

MEDICAL PHYSICS IN NIGERIA: CHALLENGES, OPPORTUNITIES, AND THE FUTURE OF THE PROFESSION

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ABSTRACT

Medical physics is a vital discipline that applies the principles of physics to healthcare, particularly in diagnostic imaging, radiation therapy, nuclear medicine, and radiation protection. Despite its growing importance worldwide, the profession remains underdeveloped in Nigeria due to challenges such as a shortage of qualified medical physicists, limited training opportunities, inadequate infrastructure, and insufficient funding. This review examines the evolution and current status of medical physics in Nigeria, highlighting key achievements, existing challenges, and opportunities for growth. It also discusses government policies, workforce development, technological advancements, and the increasing demand for medical physics services in the country's healthcare system. Finally, the paper provides recommendations for strengthening education, research, professional practice, and policy implementation to support the sustainable development of medical physics in Nigeria. This review aims to serve as a valuable resource for students, researchers, healthcare professionals, and policymakers interested in advancing medical physics in Nigeria.

KEYWORDS: Medical Physics, Nigeria, Radiation Therapy, Diagnostic Imaging, Healthcare, Medical Education, Radiation Protection.

1. INTRODUCTION

Medical Physics is a specialized branch of physics that applies the principles of physics to the diagnosis, treatment, and prevention of diseases. It plays a critical role in ensuring the safe and effective use of radiation and advanced medical technologies in healthcare. Rather than studying the abstract laws of the universe, medical physics applies the principles of energy, electromagnetism, mechanics, and radiation directly to the human body and healthcare technology.

It acts as the critical bridge between pure science and patient care, taking the fundamental behaviors of particles and waves and translating them into tangible medical tools.

2. HISTORY OF MEDICAL PHYSICS IN NIGERIA

The Foundation: Radiology

The journey of radiation medicine in Nigeria began with diagnostic imaging. The first Department of Radiology was established in 1953 at the University College Hospital (UCH) in Ibadan, Oyo State (Aweda & Obed, 2003). This pioneering department was spearheaded by Professor Alexander Brown, who served as its first head. The establishment of this department laid the groundwork for the use of radiation in Nigerian healthcare, highlighting the eventual need for experts who understood the underlying physics of these clinical machines.

The Birth of Medical Physics and Radiotherapy

Medical physics as a distinct clinical practice and academic discipline officially took root in 1968 (Aweda & Obed, 2003). The first radiation therapy and nuclear medicine services in both Nigeria and the broader West African region were established at the Lagos University Teaching Hospital (LUTH) and the College of Medicine, University of Lagos, in Lagos State.

Clinical radiation therapy operations commenced a year later, in 1969, utilizing a superficial X-ray machine. A major technological advancement occurred in 1975 when the Canadian government donated a Theratron 780 Cobalt-60 machine to the facility for the treatment of cancer and other malignancies. This was acquired through the assistance and procurement programs of the International Atomic Energy Agency (IAEA) (IAEA, 2014). Alongside the clinical services, the College of Medicine at the University of Lagos pioneered the academic side of the profession. It became the first institution in West Africa to offer formal courses in Radiation Biology, Radiation Therapy, and Medical Physics.

Regulation and Infrastructure Expansion

For decades, the profession grew steadily, with medical physicists primarily operating in the background of radiotherapy departments. However, significant milestones in the early 2000s brought the field to the forefront:

- **Regulatory Bodies:** The activation of the Nigerian Nuclear Regulatory Authority (NNRA) in 2001 and the subsequent establishment of the National Institute of Radiation Protection and Research (NIRPR) in 2006 highlighted the critical need for radiation protection and formally cemented the role of medical physicists in enforcing safety standards across Nigerian hospitals (Usikalu, 2010).
- **VAMED Project (2003):** The federal government launched the VAMED Hospital Equipment Project, which equipped 14 teaching hospitals across the country with up-to-date medical and imaging technologies. This massive infrastructure upgrade drastically increased the demand for medical physicists to manage, calibrate, and assure the quality of these complex machines.

Professional Training and Residency

Historically, medical physics education in Nigeria has been exclusively a postgraduate pursuit. No Nigerian university offers medical physics as a standalone undergraduate degree; it is strictly studied at the Master's and Ph.D. levels across several institutions, largely within their faculties of science.

A major hurdle for the profession was the lack of structured clinical training to transition academic graduates into hospital roles. This changed in 2012 when the first clinical residency training for medical physicists commenced (Obed & Aweda, 2012). Backed by the IAEA and managed by the Federal Ministry of Health, this program selected an initial cohort of seven young physicists (Obed & Aweda, 2012). Their training involved rigorous clinical rotations across major centers, including the National Hospital Abuja (NHA), UCH Ibadan, Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, and Ahmadu Bello University Teaching Hospital (ABUTH) Zaria.

Today, the profession is governed and represented by the Nigerian Association of Medical Physicists (NAMP), which works in conjunction with the Federal Ministry of Health to regulate clinical practice and align Nigerian medical physics with global healthcare standards.

