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Radiotherapy services in low resource settings: The situation in Nigeria

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Abstract

Objective: About 50%–60% of all cancer cases will require radiotherapy during their treatment. Nonetheless, radiotherapy facilities are limited in low- and middle-income countries and despite high cancer burden in these regions of the world, only 5% have access to radiation therapy. This study identified the location of radiotherapy centers, the types of radiotherapy machines available and the personnel available in each radiotherapy center in Nigeria.

Methods: A cross-sectional questionnaire-based study conducted across the six geopolitical zones of Nigeria from May 2020 to April 2021. A questionnaire having sections on facility profile, status of facility, and human resources, was used to elucidate information for the study. Descriptive statistics (frequency and proportion) were used to describe facilities' characteristics, status, and human resources available.

Results: Out of nine radiotherapy centers evaluated, the majority 33.3% ($n = 3$) were found in the southwest geopolitical zone of Nigeria. Out of 10 equipment and accessories evaluated for availability, Ahmadu Bello University Teaching Hospital and University of Benin Teaching Hospital had the highest number of available equipment and accessories 90% ($n = 9$) each respectively. Out of the nine centers evaluated, only four centers had at least one functional equipment. The highest number 64.3% ($n = 9$) out of the 14 required number of staff in each center was found at University College Hospital. Out of 31 medical physicists identified, the majority 22.6% ($n = 7$) was found at University of Nigeria Teaching Hospital.

Conclusion: A high percentage of radiotherapy centers in Nigeria lacks the equipment and manpower to function optimally and is located within the southwest geopolitical zone of Nigeria. Therefore, proper investment in the radiotherapy service through private–public partnership, staff training, and equipment upgrade and maintenance could substantially improve the state of cancer care.

Keywords

Cancer, radiation oncologists, radiotherapy, assessment, services

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Introduction

Cancer is an important cause of morbidity and mortality worldwide. The global burden of cancer has been reported to be on the increase.[1] In 1985 the incidence of cancer was 7.6 million. Recent reports by GLOBOCAN puts the incidences of cancer at over 19 million and the greatest increase in newly reported cases occurred in low- and middle-income countries (LMICs).[1,2] It has also been projected that by 2030, about 70% of new cancer cases and cancer-related deaths would occur in these regions of the world.[5]

In the management of cancer cases, early diagnosis and treatment are essential. Radiation therapy is an important and cost-effective component of modern cancer care in the definitive, adjuvant, and palliative settings.[5–7] It has been estimated that about 50%–60% of all cancer cases will require radiotherapy during the course of their treatment.[3] Nonetheless, radiotherapy facilities are limited in LMICs and despite high cancer burden in these regions of the world, only 5% have access to radiation therapy.[8]

Nigeria with a current population of 206,139,590 was reported to have 100,000 cancer cases in 1991[9]; that number has risen to 124,815, a mortality of 78,899, and a 5-year prevalence of 233,911 according to a 2020 GLOBOCAN report,[3] while between 50% and 60% of these patients will require radiotherapy at least once during the course of treatment.[4] The need for establishment of radiotherapy centers in Nigeria arose from the increasing number of people diagnosed with cancer and radiotherapy serving as one of the ways of managing the disease among other curative or palliative treatments.[10] Nigeria has less than one radiotherapy unit per 19 million people as compared to 1 unit per 250,000 in high-income countries.[11] There is recorded evidence of improvement of service delivery.[4] However, the high prevalence of cancer and the widening gap in patients to facility ratio, has undermined efforts of cancer care in Nigeria. This study therefore seeks to highlight the current status of radiotherapy facilities in Nigeria.

Methods

Study design

A cross-sectional study was adopted to elicit information from various radiotherapy centers in Nigeria May 2020–April 2021.

