although Ghana's WT survival has improved, informal employment and distance from KBTH predisposed patients to delayed referral, greater tumor burden, hypoalbuminemia, and lower survival.
Type of Study: Prognosis Study.
Level of Evidence: II.

1. Introduction

Optimal treatment of Wilms tumor (WT) remains a challenge in low-income settings in Sub-Saharan Africa, with 5-year survival rates as low as 25% compared to greater than 90% survival rates in high-resource countries [1]. Both molecular and social determinants of health contribute to this alarming cancer health disparity [1]. For example, WT patients in Kenya have been shown to acquire treatment-resistant molecular alterations that complicate outcomes, exacerbated by financial burden of transportation and treatment, cultural norms concerning the family structure, and

Abbreviations: WT, Wilms tumor; KBTH, Korle-Bu Teaching Hospital; LTFU, lost to follow-up; EFS, event-free survival; OS, overall survival; SIOP, Société Internationale d'Oncologie Pédiatrique; MCJCHV, Monroe Carell Jr. Children's Hospital at Vanderbilt; LMIC, low- and middle-income countries; NHIS, National Health Insurance Scheme.

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the limited availability of intensified chemotherapy and radiotherapy for higher risk disease and of salvage therapy following relapse [1–4].

WT is the most common pediatric renal tumor and the fourth most common pediatric cancer overall in Ghana. Currently, WT in Ghana is treated according to the European protocol established by the SIOP (Société Internationale d'Oncologie Pédiatrique) group, which recommends neoadjuvant chemotherapy followed by delayed nephrectomy. Postoperatively, patients are stratified to adjuvant therapy according to low-, intermediate-, and high-risk (e.g., blastemal predominance) histologic features. However, in Ghana, patients often do not complete therapy. After providers expounded the importance of establishing ethically-driven, locally-adapted clinical trials for WT care to address this challenge, supportive regional collaborative networks were formed to move the needle [5]. A regional collaboration studying 176 patients in 8 countries in Sub-Saharan Africa demonstrated that incomplete treatment was the most common cause of therapeutic failure (31%) [6]. The cost of complete treatment was a major cause for care abandonment [6]. As a result, the survival rate was a dismal 25% [6]. In a later collaboration among Ghana, Cameroon, and Malawi, an adapted Wilms treatment protocol resulted in improvement in 2-year event-free survival to 50%, evidence of disease at the end of treatment to 52% from 69% pre-protocol ($p = 0.002$), and abandonment of treatment to 12% from 23% ($p = 0.01$) [7].

With this background, establishing a foundation of patient diagnosis, treatment, outcomes, and follow-up, along with outlining barriers to each step of that patient journey, is necessary before solutions can be implemented. The aim of our study was to create a registry of patients diagnosed with and treated for WT at Korle-Bu Teaching Hospital (KBTH) from 2014 to 2022 in order to clarify patient social and disease characteristics that portend adverse events from WT in Ghana. Our hypothesis was that varying social determinants of health associate with WT prognosis in Ghana. In this study, we established an international collaboration between KBTH in Ghana and Monroe Carell Jr. Children's Hospital at Vanderbilt (MCJCHV) in Tennessee to uncover the multiple social determinants of health that lead to more aggressive disease presentation and preventable cancer deaths from WT in Ghana, while outlining specific actions to address them. As the largest teaching hospital in Ghana and the third largest teaching hospital in Sub-Saharan Africa, KBTH serves as the number one referral center for pediatric oncology in Ghana and surrounding countries in West Africa. WT care is rendered by specialized pediatric oncologists, pediatric surgeons, and pathologists, who all contributed to this important study. This international collaborative research team has previously demonstrated competency with this study design for Kenya [2–4].

2. Methods

IRB approval was received from KBTH on November 4th, 2022 with the approval number: **KBTH-IRB 000132/2022.**

2.1. Medical record abstraction

At KBTH, medical records for the Pediatric Oncology Day Care Unit were stored solely in paper files before late 2021, and before 2014, those files were inconsistently compiled (Fig. 1). Therefore, we conducted a retrospective review of WT paper and electronic clinical, operative, and histological records from August 2014 to June 2022 for patients 15 years and younger who had completed treatment at the time of the study.