Evolution of Radiation Protection and Regulatory Institutions in Nigeria

- **1964:** The Federal Radiation Protection Service (FRPS) was established and managed by the University of Ibadan. For several decades, this served as the primary framework for handling radiation-related matters in the country before a dedicated national regulatory agency existed.
- **August 3, 1995:** The Federal Government enacted the Nuclear Safety and Radiation Protection Act (Act No. 19 of 1995) (Federal Republic of Nigeria, 1995). This crucial legislation officially established the NNRA to control the use of ionizing radiation and ensure the safety of all nuclear and radiological activities.
- **May 2001:** The NNRA officially began effective operations (Usikalu, 2010). Operating as an independent regulatory body, it assumed the mandate to register, license, inspect, and enforce radiological protection standards in all practices across the country.
- **2005:** The NIRPR was established at the University of Ibadan following a Memorandum of Understanding (MOU) between the NNRA and the university.
- **2006:** The NIRPR commenced full operations, functioning as the technical support arm for the NNRA, providing essential services such as clinical equipment calibration, specialized analytical services, and training.

3. CURRENT STATE OF THE PROFESSION

3.1 The Population-to-Workforce Deficit

Although having fewer than 100 practicing clinical medical physicists is an issue on its own, it becomes a crisis when weighed against Nigeria's population of over 200 million. Currently, Nigeria has approximately 0.1 medical physicists per 100,000 people. This is alarmingly below the global average of 2 per 100,000 (IAEA, 2014). The sheer volume of patients requiring radiation therapy and diagnostic imaging places an immense, often unsustainable workload on the few available professionals.

3.2 Skewed Specialization: The Neglect of Radiology

The few medical physicists operating in Nigeria are disproportionately concentrated in Therapeutic Medical Physics (Radiotherapy). Because cancer treatment relies entirely on precise radiation doses, radiotherapy centers are forced to employ physicists. Consequently, Diagnostic Radiology and Nuclear Medicine are left critically understaffed. Hundreds of diagnostic centers across the country operate without dedicated physicists to conduct routine Quality Assurance (QA) or patient dose optimization, compromising image quality and exposing patients to unnecessary radiation.

3.3 Infrastructure Decay and The "Downtime" Crisis

Medical physics is a highly technological field, and physicists in Nigeria are frequently hindered by failing infrastructure. Public federal hospitals often struggle with:

- **Equipment Downtime:** Linear Accelerators (LINACs) and Cobalt-60 machines frequently break down due to unstable power grids, lack of maintenance contracts, and the high cost of importing spare parts (IAEA, 2014).
- **Obsolete Technology:** Some centers still rely on outdated 2D treatment planning rather than modern 3D treatment planning or Volumetric Modulated Arc Therapy (VMAT) for grammatical completeness, limiting a physicist's ability to provide state-of-the-art care.

3.4 The Education vs. Clinical Experience Gap

The pathway into the profession is heavily academic (M.Sc. or Ph.D.). However, there is a severe disconnect between university curricula and hospital realities. Because many universities lack their own functional clinical equipment, students often graduate with deep theoretical knowledge but little to no hands-on experience with multimillion-dollar medical hardware (Obed & Aweda, 2012). Consequently, many graduates remain unemployable in a clinical setting until they secure scarce, unstructured "on-the-job" training at an active hospital.

3.5 The Internal Brain Drain (Public vs. Private Sector)

Beyond the international brain drain, Nigeria is experiencing an internal shift. Over the last decade, advanced private oncology centers (such as the NSIA-LUTH Cancer Centre and Marcelle Ruth Cancer Centre) have emerged to fill the gaps left by the public sector. These private facilities boast state-of-the-art equipment and offer competitive salaries. As a result, highly trained physicists are migrating away from state and federal hospitals, crippling the public healthcare system where the majority of citizens seek affordable care.

3.6 The Urgency of the Medical Physics Bill

The absence of a statutory regulatory board creates a dangerous vacuum. The NNRA mandates strict radiation safety standards, but enforcement is nearly impossible when hospitals cannot find certified physicists to hire. The pending "Medical Physics Bill" aims to establish a Medical Physics Regulatory Council of Nigeria. Passing this bill would drastically change the landscape by providing a legal framework to prosecute unqualified personnel, mandating structured clinical residency programs, and granting medical physicists independent clinical autonomy.

4. NUMBER OF HOSPITALS OFFERING MEDICAL PHYSICS SERVICES

Medical physics services in Nigeria are currently available in a limited number of tertiary healthcare institutions and specialized cancer treatment centers. Although diagnostic imaging equipment is present in many hospitals across the country, comprehensive medical physics services are concentrated in a small number of facilities with established radiotherapy and oncology departments.

Available data indicate that Nigeria has approximately eight to ten major hospitals with functional medical physics units (NAMP, 2021). These institutions are predominantly government-owned teaching hospitals and federal medical centers. Studies assessing radiotherapy infrastructure in Nigeria identified eight government-funded radiotherapy centers distributed across the six geopolitical zones, namely: National Hospital Abuja (NHA), Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, Ahmadu Bello University Teaching Hospital (ABUTH) Zaria, University of Nigeria Teaching Hospital (UNTH) Enugu, NSIA-LUTH Cancer Centre Lagos, Federal Teaching Hospital (FTH) Gombe, University College Hospital (UCH) Ibadan, and University of Benin Teaching Hospital

(UBTH) Benin City (NAMP, 2021). In addition, a few private institutions, such as Eko Hospital and Marcelle Ruth Cancer Centre in Lagos, have established oncology and medical physics services.

