

Radiotherapy in Nigeria: Current Status and Future Challenges

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ABSTRACT

Aims: Incidence of cancer is on the increase and the greater proportion of that increase is from developing countries. About 50-60% of the cancer cases will require radiotherapy at least once during the course of the treatment. This paper is an effort to appraise the present radiotherapy capacity to treat cancer in Nigeria and to project its future challenges and development. **Materials and Methods:** The available radiotherapy centers in Nigeria were identified and information about the types and number of radiotherapy equipments, imaging systems, personnel, and training capacity were obtained. **Results:** In 2001, there were five radiotherapy centers with six megavoltage therapy machines in Nigeria comprising of five cobalt-60 and one linear accelerator. The population of the country then was 120 million, that is, one therapy machine for a population of about 20 million. By the end of 2010 the number of megavoltage therapy machines has reached eight with one therapy machine situated in each of eight radiotherapy centers, but the population has equally increased to more than 155 million giving only a marginal improvement in the radiotherapy service. **Conclusion:** There has been an increase of radiotherapy centers in Nigeria however, the number of available facilities is grossly inadequate and there is dearth of trained personnel. Careful and strategic planning is needed to develop manpower capabilities in all fields of specialization related to radiotherapy service in order to adequately care for the multitude of cancer patients.

Key words: Megavoltage therapy machine; Nigeria; radiotherapy centers

Introduction

The incidence of cancer has been reported to be on the increase worldwide.^[1] It has risen from about 2 million cases per annum in 1985 to about 5 million in 2000 and now more than 12 million new cancer cases per annum.^[1] Cancer is now one of the leading causes of death in the world with about 7.6 million deaths reported in 2007.^[2] It has been estimated that the incidence will reach 15 million cases per annum by 2015, two-third of which will be from the less developed low and middle income group countries. Nigeria belongs to this group, with the incidence of cancer estimated to be more than 100,000 cases annually.^[1] As a matter of fact, going by

previous estimate the incidence of cancer in Nigeria should have increased to 500,000 per annum.^[3] Apart from the high rates of infectious diseases, cancer awareness is very poor and treatment facilities grossly inadequate in these countries if available.^[4,5] The increasing burden of cancer seemed to have spurred low resource nations, including Nigeria to recognize the threat of malignant diseases and hence the need to improve the standard of care for the patients, especially with the use of ionizing radiation.^[6,7]

According to Levin *et al.*,^[6] the first therapeutic use of ionizing radiation was in January 1896 when two patients, one with breast cancer commenced treatment with radiotherapy in Chicago. Thereafter, other malignancies were treated. Following the introduction of megavoltage (high energy) radiotherapy in the 1950s, the practice of radiotherapy achieved a great and accelerated improvement.^[6]

It is estimated that 52% of cancer patients need the service of radiotherapy at least once at one time or the other during the course of their disease.^[8] However, not all of the African countries have radiotherapy facilities and most of the

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available centers are in many cases inadequately equipped from the point of view of machines and staff.^[9,10] Majority of the cancer cases seen in Nigeria are locally advanced and metastatic diseases^[11,12] usually requiring palliation with radiotherapy. The situation is similar to what obtains in other African countries as reported recently.^[10] Therefore, the overall need for radiotherapy in Nigeria should be more than 52%.

Nigeria is situated along the west coastal area of West Africa, with an area of 356,669 square miles (923,768 km²). It is the most populated nation in Africa with an estimated population of more than 155 million people.^[13] According to the National Population Commission, 97% of the population in the country is less than 65 years.^[14]

Effort to improve cancer care in Nigeria began in 1968, when Lagos University Teaching Hospital (LUTH), Lagos, Nigeria acquired a superficial radiotherapy machine. The LUTH became the first center in West Africa in 1973 to acquire a cobalt-60 teletherapy machine. It is one of the three old radiotherapy centers; the other two being University College Hospital (UCH), Ibadan and Ahmadu Bello University Teaching Hospital (ABUTH), Zaria. This paper is an effort to appraise the present radiotherapy capacity in Nigeria and to project its future challenges and development in Nigeria.

Materials and Methods

The number of radiotherapy centers along with the available equipments, the personnel and training capacity was documented by contacting all the radiotherapy centers in the country using a Proforma. Equipments and personnel were analyzed and related to known benchmarks such as megavoltage machine/million population. The status of the radiotherapy equipments at present were compared to the reported situation status in 2001 as well as 2005.^[9]

Results

The radiotherapy machines in Nigeria as at 2001 is shown in Table 1 and the status as at 2010 is shown in Table 2.