Patients who were initially misdiagnosed with WT and those who were referred out of the country for more advanced care were excluded from this study. Each patient was assigned a de-identified coded name, such as KBWT001, KBWT002, etc. (the initials signifying Korle-Bu patients with Wilms tumor in chronological order), which was entered it into a password-protected, log-in only Research Electronic Data Capture (REDCap) registry. The following data were captured: demographics, distance of residence from hospital, past medical history, history of presenting illness, disease characteristics (e.g., tumor volume, stage, histology), oncologic treatment regimen, operative and perioperative course, follow-up care, and survival outcome (e.g. progression, relapse, death). Social determinants of health, or non-medical aspects of a patient's life that impact health outcomes, included race, nationality, sex, region, distance of residence from hospital, insurance status, and caregiver employment.

2.2. Survival

Survival was calculated from date of diagnosis (i.e., date of presentation at KBTH) to end of data collection (February 9, 2023) or patient event/death, whichever occurred first. Patients seen after February 2021 were excluded from 2-year survival analyses, and those seen after February 2019 were excluded from 4-year survival analyses. Event-free survival (EFS) was defined as time from diagnosis to any documented disease relapse or treatment abandonment. Overall survival (OS) was defined as time from diagnosis to most recent documentation of patient being alive with or without disease. Patients who completed treatment and followed up for at least a year were classified according to their survival status (alive or dead). Those who completed treatment but followed up for less

Fig. 1. Paper medical records at KBTH
Section of KBTH Pediatric Oncology Day Unit storage shelves for paper medical records, with paper records adding to the complexity of data completeness, collection, and analysis when compared to electronic medical records.

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than a year or who were made palliative without subsequent feedback on survival status were classified as lost to follow-up (LTFU). Following study completion, a Pediatric Oncology nurse called the caregivers of these patients who were LTFU to ascertain their survival status. The palliated patients who were still LTFU after these calls were assigned as deceased, as were the patients who abandoned treatment prior to nephrectomy. Patients who abandoned treatment after nephrectomy but before adjuvant treatment completion were also classified as LTFU, unless their survival status had subsequently been communicated to KBTH.

2.3. Statistical considerations

Summary statistics, including mean, median, standard deviation, interquartile range (IQR) for continuous variables, and count and proportion for categorical variables, were reported. All data underwent statistical analysis using R programming, with unpaired t-tests run for continuous variables and Pearson Chi-square tests run for categorical variables. Between-group differences were assessed with t-test (two groups) or analysis of variance (three or more groups) based on a continuous variable. The Cox proportional hazards model was used for multivariable modeling. Missing data was excluded from the relevant analyses above. Time-to-event data analysis was conducted using Kaplan–Meier estimates and log-rank tests, with Kaplan–Meier survival plots reflecting 2-year and 4-year EFS and OS. Statistical significance was set *a priori* at $p < 0.05$.

3. Results

3.1. Cohort demographics

Records from 127 patients with histologically-confirmed WT diagnosed at KBTH over the 8-year study period were reviewed. The cohort comprised 65 females (51.2%) and 62 (48.8%) males, with the median age at diagnosis being 44 months (range 9–122 months, [IQR 25–66 months]) (Table 1). Ghana was the country of origin for 122 patients (96.0%), with 5 from Ivory Coast, Togo, Sierra Leone, Burkina Faso, and Gabon. Five patients (3.7%) originally diagnosed with WT were later found to have other conditions (clear cell sarcoma, renal cell carcinoma, neuroblastoma, Burkitt's lymphoma, lymphoma, and cystic nephroma) and were excluded from our analysis, as were two patients with WT who were referred abroad for more advanced surgical treatment.

