

Review Article

A Review of Radiotherapy Services in Zambia: Challenges, Opportunities and Way Forward

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Abstract: Cancer significantly contributes to the cause of morbidity and mortality in Zambia 71% of people diagnosed with cancer in Zambia die from the disease; however, access to radiotherapy (RT) services is lacking. More than 50% of cancer patients will require radiotherapy for curative or palliative intent. The country first established RT services in 2006. Prior to that only a few Zambians accessed this specialised treatment abroad, mainly due to the high costs. After a successful run of service for over a decade, in 2022 the country suffered total disruption of RT services due to obsolete equipment that has been earmarked for decommissioning. The country is now in the process of re-establishing the RT services to make them sustainable. This article aims at reviewing how the RT services (RT equipment and personnel) have been managed, the opportunities that exist (demand for RT services, availability of training institutions, support from the government and cooperating partners) and lastly the challenges (equipment shortages and operation, lack of medical physicists and biomedical engineers, financial constraints, procurement and maintenance delays). The insights offered by this work will elicit a data based decision making approach to meticulous RT service provision.

Keywords: Challenges, opportunities, radiotherapy, Zambia.

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1.0 INTRODUCTION

In Zambia, radiotherapy (RT) services are offered at the Cancer Diseases Hospital (CDH) located in Lusaka on the grounds of the University Teaching Hospitals (UTH). It is the only hospital offering RT services in the country, serving a population of 19 million. CDH was established in July 2007 with 252 bed capacity in patients and several out-patient departments (OPD) facilities and an annual rate of 2734 out patients (Lishimpi, 2019; Zambia Statistics Agency, 2022). Other medical imaging services offered to support RT include Digital diagnostic radiography, fluoroscopy, diagnostic computer tomography (CT) Magnetic Resonance imaging (MRI), Mammography, and ultrasound. In an estimated population of 19,000,000 inhabitants, Zambia still experiences high morbidity and mortality rates from cancer, which is one of the major non-communicable diseases. IARC's GLOBOCAN 2020 estimates 13,831 new cancer cases (5,968 men, 7,863 women) and 8,672 cancer deaths (3,791 men, 4,881 women) (WHO, 2020).

Data from the Zambian National Cancer Registry (NCR) from 2008 to 2022 captured 49,698 cancer diagnoses. In the past 15 years, 33,000 patients have been treated at the Cancer Diseases Hospital out of which 14762 received RT (CDH data base). More than 50% of cancer patients will require radiotherapy for curative or palliative intent (Abdel-Wahab *et al.*, 2021). Disruptions in treatment regimens negatively affect local control of the disease and the overall survival rate of cancer patients (Gupta *et al.*, 2018). Research studies have shown that missing early RT sessions by cancer patients can result in disease progression, such as distant metastases and poor survival rates (Chanda *et al.*, 2019; Chiang *et al.*, 2020). A delay in commencing treatment has been shown to reduce tumour control probability, which is particularly more for fast-growing tumours (Whyatt *et al.*, 2003). For instance, a 1.5% reduction in tumour control per week has been noted for head-neck cancers earmarked for post-surgery treatment and other fast-growing tumours are most affected by delays of one to two months, while the effects on slow-growing

tumours are less significant (Whyatt *et al.*, 2008; CDH, 2022).

2.0 Historical Perspective of Radiotherapy Services in Zambia

In Zambia, radiotherapy (RT) services were available at the Cancer Diseases Hospital (CDH) from 2007 until the equipment became inoperable at the end of 2022. Since then, the country has experienced a disruption in RT services to date at the time of writing (CDH, 2023). There were no noticeable restorative measures of procuring the RT equipment to offer services from 2021 to 2022. In 2022, an initiative by CDH staff and International Atomic Energy Agency (IAEA) with authority from the Ministry of Health (MOH) developed a bankable document for the replacement of equipment. This led to the release of funds by the government for the potential procurement of RT equipment and, ultimately, the restoration of RT services. This write up aims to give a historical background of RT services in Zambia, review the challenges the country has faced in ensuring the availability of RT services and identify opportunities for RT services in Zambia. It will contribute to the body of literature that can be utilised in an evidence based approach to restoring sustainable RT services.

Zambia made notable milestones in providing cancer treatment to its citizens. It has been reported that between 1995 and 2004, only 350 out of the 5,000 patients identified for radiotherapy treatment were sent abroad due to the prohibitive costs (Kanduza, 2021). Patients had to travel to Zimbabwe, South Africa, and India to get the treatment. In 2003, the Government of the Republic of Zambia commenced the construction of a cancer hospital in Lusaka with OPEC funding for international development and technical support from IAEA (OFID 2009; IAEA, 2017).