Area of study

This study was carried out across the six geopolitical zones in Nigeria. As at the time of this study, the following nine radiotherapy centers were available: Lagos University Teaching Hospital (LUTH), Lagos (southwest); University College Hospital (UCH), Ibadan (southwest); Ahmadu Bello University Teaching Hospital (ABUTH), Zaria (northwest); National Hospital Abuja (NHA), Abuja (north central); University of Nigeria Teaching Hospital (UNTH), Nsukka (southeast); Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto (northwest); University of Benin Teaching Hospital (UBTH), Benin (south-south); Federal Teaching Hospital (FTH), Gombe (northeast); Eko Hospital, Lagos (southwest).

Ethical consideration

Ethical clearance was obtained from the Ethics Committee of the Institute of Advanced Medical Research and Training, University of Ibadan/University College Hospital, Ibadan (UI/EC/20/0184), and Ethical Committee of FTH Gombe (NHREC/25/10/2013). The entire study procedure was adequately explained to the participants and their written consent was duly sought and obtained. Information obtained from them were held in strict confidence and used only for the purpose of this study.

Sources of data collection

Data used in this study were from nine radiotherapy facilities across the six geopolitical zones of Nigeria. Data was primarily collected using a hard-copy semi-structured questionnaire and was administered by the researcher. The questionnaire includes sections on facility profile, status of facility, and human resources. The available equipment was checked for functionality, that is, in-use (active) or not-in-use (inactive). The head of radiation oncology department and four other staffs (Oncologist, radiation therapist/radiographer, and Oncology Nurses, medical physics) with direct access to patients at selected facility were purposefully included in the study. The completed questionnaires were checked for completeness and computed into a spreadsheet for data analysis.

Statistical analysis

Data was entered and cleaned using Statistical Package for Social Sciences (SPSS v21); descriptive statistics (frequency and proportion) were used to describe respondents' characteristics, status of various radiotherapy centers, and human resources available.

Results

This study is an effort to describe the current situation of radiotherapy services in Nigeria. The study had 80% participation rate by respondents.

Distribution of radiotherapy facilities across the geopolitical zones

Out of nine radiotherapy centers evaluated, 33.3%($n=3$) were found in the southwest geopolitical zone of Nigeria and

Table 1. Distribution of radiotherapy centers based on geopolitical zones.

Radiotherapy centers based on geopolitical zones	Frequency (*n*)	Percentage (%)
Southwest	3	33.3
Eko Hospital, Lagos University Teaching Hospital, Lagos and University College Hospital, Ibadan		
Southeast	1	11.1
University of Nigeria Teaching Hospital, Nsukka		
South-south	1	11.1
University of Benin Teaching Hospital, Benin		
North central	1	11.1
National Hospital Abuja		
Northeast	1	11.1
Federal Teaching Hospital, Gombe		
Northwest	2	22.2
Ahmadu Bello University Teaching Hospital, Zaria		
Usmanu Danfodiyo University Teaching Hospital, Sokoto		

Figure 1. Map distribution of facilities.
Source: Map data ©2023 Google.

the least 11.1% ($n=1$) was each found in north central, northeast, southeast, and south-south geopolitical zones of Nigeria respectively (Table 1; Figure 1).

Patient distribution across regions and selected facilities

Figure 2 shows the average throughput of patients across functional facilities. Facilities located within the southwest region accounted for about 56% ($n=210$) of patient throughput in Nigeria closely followed by 18.1% ($n=75$) from the southeast, 12% ($n=50$) and 4.8% ($n=20$) from the northwest and northeast respectively. Eko Hospital and LUTH had on average 65 and 80 patients per month respectively. UCH Ibadan attended to 65 patients on average per month, UNTH Enugu attended to 75 patients, while FTH Gombe attended to 20 patients per month (Figure 2).