3.2. Social determinants

Caregivers of 82 (64.6%) patients were employed in the informal market (the grey market of labor that is not taxed or monitored by the government), 39 (30.7%) were employed formally by registered companies, and 6 (4.7%) were unemployed. Patients from informally-employed or unemployed families had worse outcomes: they comprised 80.0% of decedents compared to 63.0% of survivors ($p = 0.048$, Table 1), had larger median tumor size of 13.3 cm ([IQR 10.6–17.4 cm], $p = 0.003$), and had more stage IV disease (45.0%) compared to patients with formally-employed caregivers (26.0%) ($p = 0.04$, Table 2). Almost all patients (115, 90.6%) were covered by Ghana's National Health Insurance Scheme (NHIS), which covers admission and consumables but not cost of treatment, with NHIS status not conferring any survival advantage ($p = 0.58$). Median distance from patients' residence to KBTH was 40 km (range 4–2047 km, [IQR 17–140]), with survivors' median distance being 26 km [IQR 17–138] and decedents' median distance being 78 km [IQR 16–168] ($p = 0.12$; Table 1). Distance greater than 40 km from the hospital associated with delayed referral to KBTH ($p = 0.03$), although statistical significance was not achieved for survival.

3.3. Disease characteristics

Delay between initial symptoms and presentation to KBTH ranged from 0 days to over 2 years. Greatest dimension of tumor on preoperative imaging ranged from 3.9 cm to 25.2 cm, with larger tumor size at presentation associating with distant metastasis ($p = 0.002$) and hypoalbuminemia (albumin <3.5 g/dL) ($p = 0.02$). Hypoalbuminemia was also more prevalent in patients with distant metastasis compared to localized disease (24.5% vs. 20.0%, $p = 0.009$). Although increased tumor size and decreased tumor regression were more prevalent in decedents, these factors were not statistically significant. In contrast, hypoalbuminemia, incomplete tumor resection, high-risk histology group, and stage IV disease were significantly associated with mortality (Table 3).

Compared to stage I disease, patients with stage IV disease represented 65.0% of survivors and 100% of decedents ($p = 0.008$). Compared to all other stages combined, patients with stage IV disease represented 21% of survivors and 52% of decedents ($p = 1.2 \times 10^{-5}$). Four (8.3%) patients with stage IV disease were LTFU compared to three (3.8%) in all other stages combined.

3.4. WT management

Twenty-four cases (18.9%) had uncertain diagnoses and underwent confirmatory preoperative biopsies. Following confirmation of diagnosis by imaging or preoperative biopsy, 122 patients received neoadjuvant chemotherapy (96.1%), and 5 patients (3.9%) did not. Of the five patients who did not receive neoadjuvant therapy, one patient died of complications from progressive deteriorating kidney function due to tumor lysis syndrome while caregivers were gathering funds, one died of massive pleural effusion two days after admission, one patient underwent upfront surgical resection in Burkina Faso, one underwent upfront surgical resection at an outside hospital in Ghana due to misdiagnosis of polycystic kidney disease, and one underwent upfront emergency surgical resection at Korle-Bu due to acute intestinal obstruction. Sixty-one patients (50.0%) underwent two-drug therapy, and sixty (49.2%) underwent three-drug therapy. Seven patients (5.7%) abandoned treatment during neoadjuvant chemotherapy, and five patients (4.0%) died of advanced disease during neoadjuvant chemotherapy.

Table 1
Social determinants of health and survival.

	Survivors (n = 80)	Decedents (n = 40)	p-value	Lost to follow-up (n = 7)
Age (median months)	45 [29–67]	41.5 [23–59]	p = 0.78	29 [26–66]
Female gender vs. male	38 (48%)	23 (58%)	p = 0.30	4 (57%)
Self- or unemployed vs. company-employed	50 (63%)	32 (80%)	p < 0.05	6 (86%)
Uninsured vs. insured	7 (9%)	3 (8%)	p = 0.58	0 (0%)
Distance from KBTH (median km)	26 [17–138]	78 [16–168]	p = 0.12	95 [25–202]

Comparisons for survivors & decedents only; lost to follow-up shown for clarity.

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Table 2
Stage IV disease per employment status.