Teletherapy machine (megavoltage)

Cobalt-60 (Co-60)

At the end of 2010, there were three telecobalt machines functionally operational, situated in each of the three old radiotherapy centers in Nigeria. Two of them are located in two federal government teaching hospitals and one in a privately owned hospital. These two Co-60s in the teaching hospitals were purchased and installed with the assistance of the International Atomic Energy Agency (IAEA). The machines have become old and often a breakdown occurs, with maintenance being done by the local maintenance engineers. There is considerable delay in replacement of the Cobalt sources, thus increasing the treatment duration for

a patient. These centers lack functional treatment planning systems and there are no functional simulators. Treatment planning of patients was done in most cases, manually by 'clinical mark-up'. The first two Co-60 units installed in Nigeria in the late 70s and 80s have since been decommissioned and removed from the center.

Linear accelerators

There are five LINAC machines in Nigeria. All the LINACS were purchased and installed by the Federal Government of Nigeria (FGN). The first ever LINAC was installed at the National Hospital (NHA) in the Federal Capital, Abuja, about 10 years ago. Subsequently, with the increased demand for more radiotherapy facilities, four new LINACS were installed in four centers from 2007 till date. Three new radiotherapy centers were developed in the process. This was made possible through the FGN/Vamed Engineering Project. Only three of the LINACs in Nigeria are functional by the end of 2010. The remaining two newly installed LINACs are awaiting to be commissioned. The LINACs are equipped with complements of CT-Sim, Elekta Precise Treatment Planning System, modern mouldroom facility and can perform 3-D treatment planning. However, these centers lack adequately trained manpower to effectively make use of the treatment planning units. Only one trained LINAC maintenance engineer is available in NHA. Presently, there are a total of nine radiotherapy facilities: Six centers are functional, while the remaining three are yet to commence operations. A total of eight megavoltage machines are in the eight of the nine centers (five LINACs, three Cobalt-60) [Table 2], the remaining center has only a high dose rate brachytherapy machine.

Estimated need for megavoltage machine

Even though about 52% of cancer patients in the developed countries would need radiotherapy at least once,^[8] because most cancer patients present to hospital with advanced cancer in Africa, it is estimated that about 55% of new cancer patients need radiotherapy service at least once.^[7] If more than 100,000 new cancer patients are recorded in the country annually, then more than 55,000 of them would require radiotherapy at least once. By the International Atomic Energy Agency's (IAEA's) recommendation, one LINAC megavoltage therapy machine is required for 400 patients,^[15] and then Nigeria requires at least 137 LINACs, a shortfall of more than 129 LINACs, that is, presently Nigeria has less than 6% of the required need for megavoltage radiotherapy machines.

Brachytherapy

There are presently six brachytherapy units located in five of the nine radiotherapy centers. Four of these are low-dose rate (LDR), while two are high-dose rate (HDR) brachytherapy. Only half of these units are functional as at the end of 2010 (two Cs-137 LDR and one Co-60 HDR). It can therefore be concluded that three brachytherapy units are presently serving a population of more than 155 million, that

Table 1: The status of radiotherapy centers in 2001

Radiotherapy center	Co-60	LINAC	LDR brachytherapy	Treatment planning/ imaging machine	Population served	Megavoltage machine per million population
LUTH, Lagos	2		2			
EKO Hospital	1					
UCH, Ibadan	1		1			
ABUTH, Zaria	1		1			
NHA, Abuja		1	1	1 simulator		
Total	5	1	5	1	120×10 ⁶	20×10 ⁶

LUTH – Lagos university teaching hospital, UCH – University college hospital, ABUTH – Ahmadu bello university teaching hospital, NHA – National hospital, LINAC – Linear accelerator, LDR – Low-dose rate, HDR – High-dose rate

Table 2: Present status of radiotherapy centers in Nigeria by the end of 2010

Radiotherapy centers	Cobalt-60	LINAC	LDR brachy therapy	HDR brachy therapy	Treatment planning/ imaging systems	Population served	Population per megavoltage machine
LUTH, Lagos	Decommissioned	1	Decommissioned		CT-Sim		
UCH, Ibadan	1			1			
ABUTH, Kaduna	1		1				
NHA, Abuja		1	1		1 Simulator		
Eko Hospital, Lagos	1						
UNTH, Enugu		1			1 CT-Sim		
UDUTH, Sokoto		1			1 CT-Sim		
UBTH, Edo		1			1 CT-Sim		
FMC, Gombe				1			
TOTAL	3	5	2	2	5	>155×10 ⁶	19.4×10 ⁶