In the first stage CDH had one (1) linear accelerator, one (1) cobalt machine, one (1) brachytherapy machine, one (1) simulator, one (1) mammography and a treatment planning unit others were chemotherapy, imaging and laboratory services.

The expansion came into 2010 through to 2016 starting with second brachytherapy unit, nuclear medicine, theatre, in-patient facility, chemotherapy out-patient suite, magnetic resonance imaging (MRI) and two (2) CT simulators and another phase which will see new centres established outside Lusaka (Lishimpi, 2019). The RT machines are obsolete and waiting for decommissioning. Namely one (1) linear accelerator, two (2) cobalt machines, and two (2) high-dose rate units. Below in Figure 1 is the linear accelerator and Figure 2 is the treatment console for the cobalt machine unit at CDH.



Figure 1: Showing Linear Accelerator

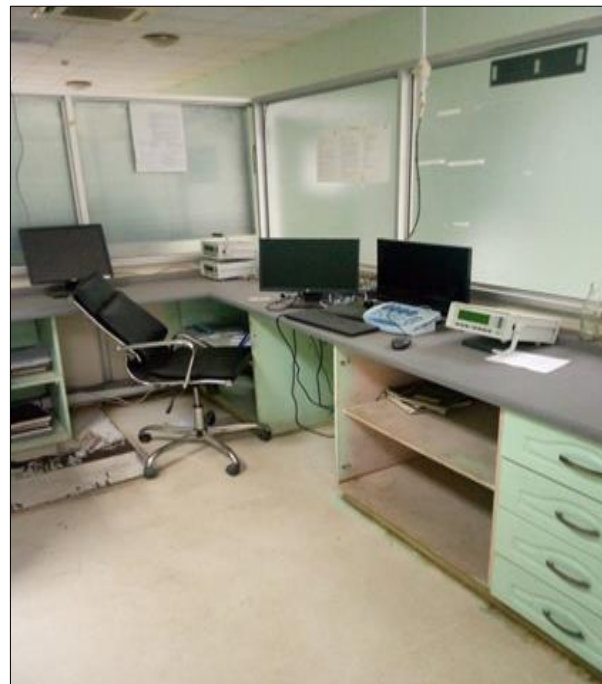


Figure 2: Showing Control console for Cobalt

2.0 Cancer Diseases Hospital (CDH) Training College

Specialist medical human resource constraints are a global challenge. This is more pronounced in developing countries establishing intricate services such as oncology care (CUGH 2013). At establishment in 2006, CDH had six (6) radiation therapists, one medical physicist, and one radiation oncologist (foreign). Cohorts of Zambians in the various capacities were further trained abroad with the first graduates returning in 2007 to escalate the services. As the patient and service load grew exponentially (from 35 OPD patients in 2006 to 2,586 in 2018) the need for more human resource was evident.

It was recognised that training of staff abroad was expensive and unsustainable. This led to the establishment of the Cancer Diseases Hospital Training College in 2012. The aim was to train radiation oncologists, radiation therapists, oncology nurses, oncology pharmacists, and medical physicists. An opportunity was also seen to train other health personnel from other countries both as gesture of good will and a revenue stream to sustain oncology services. The college is housed within the CDH premises and is part of the

hospital. So far, 54 radiation therapists have been trained (including 20 foreign nationals) and thirteen (13) radiation oncologists seven (7) Zambians six (6) other countries) (MOH -CDHTC, 2019).

3.0 Challenges of Radiotherapy Services in Zambia

Zambia is a low-resource country and, many challenges are being experienced in offering quality RT. During this review, at least four challenges were identified, as summarised in Table 2.

Table 1: Challenges of Radiotherapy Services in Zambia

Challenges of Radiotherapy Services in Zambia	
1	Equipment shortages and operation challenges
2	Lack of medical physicists and biomedical engineers
3	Education and training challenges
4	Financial constraints, procurement, and maintenance delays
5	Lack of a retention strategy for staff

4.1 Equipment Shortages and Operation Challenges

Zambia urgently needs approximately 17 to 18 radiotherapy machines to manage its cancer burden (Nkonde *et al.*, 2020). However, it is deeply concerning that of the country’s RT equipment, is obsolete not functional and earmarked for decommissioning. This equipment shortage has resulted in long patient waiting times, forcing the government to resume sending patients to neighbouring countries and overseas for treatment (CDH, 2020).