	Stage IV	All others	% Stage IV
Informally employed	37	45	45%
Formally employed	10	29	26%
Unemployed	1	5	17%
Total	48	79	p = 0.04

Following completion of neoadjuvant chemotherapy, three patients absconded without resection due to fears of high-risk surgery, belief that people should die with all their organs, and unknown reasons. The remaining 110 patients underwent surgical resection: 107 at Korle-Bu and 3 at other institutions (CHUP in Burkina Faso, 37 Military Hospital in Ghana, and South Africa). There were no intraoperative mortalities. When there was no regional involvement, 84.0% of patients survived compared to 59.0% when there was tumor adherence to adjacent structures and 77.0% when there was tumor invasion into adjacent organs (p = 0.08). Lymph nodes were harvested in 57 cases (51.8%), not harvested in 40 cases (36.3%), not documented in 6 histopathology reports (5.5%), and unknown due to 7 missing histopathology reports (6.4%). Aside from sub-optimal regional lymphadenectomy rates, treatment course adhered to SIOP-PODC (Pediatric Oncology in Developing Countries) adapted guidelines, with deviations in four patients only: two patients with high-risk rhabdoid features and <65% necrosis and two patients with high-risk blastemal predominance and <65% necrosis were treated on intermediate-risk rather than high-risk protocol. All four patients were alive without evidence of disease at the conclusion of the study. Tumor rupture occurred in six cases (5.5%) with spillage in five cases (4.5%). R1/R2 residual disease was present in 33 cases (30.0%), which negatively impacted survival, while 72 cases (65.5%) had R0 disease ($p = 2.7 \times 10^{-5}$). Resection status of five cases (4.5%) was unknown. Following surgical resection, most patients (98, 91.0%) had no 30-day post-operative complications.

Of the 110 patients who underwent nephrectomy, histopathology reports were missing in 7 patients (6.4%) and incomplete in 30 (27.3%) due to failure to mention margin status, necrosis status, lymph node status, or pathology stage. No necrosis was present in 6 samples (5.5%), while 77 (70.0%) had necrosis, and 27 (24.5%) had unknown necrosis status. Patient tumor histology was recorded, with roughly one half (59, 53.6%) harboring triphasic histology (epithelial + stromal + blastemal). Regarding documentation of high-risk factors, 5 patients (4.5%) had rhabdoid histology, 17 (15.5%) had blastemal predominance, and 1 (0.01%) had diffuse anaplasia.

All post-operative patients received at least one dose of adjuvant chemotherapy, and 49 patients (44.5%) received radiation therapy to the abdomen, flank, tumor bed, liver, lungs, or brain, depending on residual tumor location. Patients with high-risk histology had more decedents at 40% vs. 16% in the intermediate-risk and 13% in the low-risk histology groups (p = 0.02). During adjuvant therapy, eight patients were escalated to more aggressive protocols (Table 4).

Table 4
Adjuvant chemotherapy regimen.

Protocol	Number of Patients
VCR + ACT	18
VCR + ACT + DOX	54
CYCLO + CARBO + DOX + VP16	28
VCR + ACT → CYCLO + CARBO + DOX + VP16	8
VCR + DOX + CARBO + CYCLO + VP16	1
Modified ICE protocol	1
Total	**110**

Following at least one dose of adjuvant chemotherapy, 99 patients (90.0%) went into remission, but only 91 patients (82.7%) completed treatment. Of 63 patients with stage III or stage IV disease post-operatively, only 49 (77.8%) received radiotherapy.

3.5. Survival analysis

Survival was analyzed across three categories: documented survival status, inferred survival status, and treatment completion (Fig. 2). Following adjuvant therapy, 28 patients (22.0%) relapsed – 13 (10.2%) with disease recurrence and 15 (11.8%) with disease progression – with most receiving salvage therapy (Table 5). On initial review of records, 71 patients (57.0%) overall were alive without evidence of disease, 1 (0.01%) was alive with disease not on palliation, 24 (19.0%) had died of disease, and 31 (24.0%) were LTFU after either abandoning adjuvant treatment, abandoning follow-up after less than one year of surveillance, or transitioning to palliative care. We enlisted KBTH's oncology nurse to call caregivers of the 17 patients who had been LTFU after completing treatment or transitioning to palliative care, and we received an 88.2% response rate. Once we assigned patients who abandoned treatment before nephrectomy and those who were made palliative and not confirmed to be alive to the deceased group, only seven (5.5%) patients out of the original cohort of 127 remaining with unknown survival status. When analyzing only patients who completed therapy and excluding palliative and LTFU patients, 4-year EFS was 86.4% and 4-year OS was 88.6%. When including palliation and treatment abandonment prior to nephrectomy in the deceased category, 4-year EFS dropped to 59.8% and 4-year OS to 66.7%. A similar pattern was seen at the 2-year mark. Highlighting only the cohort who completed treatment, 2-year EFS was 86.4% and 2-year OS was 92.0%. When assigning patients who underwent palliation or abandoned treatment prior to nephrectomy in the deceased category, EFS dropped to 60.6% and OS to 70.8%.

