

Assessment of Knowledge, Attitude and Utilization of Nuclear Medicine Imaging among Clinical and Radiation Oncologists in Nigeria

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Submitted: 1 August 2022. Published: 12 January 2023

ABSTRACT

Background: Optimal decision making regarding the diagnosis, initial staging, restaging, treatment response monitoring, detection of recurrence or metastasis and adequate post treatment follow up and monitoring of patients with cancer requires appropriate knowledge of imaging modalities and proper utilization among Clinical and radiation oncologists. The aim of this study was to assess the knowledge, attitudes, and reported practices regarding the utilization of nuclear medicine imaging among clinical and radiation oncologists in Nigeria. **Method:** Self-administered survey of physicians in radiation oncology in Nigeria on knowledge, attitudes, and their practices regarding the utilisation of Nuclear Medicine (NM) imaging was conducted between June and October 2018. In consultation with Nuclear medicine experts, 20 questions were developed, including 10, 7 and 3 questions for each of the following domains: knowledge, attitudes, and practices respectively. For each domain, we created a score equal to the number of questions correctly answered out of the number of questions available. **Results:** Fifty-two oncologists participated in the study. Age range of participants was between 26 and 68 years. The survey response rate was 51.4% in a sample of 101 radiation oncologists from the database. Thirty-nine percent of respondents were consultants and 61% were residents. Approximately 46.2% of the participants had 5 to 10 years working experience. All of the respondents were involved in the diagnosis and treatment of cancer. On the average, 83.1% of participants had adequate cumulative knowledge of nuclear medicine imaging applications in oncology practice, 90.4% had a positive attitude to the use of NM imaging and the referral of patients for NM imaging was poor with those with more years of experience more likely to refer. However, there was no significant difference of NM practice with age of participants. Most important factors responsible for poor utilization include the shortage of functional NM imaging centres and poor accessibility of existing ones. Potential facilitators may include providing adequate NM facilities, and improving access to the usage. **Conclusion:** Our study shows that clinicians involved in the treatment of patients with cancer in Nigeria have good knowledge and attitude towards the use of nuclear medicine imaging and its application. However, availability and accessibility drive the utilisation.

Keywords: Clinical and Radiation Oncologist, Nuclear Medicine, Knowledge, Attitude, Utilisation.

Access to the article



Website: www.jmbsr.com.ng
eISSN: 2971-7833
pISSN: 2971-7108



How to cite this article

O T Ahmadu, S S Umar, L A Kbai, D J Jimeta, H E Theyra. Assessment of Knowledge, Attitude and Utilization of Nuclear Medicine Imaging among Clinical and Radiation Oncologists in Nigeria. *J Med & Bas Sci Res.* 2023;4(1-2):43-50. DOI: 10.5281/zenodo.7655160

INTRODUCTION

There has been tremendous worldwide progress in nuclear medicine (NM) applications in recent years with particularly noticeable impact in the field of oncology. (1,2) Over the last three decades Africa has shown consistent development of NM with South Africa and North African countries having closer development profiles to the developed world when compared to many other countries in the continent that have remained rather limited to the expansion of basic clinical services provided by studies with ^{99m}Tc and treatment with Iodine 131. (2) The International Atomic Energy Agency (IAEA) has supported the growth and development of NM in the African continent through existing technical cooperation. (24) Nuclear medicine imaging provides information at both the molecular and the cellular level for guiding tissue sampling, appropriate baseline staging, evaluating disease progression, supporting treatment planning, and assessing treatment responses.(5)

Advanced research into molecular imaging has led to the development of radiopharmaceuticals that can explore the cellular metabolism, equipment development has produced high-technology instruments such as those used in positron emission tomography (PET), able to produce high-quality images that have become indispensable in the diagnostic work-up of cancer patients, because they often reveal alterations and lesions not demonstrated by conventional morphologically oriented techniques while research in the area of image fusion techniques has led to the design of software programs able to merge in a single image the molecular, functional, and metabolic information of nuclear medicine with the morphological information provided by radiology. (6,7) All of these achievements have great impact on not only the diagnosis but also the treatment of cancer with great improvement in the concept of individually tailored therapy ('personalized medicine') ensuring the practise of personalized medicine, which has led to fewer

patients undergoing invasive and costly tests and sometimes unnecessary treatments and providing physicians with critical patient information on which important medical decisions are based.(5,6) The practice of nuclear medicine (NM) in Nigeria has experienced a slow growth in the last 2 decades. Nigeria acquired its first single-head gamma camera in April 2006 through the assistance of the International Atomic Energy Agency, this camera was installed to complement the in vitro laboratory at the University College Hospital, Ibadan. (8,9) Until the year 2020, only government owned NM centres existed and they are located in two major cities of the country (Abuja, the capital of the country and Ibadan a city in the South West of the country).(9) Fourteen years after the first gamma camera in Nigeria, there are four functional NM centres (2 public and 2 private owned), with three gamma (γ) cameras and one Positron Emission Tomography/Computed Tomography PET/CT.(9) This translates to an average of 70 million inhabitants per gamma camera and 200 million to one PET/CT machine, This is grossly inadequate for a country with rising incidence of cancer.(10)