Staff distribution across regions and selected facilities

Report of available human resources/staffs obtained from selected institutions showed that there are 68 staff in the southwest region, 45 in the northwest, and 7 in south-south

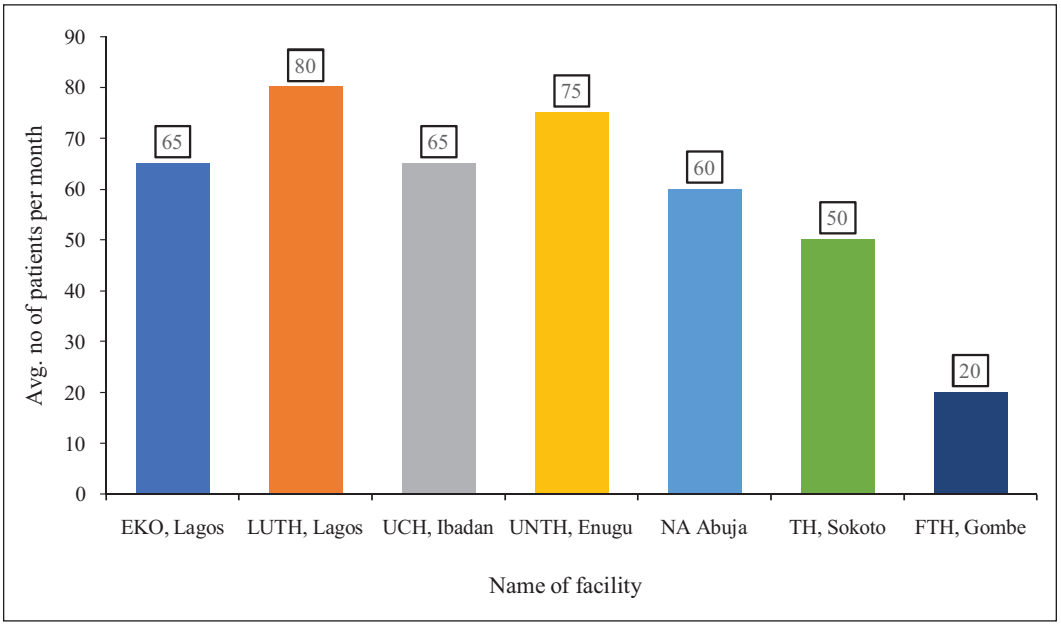


Figure 2. Average monthly distribution of patients across selected facilities.

(Figure 3(a)). Our analysis showed there are 11 radiation oncologists in the southwest, and five in the northwest. There were 15 radiation therapists in the southwest and 8 in the northwest, while there were 3 in the northeast (Figure 3(b)). Table 2 shows the distribution of personnel across selected facilities. ABUTH had five medical physicist, radiation therapist, and resident doctors respectively. In Eko Hospital, there were three radiation therapists. FTH Gombe had two medical physicists, four oncology nurses, three radiation oncologists, and four resident doctors.

LUTH had two house officers, six medical physicists, five oncologists, nine radiation therapists, and three senior registrars. UCH Ibadan had three clinical psychologists, five medical physicists, five nursing officers, nine radiation oncologists, six radiation therapists, and three registrars. In UNTH, they had seven medical physicists, six radiation therapists, while in UDUTH they had five medical physicists, eight oncology nurses, and three each of radiation oncologist, radiation therapist, and resident doctors, respectively (Table 2). The estimated number of personnel required based on estimated cancer incidence in geographic region is shown in Figure 4. It was observed that the northwest region will require approximately 157 radiation oncologists and 261 medical physicists and oncology nurses respectively. Meanwhile, the southwest will require an estimated 306 medical physicists.

Distributions of equipment across selected facilities based on availability and functionality

Table 2 shows the distribution of equipments across selected facilities. Out of 10 equipment and accessories evaluated for availability, LUTH and UCH had the highest number 90% ($n=9$) of available equipment and accessories respectively, while FTH Gombe had four of this equipment and accessories. Based on functionality, LUTH had the highest number of functional equipment 33.33% ($n=4$) and the least were Eko Hospital, FTH Gombe, and UNTH, which was 10% ($n=1$) each respectively. Out of nine centers evaluated, only four had at least one functional equipment (Table 2). In terms of planning equipment, ABUTH and UCH uses clinical marking, 2D planning is available in NHA, 3D planning is available in LUTH, NHA, and UNTH while LUTH has IMRT and VMART (Table 3).