4. Discussion

Key findings when analyzing the impact of social determinants of health were that patients with informally-employed caregivers were more prone to advanced-stage disease, larger tumor size, and mortality. A combination of financial and health literacy constraints is a known effect of informal employment, which, unfortunately, we found negatively impacted patient survival.

Table 3
Disease characteristics and survival.

	Survivors (n = 80)	Decedents (n = 40)	p-value	Lost to follow-up (n = 7)
Tumor dimension at presentation (median cm)	12.1 [10.2–14.6]	13.9 [10.6–18.7]	p = 0.07	15.7 [12.4–18.0]
Tumor regression (median %)	−30% [-11 to −49%]	−22% [-8% to −29%]	p = 0.17	−38% [-29% to −47%]
Albumin at presentation (median g/dL)	3.8 [3.4–4.2]	3.7 [3.2–4.0]	p < 0.01	3.8 [3.7–4.2]
R1/R2 vs. R0 status	15 (19%)	14 (67%)	p < 0.01	4 (57%)
Histology high-risk group vs. low and intermediate	13 (16%)	10 (43%)	p = 0.02	2 (29%)
Stage IV vs. Stage I	17 (65%)	16 (100%)	p < 0.01	4 (100%)
Stage IV vs. All Others	17 (21%)	16 (52%)	p < 0.01	4 (57%)

Comparisons for survivors & decedents only; lost to follow-up shown for clarity.

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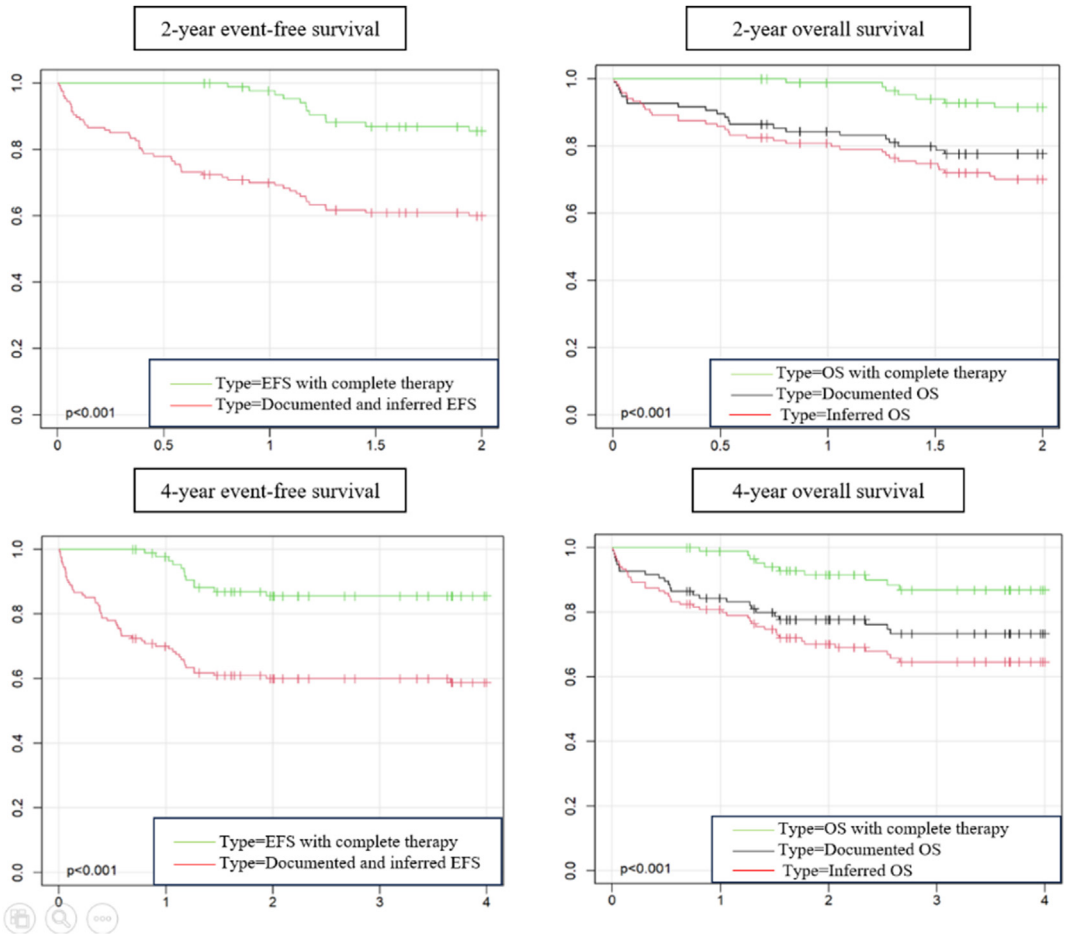