At the time of this survey in 2018, only two gamma cameras were available in the public sector of the country's health care system with no private owned nuclear medicine machine. The country has no capability of assembling ^{99}Mo - ^{99m}Tc generators or producing ^{99m}Tc from nuclear reactors nor the production of radioisotopes from cyclotrons. Therefore, generators, cold kits and therapeutic agents are imported from outside the country.(11) Most countries in Africa are reliant on a single generator supplier and there is great deficit in the supply of ^{99m}Tc generators with Africa ranking as the most limited in the world. (5) This invariably affects the constant supply of radio isotopes and optimal uptime for nuclear medicine studies in the country. The availability of trained man power for nuclear physicians, radiographers, radio-pharmacists and medical physicists is also grossly inadequate.(2)

Some of the most important factors driving the application of NM worldwide are its availability, affordability and the clinician's awareness of the importance and role of NM in the management of diseases.(2,8)

The role of nuclear medicine in disease management is becoming more salient with the rising impact of non-communicable diseases, especially cardiovascular disease and cancer, which are now leading causes of mortality^(3,1216)

It is upon the above background that this study aims to assess radiation oncologists' knowledge, attitude and practice of utilisation of nuclear medicine imaging in their clinical practice.

METHODS

This was a cross-sectional prospective survey conducted between June to October 2018. The survey examined the knowledge, attitudes, and the utilization of nuclear medicine investigations amongst Radiation and clinical oncologists at different levels involved in the management of cancer. Self-administered questionnaires were issued to members of the association present at regional clinical meetings or at place of work.

The target population, The Association of Radiation and Clinical Oncologists of Nigeria (ARCON) database was used to capture the population of radiation oncologists in Nigeria. The ARCON database has approximately 100 radiation oncologists spread across 10 states in Nigeria, this helps to reflect a nationwide involvement.

Those eligible for the study ranged from doctors in training, registrars who have spent at least 1 complete year in training and consultants of varying years of clinical experience. Radiation and Clinical oncologists who were not practicing in Nigeria at the time of the survey were excluded from the study.

The Survey tool was a detailed questionnaire containing both coded and open-ended questions about knowledge, attitudes and practices on NM

scans, availability, indications, appropriate use and issues relating to access was sent to all participants. A self-administered questionnaire that consisted of four main domains and required approximately 10-15 minutes to complete. The first section included data on demographic characteristics such as the participant's name, institutional affiliation and location, cadre, number of years in practice. Questions for each of the three other domains: knowledge, attitudes, and utilization practices were evaluated.

Knowledge about nuclear medicine was evaluated by eliciting if a respondent knew the following; The various NM modalities available, the full meaning of acronyms of the two machines used, availability of NM services in Nigeria, indications for its use in oncology, sensitivity/specificity, advantages over conventional imaging (early detection, time benefit, radiation exposure). Knowledge was scored equal to the number of questions correctly answered out of 10. Knowledge was considered to be adequate if participants knew at least half of the above mentioned.

Attitude was evaluated by considering how often nuclear medicine imaging is considered during management of patients, the basis for decision to use NM applications, its preference over conventional imaging when readily available and accessible, willingness to use the services when not available in hospital or practice. The attitude was scored as positive or negative using the attitude scoring system.

Practice was evaluated by how often patients are sent for NM investigations, the commonly requested imaging scan, factors that influence the use of the services, at what stage of management they are considered for these investigations (pretreatment, staging, restaging after treatment, monitoring response, recurrence, metastasis).

The information was obtained, and data were compiled and was processed using the IBM SPSS Statistics version 23.00 for windows.

RESULTS

The survey response rate was 51.4% in a sample of 101 radiation and clinical oncologists from the database. About Sixty-one percent of respondents were consultants and 39% were consultants. The age range of participants was between 26 and 68 years with modal age group 31 to 40 years accounting for 27 (51.9%). There were 27 (51.9%) female participants, 20 (38.5%) specialists, and about half 24 (46.2%) of the participants had 5 to 10 years working experience (Table 1).

Table 1. Socio-demographic characteristics of study participants

Variable	n (%)
Age (years)	
< 30	3 (5.8)
31- 40	27 (51.9)
41- 50	18 (34.6)
51 and above	4 (7.7)
Gender	
Male	25 (48.1)
Female	27 (51.9)
Rank	
Registrar	15 (28.8)
Senior Registrar	17 (32.7)
Consultants	20 (38.5)
Duration of practice of radiation oncology (years)	
< 5	18 (34.6)
5- 10	24 (46.2)
>10	10 (19.2)

Knowledge.