Discussion

This study seeks to describe the existing status of radiotherapy facilities in Nigeria. Nigeria currently has nine radiotherapy centers of which seven are functional. The majority of the centers were found in the southwest geopolitical zone of Nigeria. This implies that despite the sustained increase in the incidence of cancer worldwide with accompanying high demand for radiotherapy services irrespective of cancer stage, radiotherapy service delivery in Nigeria is well below standard.[5] This finding also showed that majority of the cancer patients will not have access to radiotherapy services, especially those in southeast, south-south, north central, and northeast that has only one center each respectively.[10]

There are presently 28 radiation oncologists and 34 radiation therapists in Nigeria, based on the current cancer incidence in Nigeria, that is, about one radiation oncologist for >4000 persons and one radiation therapist for >3000 persons. Furthermore, there are 31 medical physicists, 3

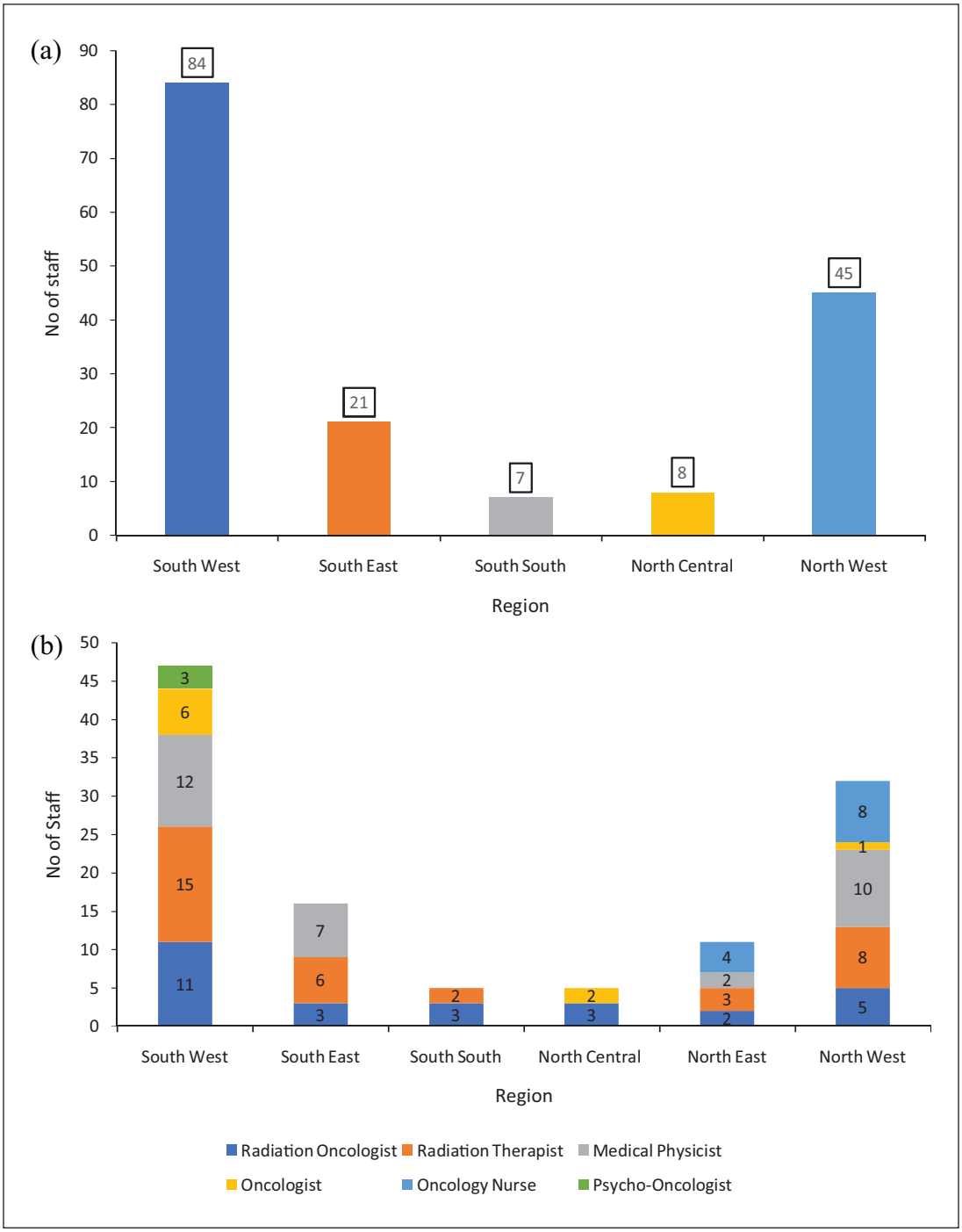
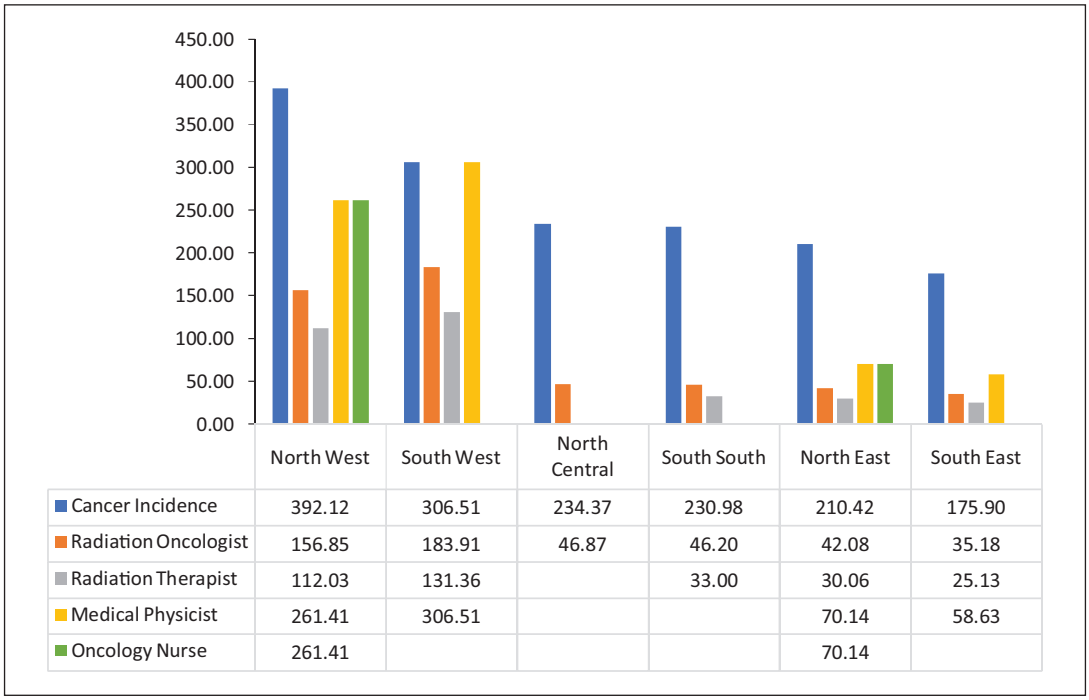


Figure 3. (a) Distribution of staff per region. (b) Distribution of core radiotherapy staff by region.