Another challenge relates to the management of service contracts for the maintenance and servicing of the RT machines. A well-funded service contracts are required to prevent breakdowns and repair of the equipment. However, there have been no service contracts for RT equipment in Zambia since December 2019, and this situation did not improve until 2022 when obsolete RT equipment malfunctioned. The RT treatment sessions for patients were inconsistent before the machines completely broke down due to frequent machine downtime. Further, the situation is worsened because there is only one monopoly of maintenance Service Company in the country that can diagnose and fix equipment problems. There is a need to introduce another service company for RT equipment in the country. This will create a wider choice for the MOH to consult when it comes to the management of the equipment.

4.2 Lack of Medical Physicists and Biomedical Engineers

The capacity of medical physicists in Zambia is limited to diagnostic medical imaging and RT equipment. Currently, there are only ten (10) medical physicists in the country, with just four (4) working at CDH, while the rest are in academia and other fields. The four medical physicists carry out quality control of RT equipment and at the same time provide services to over 250 diagnostic imaging equipment spread across the country (Bwanga & Chanda, 2020). At CDH alone, there

is a need to fill the gap for more than 64% of medical physicists (Kawesha., 2017; Nkonde *et al.*, 2020). The field of medical physics in the country has struggled with low recruitment due to limited funded positions at CDH, the existence of only one (1) RT centre, the lack of a local training program, and high attrition rates for the past few years

Currently, there are only two (2) qualified biomedical technicians for an establishment of fourteen (14). Challenges with discordant human resource management insights have resulted in available positions not being utilised as their funding has been withdrawn from central government. Biomedical technician’s role is the maintenance and management of medical equipment (Pendig *et al.*, 2023). In Zambia biomedical engineering is offered at Evelyn Hone College at the diploma level the program started in 2015 and has since produced 350 graduates. Northern Technical College on the Copperbelt is another institution offering the program which commenced in 2013 and has produced approximately 500 graduates. There will be a need to unfreeze the positions and employ a few more Biomedical technicians since they are readily available in the country.

4.3 Education and Training Challenges

The IAEA has recommended a deliberate policy to employ staff immediately after completion of training to help sustain RT service (IAEA, 2014). The CDH training college has trained seven (7) radiation therapy technologists, now employed as diagnostic radiographers at other centres around the country. These could have been employed and a late-night shift made available for the treatment of in-patients to reduce waiting times. Experienced, trained, and skilled staff is central to delivering treatment and managing patients safely. Staff adjustments are required whenever any upgrade is introduced in the department, such as education and training (IAEA, 2015). The first six (6) radiation therapists initially trained in RT are no longer actively involved in the day-to-day planning and delivery

of RT except for one currently managing the department at CDH. Two are in academia, one has gone back to practice diagnostic radiography, the fourth one has been seconded to MOH as an administrator and the fifth one as migrated to Europe. However, Zambia has not adjusted staffing needs since 2012 after establishing the college, and the law of demand-based approach in staffing has yet to be followed, creating the potential of negatively affecting the quality of service for both RT and the college. If staff is not adequately trained, it can introduce an inherently poor quality of service in the future, even with improved infrastructure (Ukandu *et al.*, 2013).

Providing high-quality education in the medical sector is a significant challenge due to the requirement of a dedicated teaching team and fair compensation for the existing staff. The current scenario of utilising clinical staff as temporary teaching staff presents a considerable challenge, as no dedicated teaching time is allocated to staff. This puts demand on teaching staff because of the dual function: clinical and teaching roles (Bwanga & Mwansa, 2022). This could negatively affect the quality of teaching and graduates. Therefore, dedicated full-time staff is recommended. Although the RT College is officially established, there is no clear policy on how to manage the college as it depends on the part-time administration and teaching staff. The locals started shunning away from the diploma program because of the apparent seemingly unattractive enumerations for diploma holders. It is also challenging to get employed as a radiation therapist due to the non-availability of other cancer disease hospitals in the country.