LUTH – Lagos university teaching hospital, UCH – University college hospital, ABUTH: Ahmadu bello university teaching hospital, NHA – National hospital, UNTH – University of Nigeria teaching hospital, UDUTH – Usmanu danfodiyo university teaching hospital, UBTH – University of benin teaching hospital, FMC – Federal medical center, LINAC – Linear accelerator, LDR – Low-dose rate, HDR – High-dose rate

is, >51 million/brachytherapy machine. The services offered by these brachytherapy units are mainly for gynecological cancers.

Human resources in radiotherapy services in Nigeria

There are three main specialties/specialists involved with the practice of radiotherapy. They are radiation oncology, medical physics, and therapy radiography. The radiation oncologists are the medical doctors who develop and prescribe each patients treatment plan. They ensure that the treatment is accurately given. The medical radiation physicists take precise measurement of radiation beam characteristics and ensure that the treatment planning is properly tailored for each patient. Among other roles, they are responsible for developing and directing quality control programs for equipment and procedures. The therapy radiographers take the images for treatment planning, administer the daily radiation dose under the doctor's prescription and supervision. Any of the above mentioned specialists can equally study further to become a dosimetrist who carefully calculates the dose of radiation and plans the treatment to ensure the tumor gets enough radiation. The numbers of the radiotherapy personnel in the country are shown in Table 3. The radiation oncologists also functions as the medical oncologists in most centers in Nigeria as many centers do not have qualified medical oncologists. The number of the radiation oncologists per radiotherapy center

ranged from 0 to 6. Presently, there are 21 practising radiation oncologists in Nigeria, that is, one radiation oncologist for > 7.4 million population. Medical physicists are very few. Some of the radiotherapy centers do not have a qualified medical physicist. Majority of the maintenance engineers are not trained. There is only one qualified LINAC engineer in the whole country.

Cancer registry

There are two population-based cancer registries, in Calabar and UCH, Ibadan. The Ibadan registry is far more developed and it is now the accepted national cancer registry. Majority of the teaching hospitals operate mainly a hospital-based cancer registry. The cancer registries are poorly funded, lack appropriately trained staff, and therefore unable to provide very good and reliable data.

Role of international organizations in radiotherapy development in Nigeria

Nigeria has benefitted from the assistance of various international organizations such as IAEA, World Health Organisation (WHO), Japan International Cooperation Agency (JICA), in the development of radiotherapy facilities. The IAEA has been helping through: Technical cooperation projects, coordinated research programs, fellowships, training programs and short courses, seminars, and publications.

Table 3: Present staff strength in Nigeria

Centers	Radiation oncologist	Medical physicist	Therapy radiographer	Engineers
LUTH	4	3	4	1
UCH	6	2	6	1
ABUTH	4	1	3	1
Eko Hospital	2		4	1
NHA	3	2	4	1 (LINAC)
UNTH	1		1	
UDUTH			2	
UBTH	1		3	
FMC, Gombe	1			
Total	22	8	20	5

LUTH – Lagos university teaching hospital, UCH – University college hospital, ABUTH – Ahmadu bello university teaching hospital, NHA – National hospital, UNTH – University of Nigeria teaching hospital, UDUTH – Usmanu danfodiyo university teaching hospital, UBTH – University of benin teaching hospital, FMC – Federal medical center, LINAC – Linear accelerator

The first three radiotherapy centers in Nigeria were established through the technical cooperation project of IAEA. These include LUTH; UCH, Ibadan; and ABUTH, Zaria. The project provided radiotherapy equipments and training of radiotherapy staff. Also, the first HDR brachytherapy installed in Nigeria came through the assistance of the IAEA. Many radiotherapy professionals have undertaken IAEA's fellowships in various countries in the fields of radiation oncology, medical physics, therapy radiography, and nuclear medicine. JICA has contributed in manpower development by assisting in short course training of some staff in radiation oncology in cancer institutions in Japan.