psycho-oncologists, and 16 resident doctors in Nigeria. According to the International Atomic Energy Agency (IAEA) International Basic Safety Standards, a radiotherapy center should have at least four-to-five radiation oncologists, three medical physicists, seven radiation therapists, three radiation oncology nurses, and one maintenance technician/engineer.[12,13] This study showed that only a handful of centers meets the requirement, consequently resulting in a massive shortage in the availability of specialist personnel to contend with the menace of cancer in Nigeria.[4] This shortfall could be attributed to a lack of investment in radiotherapy service delivery especially personnel empowerment. In addition, a



	North West	South West	North Central	South South	North East	South East
Cancer Incidence	392.12	306.51	234.37	230.98	210.42	175.90
Radiation Oncologist	156.85	183.91	46.87	46.20	42.08	35.18
Radiation Therapist	112.03	131.36		33.00	30.06	25.13
Medical Physicist	261.41	306.51			70.14	58.63
Oncology Nurse	261.41				70.14	

Figure 4. Estimation of personnel required based on estimate of cancer incidence in each geographic region.

perceived negligence of radiotherapy services by major stakeholders could also have contributed to the shortfall in staff strength, coupled with the fact that most personnel will prefer to offer their services where facility and financial incentives are not only available, but sustainable as well.

The results of our study showed that only few of the centers had some of the required equipment and accessories, and only less than 50% of the centers had functional equipment, which include two Cobalt-60 machines, four Linear Accelerators (LINACs), and three brachytherapy machines. Although our findings show a considerable improvement from a previous study by Nwankwo et al.[4] due to upgrade of some facilities, however, majority of the facilities failed to measure up to the recommendations of IAEA.[11] According to the IAEA (2008), there should be one megavoltage equipment per 250,000 populations and one megavoltage equipment per 350–400 new cancer patients.[12] From the foregoing, Nigeria will be requiring an estimated 312 megavoltage equipment for optimum care. Radiotherapy is a critical and inseparable component of comprehensive cancer treatment and care. Studies have shown that than more 50% of cancer patients will need radiotherapy, but unfortunately, more than 90% of cancer patients in low-income countries do not have access to radiotherapy services.[11]

Nigeria has an estimated population of over 200 million people; there are nine megavoltage therapy facilities in Nigeria. However, in comparison with the prescribed standards, radiotherapy centers in Nigeria need to be upgraded. The IAEA reported that the biggest gap between radiotherapy service availability and need is in Nigeria.[4] Apart from the grossly insufficient number of radiotherapy machines and facilities, this sector is often overwhelmed by a dearth of trained personnel, erratic power supply, lack of planning and evaluation, incessant staff industrial action, breakdown of machines, and a considerable delay in replacement of faulty parts. It is therefore imperative for stakeholders to take a holistic approach toward revitalization of radiotherapy facilities in Nigeria through public–private partnership, considering the low budgetary allocation for healthcare.

Conclusion

A high percentage of the radiotherapy centers in Nigeria have grossly inadequate facilities, lack the equipment and manpower to function optimally, especially considering the poor patient to facility ratio and an estimated increase in the number of cancer incidence in Nigeria in future. Therefore, sustainable investment in radiotherapy service delivery through public–private partnership, and periodic monitoring and evaluation of available facilities could substantially improve the state of cancer care and improve access.

Limitations of the study

This study was conducted during the COVID-19 pandemic and was highly impacted by restriction of movement as data on weekly output of patients could not be verified. No sample size estimation was conducted for this study because majority of facilities were operating below their capacity as resources were channeled toward COVID-19 emergencies. Unwillingness of

Table 2. Distribution of equipment and personnel across selected facility.