4.4 Financial Constraints, Procurement and Maintenance Delays

Bureaucratic processes in procuring services have caused delays in maintaining and resolving issues in providing RT services. The funding for the RT centre can be improved to cover services such as service contracts and the procurement of consumables. Some critical consumables, such as processors and cassettes required for treatment verification and quality assurance, have not been available for the past four years. This non-

availability of consumables can probably be attributed to the 8% allocation of the total budget, which falls short of the 15% health financing agreed upon under the Abuja declaration (Mulenga *et al.*, 2021). Ensuring that treatment plans are verified is crucial for patients’ safety and service quality (RCR., 2008). However, persistent shortages of essential materials, such as Cerrobend and screws, for customised blocks that offer radiation shielding for critical organs in the radiation path significantly compromise patient safety and treatment outcomes. Procurement of second-hand machines or outdated machine technologies is very expensive in the long run, for instance, there will be no need for cerrobend if multi-leaf collimators (MLCs) are present. What will be needed only is a strong service contract.

4.5 Lack of a Retention Strategy for Staff

Proper recognition of staff qualifications is crucial to motivate them as a retention strategy. Out of the 24 radiation therapists employed for RT at CDH only nine (9) are on the correct establishment (CDH, 2022). The rest are sitting on the diagnostic radiography establishment with no room for career progression. Furthermore, radiation therapists currently practicing in Zambia are dual trained in diagnostic and therapy radiography. Despite receiving post-graduate training the system needs to recognise the value of additional post-graduate training and offer upgrades in terms of compensation and general working conditions to retain skilled human resources. The inertia of human resource management is also visible and this needs to be addressed. This could be probably due to a lack of resources and, a lack of understanding of the hospital asset management operation and maintenance of RT equipment. Resolving these problems will require human resources strategies that will be linked to strategic objectives of CDH (Kapur, 2020).

5.0 Opportunities for Radiotherapy Services in Zambia

A few opportunities exist to improve radiation RT services in Zambia. These are summarised under the two (2) themes as shown in Table 1.

Table 2: Opportunities for radiotherapy services in Zambia

Opportunities for radiotherapy services in Zambia	
1	Increase in demand for radiotherapy services
2	Availability of training institutions

5.1 Increase in Demand for Radiotherapy Services

Targeted communication and increased capacity of diagnostic services have increased the demand for radiotherapy services. Zambia is landlocked with 8 neighbouring countries some without RT centres, whilst other fall into the same predicament of periodic failed maintenance of existing services. This increase in cancer cases is an opportunity to expand the RT services and bring this service as close to the patient as possible

in line with the objective of the MOH (NHSP, 2022-2026).

5.2 Training

An exponential increase in demand for services creates an opportunity for training to provide the human resource required to meet this demand. CDH hosts a training college that trains Radiation therapists and Radiation oncologists. In addition, other local, regional, and international universities are available. Locally, the

University of Zambia (UNZA) is offering BSc and MSc in radiotherapy. So far four (4) students with BSc in Radiotherapy have since graduated. UNZA also started offering a postgraduate diploma in radiation protection in 2023. Plans are underway for the CDH College to start offering a BSc programme and the curriculum has been developed. This will attract locals to apply for the course which of late was only attracting foreign students as observed from the 2018 intake which had ten (10) foreign students and only one (1) local citizen.

6.0 Way Forward for Radiotherapy Services in Zambia

The re-establishment of RT services in Zambia requires a meticulous service provision approach based on informed decision-making, empirical research, and unwavering management commitment. It will be essential to comprehensively establish all the necessary components to ensure sustainable and high-quality RT services. However, a critical issue in this process has been the inadequate management of equipment, which led to the absence of consistent service contracts for maintenance from December 2019 to 2022 (CDH., 2022). It will be vital to implement steadfast and well-adhered service contracts to ensure the continued functionality and longevity of the equipment.

One of the significant challenges in the past was the lack of qualified service engineers, which needs immediate attention. Future planning should include training for biomedical engineers and competitive working conditions to ensure workforce retention. It is also essential to have an equipment replacement plan in place to prevent potential disruptions before installing new equipment. The quality of RT depends on the proficiency of the personnel delivering treatment, so it is crucial to invest in the training college at CDH. It is discouraged to expect clinical staff to undertake full-time teaching duties while performing clinical tasks, as this can affect the quality of training and clinical duties (IAEA., 2014; Bwanga and Mwansa, 2022). It is essential to develop and implement documented processes to improve service quality. Lack of documented protocols for treatment and quality control procedures has the potential to compromise the quality of RT services (RCR. 2008). Therefore, institutions must invest time and resources in creating and following comprehensive protocols. The institutional commitment is essential for enhancing service quality.