Fig. 2. Two- and four-year event-free and overall survival
These survival plots display EFS and OS, with an event being treatment abandonment, disease relapse, or death – whichever occurs first. Given challenges with follow-up, survival is broken down into 3 groups: 1) survival status as documented most recently in medical record, with LTFU excluded; 2) survival status as determined after making follow-up calls to caregivers, with palliative patients and patients who abandoned therapy prior to nephrectomy being assigned to the decedent group; 3) survival status of patients who completed therapy. The plot lines for documented EFS and inferred EFS converge to overlie one another.

Another important social determinant of health was distance of one's residence from KBTH, which is in Ghana's capital city of Accra. Distance greater than 40 km associated with delayed referral, as families living in more rural areas or distant cities required significant financial, time, and transportation resources to travel to KBTH. The power of the study was likely too low to detect an association between distance and survival or between delayed referral and survival.

When using caregivers' profession as a proxy for access to funds, work in the informal economy was a significant hindrance to early presentation. Patients from families working in the informal economy were more likely to present to KBTH with distant metastases, and those with distant metastases were more likely to be malnourished, initiating a vicious cycle of increased funds and time off work required for the longer duration of treatment for aggressive WT. Interestingly, although almost 91% of patients in this study were covered by national health insurance, the limitations of that coverage were significant. Ghana's NHIS covers inpatient accommodation fees, along with consumables and basic treatment, but patients' families pay out of pocket for chemotherapy, surgery, radiotherapy, and supportive care (labs, imaging, drugs, and transfusions). Health policy must move beyond mandating universal health coverage to mandating adequate universal health coverage so that policies translate into improved health outcomes.

Regardless of insurance status, families currently must purchase chemotherapy drugs themselves from external pharmacies. With the cost of standard multimodal therapy hovering around GHc 20,000 and informal workers expected to make GHc 600–1200 a month, the burden is enormous ($1 USD = 12 GHc). Innovative drug financing solutions have been put forth to address this barrier in other African nations, such as the revolving drug fund in Sudan, which established a currency swap system to liberalize the revolving drug fund's access to the stronger British pound at official market rates [8]. Institutional agreements to purchase chemotherapy directly from drug manufacturers without eroding margins also have potential to increase access to and affordability of drugs [9].

The principal outcome we sought to uncover from this study was survival from WT. Larger tumor size and hypoalbuminemia stood out as disease characteristics that negatively impacted survival. Given the association between large tumor size and incomplete resection, it is not surprising that worse outcomes would follow. Diagnosing patients earlier in their disease course would contribute greatly to an increase in survival. Similarly, malnourished patients have less reserve to tolerate chemotherapy, fight disease, and recover from major surgery, so enforcing preoperative nutritional optimization as standard practice in WT management could yield significant survival benefits.

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Table 5
Treatment for recurrence or progression.