Discussion

Radiotherapy practice in Nigeria started as far back as 1968 at LUTH, Lagos with an orthovoltage machine. The first megavoltage radiotherapy machine, a telecobalt, was installed at LUTH in 1973, being the first in West Africa. Since then the number of radiotherapy centers has increased moderately in the country. In 2001, there were six megavoltage teletherapy machines in five centers: Five Cobalt-60 and one LINAC [Table 1]. Three of the centers were supported by the IAEA, one LINAC by the federal government and one owned by a private hospital. By the end of 2010, nine radiotherapy centers with eight megavoltage machines were recorded in Nigeria showing about 80% increase in the number of radiotherapy centers and 68% increase in the number of megavoltage teletherapy machines. When considering the population in relation to the number of radiotherapy centers and megavoltage machines available in Nigeria, one megavoltage machine was serving a population of 19.4 million in 2010 as compared to 24 million in 2001, thus showing a marginal improvement in a decade. An increase in the number of radiotherapy centers and equipment have also been reported in other African countries, as well as other regions outside Africa.^[15,16] A survey by Levin *et al.*,^[15] showed over 100% increase in radiotherapy megavoltage

machines in Africa over a period of 8 years from 1991.^[15] In the publication by Sharma *et al.*,^[10] more African countries have procured radiation therapy equipments, some highly sophisticated. This increase in radiotherapy facilities could be attributed to the increasing incidence of cancer in the developing countries and the acceptance of radiotherapy as an integral treatment modality in the management for cancer.^[6,8] This slight improvement in the number of megavoltage machines in Nigeria is still very small when compared to some other African countries and to the European standard of one megavoltage machine per population of 250,000 people.^[9,17,18] The implication is that radiotherapy service is not readily available to a large number of Nigerian cancer patients. Some patients would need to travel a distance of more than 600 km to access the nearest radiotherapy service. This results in some people failing to access the benefit of radiation treatment due to long distance. Travel distance has been known to affect receipt of radiation therapy. Various studies have shown that patients living close to or in a city with radiotherapy facility are more likely to receive radiation treatment than those living far away or in areas without a facility.^[19] There is no internationally defined travel time limit for cancer patients to access radiation treatment. However, according to a study, radiation facility within a 100 km distance is deemed appropriate.^[20] Apart from distance, the available radiotherapy centers suffer from one inadequacy or another. For example, some of these hospitals have acquired a simulator but it is being used for treatment planning by the centers equipped with LINAC.

The rest of the centers with Co-60 do only clinical mark-ups for their patients. The radiotherapy service in Nigeria at present does not meet the need of the cancer patients. All the new centers lack adequate radiotherapy specialists and the available equipments are not optimally utilized. The most affected specialty is the medical physics group. The main reason being lack of organized training facilities for medical physicists in the country and absence of a regulatory body to lay down policies for training and practice of medical physics. There is also lack of adequate training programs and facility for therapy radiographers as is obtained in the developed countries. However, manpower training in developed countries is very expensive and many of the candidates are trained in the facilities that are not available in their home countries making the implementation of the acquired knowledge another difficult task entirely.^[7] Many of the trained specialists never come back to practice in the country of origin after their training. Some of them that return immediately go back to the developed country for greener pasture (brain-drain syndrome) as remuneration and other working conditions are poor in the home country. Development of training centers in Nigeria is an answer to manpower development for the radiotherapy practice in Nigeria.

Another worrisome problem is lack of accurate data on cancer incidence in Nigeria. What is obtainable are only estimates,

based mostly on the data from individual hospital records. The gross absence of true national figures affects proper planning of healthcare delivery. To address this problem, there are two stages in achieving adequate cancer registration to ensure adequate cancer information data in Nigeria: Firstly, every hospital must establish a hospital cancer registry. Then this will grow into regional cancer registries. This will later be collated into the national cancer registry.^[7]

Developing countries, such as Nigeria would do very well in cancer control if they are to abide by the WHO guideline which states that “an initial priority, especially in developing countries, should be the development of national diagnostic and treatment guidelines to establish a minimum standard of care, and promote the rational use of existing resources and greater equity in access to treatment services”.^[21] Also for low-resource countries, a stepwise systematic approach for building national health treatment systems has been suggested.^[22] Nigeria has established National Consultative Committee on Cancer Control and National Cancer Control Program, but the impact is yet to be felt.

In conclusion, management of malignant diseases present a significant health burden to the country. Though there has been a moderate increase of radiotherapy centers, however the number of available facilities is grossly inadequate and there is dearth of trained personnel and specialist care and poor maintenance culture.

It is recommended that careful and strategic planning be made to develop manpower capabilities in all fields of specialization related to radiotherapy service in order to adequately take care of the multitude of cancer patients in the country. Private participation is highly recommended. Government must develop regulatory policies that will encourage private ownership of radiotherapy centers.