Establishing durable financing mechanisms is crucial to ensure the availability of RT services to the Zambian population. Rigorous efforts are required to devise and implement sustainable financing models that will enhance the resilience and continuity of RT services. By doing so, accessibility to these critical services can be guaranteed. Therefore, stakeholders in the healthcare industry must collaborate to create effective financing models that will support the provision of RT services in the long run. The government and stakeholders must

urgently address challenges that exist to ensure the sector becomes sustainable and put in place a retention plan for core staff to make RT equipment management effective. Alternatively, private hospitals could be encouraged to establish radiotherapy centres by providing tax incentives and public-private partnerships (PPPs). Despite facing several challenges, such as inadequate funding, personnel shortage, and limited resources, it remains clear and confident that the sector can be transformed to deliver world-class RT care to all Zambians and all patients who might seek to access RT in Zambia.

6.1 Support from the Government and Cooperating Partners

The government of the Republic of Zambia is addressing the increased cases by expanding radiation therapy services to a new centre under construction in Ndola, Copperbelt province, and another one earmarked to be constructed in Livingstone, southern province. The expansion of RT services will require practical strategies for equipment management, RT processes documentation and staff management. The support also includes re-establishing of RT services in Lusaka. To avoid past disruptions of services, a deliberate government policy addressing medical equipment management and replacement is crucial. The policy will guide equipment, upgrade schedules, and routine maintenance over the lifespan, emergency maintenance, and overall commissioning and decommissioning of equipment, thus providing continuous quality RT treatment services in Zambia (MOH-CDH., 2022).

The government has allocated funds towards procuring essential RT equipment. The equipment to be procured will include four (4) linear accelerators (LINACs), two (2) brachytherapy units, two (2) computed tomography (CT) units, one (1) digital conventional simulator, one (1) magnetic resonance imaging (MRI) unit, one (1) mammographic unit, and one (1) ultrasound (US) machine, based on the insights gleaned from the bankable document. Furthermore, it is worth noting that the government has made a significant move by engaging a vendor through the Ministry of Health to rehabilitate and re-equip CDH in Lusaka as of October 2023 (CDH, 2023). The National Cancer Control Strategic Plan (NCCSP) 2022-2026, unveiled by the MOH in October 2023, is set to pave the way for the future development of RT services. As part of the plan, CDH will strengthen the college responsible for training radiation therapy technologists and radiation oncologists and ensuring a continuous supply of skilled workers. Plans are also underway to start training medical physicists and oncology nurses at CDH College.

International partners such as the World Health Organisation (WHO), the International Atomic Energy Agency (IAEA), and Civil Society Organisations (CSOs) provide technical and financial support. An example was the training and technical assistance that was given to the

MOH when RT was been established. They supported the training of Radiation Oncologists five (5), Radiation therapists six (6), medical physicists two (2), and equipment technicians two (2), whilst the technical assistance was in the form of expert advice on setting up

the RT centre. Plus, many more projects that still exist such as skills upgrade continuous development programs for staff and procurement of RT accessories aimed at assisting Zambia to improve and sustain RT services as shown in table 3 below.

Table 3: Showing areas of support from IAEA

Areas of support from IAEA	
1	Establishing the first Radiotherapy Centre in Zambia. Construction and equipment installation was completed in September 2006 and CDH officially opened on the 19 th July 2007
2	Improving the quality of Cancer Treatment (training of MPs, RTTs and the establishment of the QC processes for radiotherapy)
3	Strengthening the Delivery of Radiotherapy Services. establishment of a local training program for RTTs
4	Expanding the Capacity for Radiation Oncology through sustainable Local Human Resource Development to benefit National Cancer Control. Development of training curricula in Clinical Oncology, Oncology Nursing and strengthening of the RTT program. The National Cancer Control Strategic Plan 2016-2021 was completed
5	Consolidating the delivery of cancer treatment Services
6	Supporting the expansion of the delivery of Radiotherapy
7	Expanding Sustainable and Quality Applications of Nuclear techniques for decentralized radiotherapy services

7.0 CONCLUSION

The authors have reviewed RT services in Zambia. Although many challenges have been identified, there are opportunities to help deliver quality RT services. To achieve this government needs to open more cancer disease hospitals across the country and invest more in RT equipment and maintenance, and personnel development to strengthen human resources in this sector. During this review, no published research study was found on the satisfaction of cancer patients and staff with RT services in Zambia. The authors, therefore, strongly recommend a research study on this subject to provide baseline information to policymakers and other stakeholders.

Conflict of Interest: None

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