Treatment	Number of Patients
Palliation	18
Chemotherapy	15
Radiation	6
Surgery	1
None (Abandonment)	4
Total	**44**

When we consider the entire KBTH cohort of WT patients, 2-year survival represented a notable improvement in Ghana, compared to the 9 years prior (2005–2014), when disease-free survival was 44%, and overall survival was 56% [10]. However, highlighting only the cohort who completed treatment as a surrogate for optimal care, we arrived at an even more impressive survival at both 2 and 4 years. This segmentation revealed the deleterious impact of treatment abandonment, as a much higher survival was achieved for patients who completed treatment. The 22 patients total who abandoned treatment at various stages represented a 17.3% treatment abandonment rate, worse than the 11% rate following the Collaborative Wilms Tumor Africa Project's patient education guidelines, though 6 eventually returned for care [11]. Once more patients adhere to therapy, the next step is to move beyond histologic differences to understand the biologic characteristics of WT that confer resistance to specific drug therapy in order to optimize treatment protocols further. With a combination of treatment completion and administration of more personalized, risk-stratified treatment, we should see survival increase dramatically.

KBTH is working actively to address the factors that underlie challenges to therapy adherence. Every caregiver at KBTH undergoes extensive counseling with a clinical counselor upon diagnosis of his/her dependent to outline the expected treatment path and to emphasize the importance of adherence. Additionally, KBTH attempts to offset costs for patients with extreme needs by providing free accommodation locally and covering costs with donated funds, but there is not enough funding for every patient to benefit. Despite these financial challenges, provision of pediatric cancer care at KBTH is cost-effective by WHO-CHOICE criteria (cost per disability-adjusted life year averted less than per capital income), which confirms that KBTH is on the right course to improving care delivery [12]. Additionally, critical to the optimization of WT survival is regular surveillance. Without a formal process to keep track of patients following treatment completion, measuring outcomes is challenging. Our 88.2% response rate for calls to patients who were lost to follow-up after completing treatment or who transitioned to palliative care was higher than the 70.6% response rate in a similar cohort in Kenya [13]. Initiating such a practice at regular intervals could assist in tracking outcomes and even obviate the need for physical surveillance visits, bearing in mind the time and financial implications of conducting this follow-up [14].

There are several limitations to note. First, the study's sample size was likely smaller than the true presentation of WT at KBTH over 8 years due to incorrectly filed or missing paper records that were not traceable when crosschecking the intake logbook. Additionally, the variable quality and detail of recordkeeping within patients' medical files may have impacted the interpretation of clinical findings. For example, the presence of diffuse anaplasia in only one nephrectomy specimen is unusually low and calls into question whether the diagnosis was missed [2]. Missing portions of records also did not allow for complete analysis of all 127 patients at each stage of the study. The recent introduction of electronic medical records should help alleviate some of these problems, as long as the hybrid system maintains internal consistency between digital and paper files. Thirdly, treatment risk assignment groups were variable following interdisciplinary discussion among the Pediatric Surgery, Pathology, and Pediatric Oncology teams, but reasons for deviation from the stated SIOP-2001 protocol were not always documented. Finally, high LTFU numbers impeded accurate determination of survival. Calling caregivers of patients who completed therapy allowed us to elucidate a more updated survival status than that which was documented in the medical records; however, we employed the reasonable assumption that patients who abandoned therapy before receiving a resection and those who were palliative due to disease progression had died.

In conclusion, although WT survival in Ghana is higher than that in Sub-Saharan Africa as a whole, optimal outcomes are hindered by socioeconomic factors like informal employment and distance to a referral center, which then predispose patients to more advanced disease, poorer nutritional reserve, and R1/R2 oncologic resections. Korle-Bu extensively counsels all families with children diagnosed with WT, but with only two pediatric cancer referral centers in Ghana, minimal patient savings for medical care, and no insurance coverage for chemoradiotherapy or surgery, multiple potential targets exist to improve surgical and oncologic outcomes in WT therapy. Additionally, introduction of an official protocol to contact patients who have been lost to follow-up could be successful and would enable more accurate measurement of outcomes.

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