Establishment of training institutions in the country for all the radiotherapy specialists will ensure improved availability of trained radiotherapy specialists. International assistance is still greatly needed in personnel training and retraining, and the development of more radiotherapy facilities.

References

1. GLOBOCAN 2008. Available from: <http://globocan.iarc.fr/factsheets/cancers> [Last accessed on 2011 Sep 28].
2. American Cancer Society. Global Cancer Facts and Figures 2007. Atlanta: American Cancer Society; 2007.
3. Report of the Workshop on “National Cancer Control Programme for Nigeria” 1992. In: Solanke TF, editor. Communicating with the Cancer Patient in Nigeria. Information and Truth. vol. 809. New York: Annals of the New York Academy of Sciences; 1997. p. 109-18.
4. Dawotola DA, Olasinde TA. Radiotherapy in management of cancers at the Ahmadu Bello University Teaching Hospital, Zaria.

- Nigeria: Clinical impact of new radiotherapy facilities. *Niger Med Pract* 2004;49:45-8.
5. Kigula Mugambe JB, Wegoye P. Pattern and experience with cancers treated with the Chinese GWGP80 Cobalt unit at Malugo Hospital Kampala. *East Afr Med J* 2000;77:523-5.
6. Levin CV, Meghzifene A, Izewska J, Tatsuzaki H. Improving cancer care: Increased need for radiotherapy in developing countries. *IAEA Bulletin*; 43/2/2001.
7. Durosini-Etti FA, Nofal M, Mahfouz MM. Radiotherapy in Africa: Current needs and prospects-Special Report. *IAEA Bulletin*; 4/1991.
8. Barton MB, Frommer M, Shafiq J. Role of radiotherapy in cancer control in low-income and middle-income countries. *Lancet Oncol* 2006;7:584-95.
9. Sharma V, Gaye PM, Wahab SA, Ndlovu N, Ngoma T, Vanderpuye V, *et al.* Patterns of practice of palliative radiation therapy in Africa, Part 1: Bone and brain metastases. *Int J Radiat Oncol Biol Phys* 2008;70:1195-201.
10. Sharma V, Gaye PM, Wahab SA, Ndlovu N, Ngoma T, Vanderpuye V, *et al.* Palliative radiation therapy practice for advanced esophageal carcinoma in Africa. *Dis Esophagus* 2010;23:240-3.
11. Ketiku KK. The Pattern of metastases in Nigerian breast cancer patients. *Clin Radiol* 1986;37:563-5.
12. Odigie VI, Yusufu LM, Rafindadi A, da Rocha Afodu. Breast Cancer in Zaria. *Niger J Surg* 2003;9:46-50.
13. National Population Commission (NPC) of Nigeria. Available from: www.population.gov.ng [Last accessed on 2011 Sep 28].
14. National Population Commission, Nigerian Demographic and Health Survey, Abuja; 2008.
15. Levin CV, El Gueddari B, Meghzifene A. Radiation therapy in Africa: Distribution and equipment. *Radiother Oncol* 1999;52:79-84.
16. Tatsuzaki H, Levin CV. Quantitative status of resources for radiation therapy in Asia and Pacific region. *Radiother Oncol* 2001;60:81-9.
17. PAHO/WHO/IAEA/UNIDO. Design requirements for megavoltage X-ray machines for cancer treatment in developing countries. Report of an Advisory Group Consultation, Washington DC; December, 1993.
18. Madhvanath U. Maintenance problems in Asia. In: Borras C, Stovall M, editors. Design requirements for megavoltage X-ray machines for cancer treatment in developing countries. Report LA-UR-95-4528. Los Alamos: National Laboratory; 1995. p. 15.
19. Jones AP, Haynes R, Sauerzapf V, Crawford SM, Zhao H, Forman D. Travel time to hospital and treatment for breast, colon, rectum, lung, ovary and prostate cancer. *Eur J Cancer* 2008;44:992-9.
20. Taylor MR, Craighead PS, Dunscombe PB. Access to radiation therapy: Modeling the geographic distribution of demand. *Curr Oncol* 2005;12:1-4.
21. World Health Organization. Executive summary. National Cancer Control Programmes: Policies and Managerial Guidelines. Geneva: World Health Organization; 2002. p. 1-24.
22. Eniu A, Carlson RW, Aziz Z, Bines J, Hortobágyi GN, Bese NS, *et al.* Breast Cancer in limited-resource countries: Treatment and allocation of resources. *Breast J* 2006;12 Suppl 1:S38-53.

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