Most states do not have dedicated medical physics units, meaning patients often travel long distances to access treatment. Expanding medical physics services beyond the current concentration of tertiary hospitals remains critical to improving access to quality cancer care, diagnostic imaging, and radiation protection services across the country.

5. MAJOR CHALLENGES IN MEDICAL PHYSICS PRACTICE IN NIGERIA

Despite the growing importance of medical physics, the profession in Nigeria faces numerous challenges that limit its effectiveness. These obstacles directly affect the quality of cancer treatment, diagnostic imaging services, and radiation safety programs.

5.1 Shortage of Medical Physicists and Brain Drain

Recent assessments indicate that there are only about 31 to 44 practicing medical physicists across the country's major radiotherapy centers (NAMP, 2021). This workforce is grossly insufficient to meet the escalating demand for cancer diagnosis and treatment. This shortage is exacerbated by the ongoing "brain drain"—the frequent migration of highly skilled professionals to North America, Europe, and the Middle East in search of better remuneration. Domestically, the deficit is driven by limited postgraduate training opportunities and the absence of fully structured, government-funded clinical residency programs.

5.2 Equipment and Infrastructure Challenges

Nigerian healthcare facilities struggle with inadequate equipment availability, aging infrastructure, and frequent machine breakdowns. Assessments frequently reveal that less than half of the evaluated centers have operational radiotherapy machines. When equipment breaks down, hospitals experience prolonged downtime tied to a reliance on foreign Original Equipment Manufacturers (OEMs) (IAEA, 2014). Power supply instability further compounds these hardware challenges, damaging sensitive medical equipment and interrupting clinical operations.

5.3 Funding Constraints and Economic Instability

Inadequate funding is the root cause of many challenges within Nigeria's medical physics sector. The exorbitant cost of acquiring and maintaining radiological equipment is heavily exacerbated by currency devaluation and fluctuating exchange rates. Consequently, public hospitals struggle to replace obsolete equipment or upgrade existing facilities. Limited funding also stunts workforce development, as institutions cannot afford to sponsor staff for international certification or specialized clinical training.

5.4 Lack of Professional Recognition and Regulatory Framework

Unlike other established medical professions in Nigeria, medical physics suffers from a lack of strict statutory regulation. There is currently no parliamentary-backed regulatory board dedicated solely to the registration and licensing of medical physicists. This absence creates operational challenges, makes it difficult to standardize clinical training, causes stagnant career progression, and allows for the potential infiltration of underqualified personnel handling sensitive radiation duties.

6. STRATEGIC PATHWAYS FOR GROWTH: TRAINING, POLICY REFORMS, AND FUTURE PROSPECTS

6.1 Enhancing Training Opportunities and Clinical Capacity

To address the clinical training gap, there is a need to establish government-supported clinical residency programs that provide practical experience across radiation oncology, diagnostic radiology, nuclear medicine, and radiation protection. Strengthening collaboration with international organizations such as the IAEA will facilitate the adoption of globally recognized training frameworks.

6.2 Strengthening Government Policies and Regulatory Frameworks

The passage of the Medical Physics Bill by the National Assembly is paramount. It would provide a legal foundation for professional practice and protect the profession from unqualified practitioners. In addition, fiscal incentives such as tax exemptions on the importation of specialized medical physics equipment, dosimetry systems, and quality assurance instruments would drastically reduce operational costs for healthcare institutions.

6.3 Future Prospects and Promotion of the Profession

The future of medical physics in Nigeria is promising, provided awareness of the profession is actively cultivated. Professional organizations like NAMP must intensify advocacy efforts targeting undergraduate physics students. Furthermore, Public-Private Partnerships (PPPs)—such as the NSIA-LUTH collaboration—represent a highly viable blueprint for advancing medical physics services, ensuring sustainable funding, and supporting equipment maintenance across other regions of the country.

7. SUMMARY AND CONCLUSION

Medical physics remains an indispensable pillar of modern healthcare, fundamental to the safe and effective application of radiation in medicine. In Nigeria, the profession has made commendable strides since the establishment of early radiotherapy centers in the late 1960s and the subsequent formation of national regulatory bodies. However, its growth is severely stifled by an acute workforce shortage, persistent infrastructural decay, inadequate healthcare financing, and the absence of a formalized legislative regulatory council.

To secure the future of the profession, urgent interventions are required. The prompt passage of the Medical Physics Bill is essential to standardize clinical practice and provide legal backing for practitioners. Furthermore, transitioning from purely academic education to structured, funded clinical residency programs will bridge the competency gap and reduce the ongoing brain drain. By embracing innovative financing models like Public-Private Partnerships and heavily investing in capacity building, Nigeria can build a robust medical physics workforce equipped to meet the nation's growing demands for advanced diagnostic imaging and cancer care.

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