	Health facility									
	ABUTH	Eko Hospital	FTH Gombe	LUTH	NHA	UBTH	UCH	UNTH	UDUTH	Total
Equipment										
Cobalt-60 machine	A (1)$^{-}$	A (1)$^{+}$	NA	NA	A	A	A (1)$^{+}$	NA	NA	3
Linear accelerator	A	NA	NA	A (3)$^{+}$	NA	A (1)$^{-}$	NA	A (1)$^{+}$	A (1)$^{-}$	6
HDR brachytherapy	A(1)	NA	NA	A(1)	NA	A(1)	A(2)+	A(1)	A(1)	7
LDR brachytherapy	NA	NA	A (1)$^{+}$	NA	A	NA	NA	A	NA	1
Treatment planning/imaging machine	A	A	A	A (1)$^{+}$	NA	A (1)$^{-}$	A	A (1)	A (1)$^{-}$	4
Simulator	A	A	NA	A	A	A	A	A	A	—
Mold room	A	A	NA	A	NA	A	A	A	A	—
Library with shelves for references + internet access	A	A	NA	A	A	A	A	NA	NA	—
Patient toilet separate for males and females	A	A	A	A	NA	A	A	A	A	—
Staff toilet separate for males and females	A	A	A	A	A	A	A	A	A	—
Personnel										
Radiation oncologist	2	—	2	3	3	3	9	3	3	28
Radiation therapist	5	3	3	9	—	2	3	6	3	34
Medical physicist	5	1	2	6	—	—	5	7	5	31
Oncologist	1	1	-	5	2	—	—	—	—	9
Oncology nurse	—	—	4	—	—	—	—	—	8	12
Psycho-oncologist	—	—	—	—	—	—	3	—	—	3
House officer	—	—	—	2	—	—	—	—	—	2
Mold room technician	—	1	—	—	—	—	—	—	—	1
Nursing officer	3	1	—	—	—	2	5	2	—	13
Professor/HOD	—	—	—	—	—	—	1	—		1
Registrar	1	—	—	3	1	—	6	1	—	12
Resident doctor	5	—	4	—	—	—	3	1	3	16
Senior engineer	—	—	—	—	—	—	1	2	—	3
Senior registrar	1	—	—	3	2	—	—	—	—	6

A: available; NA: not available; +: functional; −: not functional (an equipment is said to be functional if it's in active use); LUTH: Lagos University Teaching Hospital; UCH: University College Hospital; ABUTH: Ahmadu Bello University Teaching Hospital; NHA: National Hospital Abuja; UNTH: University of Nigeria Teaching Hospital; UDUTH: Usmanu Danfodiyo University Teaching Hospital; UBTH: University of Benin Teaching Hospital; FTH Gombe: Federal Teaching Hospital, Gombe; HDR: High Doserate Brachytherapy; LDR: Low Doserate Brachytherapy.

Table 3. Type of treatment planning equipment available.

Equipment	Health facility								
	ABUTH	Eko Hospital	FTH Gombe	LUTH	NHA	UBTH	UCH	UNTH	UDUTH
Clinical marking	N	Y	N	N	N	N	Y	Y	N
2D	N	N	N	N	Y	N	N	N	N
3D	N	N	N	Y	Y	N	N	Y	N
IMRT	N	N	N	Y	N	N	N	N	N
VMART	N	N	N	Y	N	N	N	N	N
SRS	N	N	N	N	N	N	N	N	N

Y: yes; N: no; IMRT: intensity-modulated radiation therapy; VMART: volumetric modulated arc therapy; SRS: stereotactic radiosurgery technology.

some contact persons to participate in the study hindered the assessment of equipment. Giving the short time frame and partial operation of facilities at the time of conducting this research, the questionnaire could not be pre-tested.

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Author contributions

AMA contributed to the conception, design, and drafting of the manuscript. RA performed the statistical analysis, interpretation of results, and review of manuscript. AMA, HUC, DCU, and FI assisted in reviewing the proforma used for data collection as well as secured data release. FI, MPO, CPA, and OO reviewed the manuscript. All authors read and approved the final manuscript.

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Supplemental material

Supplemental material for this article is available online.

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