Table 2 show knowledge of participants about nuclear medicine. Most participants, 47(90.4%), knew the NM modalities available for use in oncology, while 28(53.8%) knew the full meaning of the acronyms for PET and SPECT and 49(94.2%) knew all the mentioned indications for use of NM in oncology. Forty-one (78.8%) participants were aware of the time benefit of NM applications over conventional imaging, while 28(53.8%) knew that NM applications could detect tumours as early as 6-12 months before conventional imaging. Forty-six (88.5%) participants were aware of the degree of sensitivity and specificity of the NM applications while 40(76.9%) knew that radiation exposure was less when compared to conventional imaging. However, 36(69.2%) were aware of the two facilities where NM are available in Nigeria. On the average, 83.1% of participants had adequate

cumulative knowledge of nuclear medicine imaging applications in oncology practise (Table 2).

Table 2- knowledge about nuclear medicine

Indices on knowledge about nuclear medicine	Participants with good knowledge n (%)
The commonly used NM modalities	47 (90.4)
Meaning of acronyms (SPECT, PET)	39 (75.0)
Indications for NM use in oncology.	49 (94.2)
Availability of NM services in Nigeria	48 (92.3)
Availability of NM services in Nigeria	36 (69.3)
Sensitivity/specificity compared to conventional imaging.	46 (88.5)
Detection time benefit over conventional imaging	41 (78.8)
Radiation exposure compared to conventional imaging	40 (76.9)
Participants with good cumulative knowledge score	43 (83.1)

There was no significant difference in any of the domain of knowledge assessed across age, rank or years of practice. Though specialists demonstrated better tendencies in knowledge, these were not significant.

Attitude

Seventeen (32.7%) participants would consider sending their patients for NM procedures occasionally, while 23(42.3%) would consider doing so frequently, and 10(19.2%) would consider always doing so while only 3 (5.8%) will never consider it.

There was no significant association with participants' age ($F= 9.13$, $p=0.368$), rank ($F= 12.09$, $p=0.133$) and years of practice ($F= 14.69$, $p=0.51$); using Fishers' Exact test (Table 3).

Most of the participants 48 (92.3%) will consider sending their patients for NM imaging. Of this, 7 (13.5%) will only do so if the NM imaging facility is within the city/state where they practice, while 34 (65.4%) were willing to do so only if available anywhere in the country. Only 11(21.2%) of participants would consider sending their patients abroad if NM imaging isn't available within the country.

The decision to send patients for NM procedures was guided by patients' needs for the services in 19(36.5%), sensitivity/specificity in relation to conventional imaging, in 17(32.7%), availability of the services in 11(21.2%) and patients'

preferences in 1(1.9%) of respondents.

Overall, 47(90.4%) had a positive attitude to the use of NM procedures.

Table 4- Practice of nuclear medicine by participants

Socio-demographic characteristics	How often do you send your patients for NM imaging? n (%)				Fisher's exact test	p
	Always	Frequently	Occasionally	Never		
Age (years)						
= 30	0 (0)	0 (0)	1 (1.9)	2 (3.8)	15.40	0.098
31- 40	0 (0)	11 (21.2)	10 (19.2)	6 (11.5)		
41- 50	2 (3.8)	6 (11.5)	9 (17.3)	1 (1.9)		
=51	1(1.9)	3 (5.8)	0 (0)	0 (0)		
Rank						
Registrar	1 (1.9)	4 (7.7)	2 (3.8)	8 (15.4)	21.38	0.009
Senior Registrar	0 (0)	6 (11.5)	8 (15.4)	3 (5.8)		
Consultant	3 (5.8)	9 (17.3)	8 (15.4)	0 (0)		
Duration of practice (years)						
= 5	0 (0)	4 (7.7)	5 (9.6)	9 (17.3)	23.16	0.005
5- 10	0 (0)	12 (23.1)	11 (21.2)	1(1.9)		
>10	2 (3.8)	5 (9.6)	2 (3.8)	1 (1.9)		

The referral of patients for NM procedures was poor. Only Three 3(5.8%) participants would always refer patients for Nuclear Medicine procedures when indicated (Table 4), although 20(38.5%) will do so frequently, still constitutes less than half of the total participants.

Those with more years of practice of radiation oncology ($F= 23.16, p=0.005$) and consultants ($F= 21.38, p=0.009$) were significantly more likely to send patients for nuclear medicine procedures. However, there was no significant difference of NM practice with age of participants ($F= 15.40, p=0.098$). (Table 4)

Majority 39(75%) of the participants will refer for all indications during treatment from initial staging, restaging, follow up for recurrence, evaluation of metastasis depending on patient's need. While 6(11.5%) will utilise for only the evaluation of metastasis, 3(5.8%) for only restaging after therapy, 2(3.8%) for monitoring recurrence and initial staging.

The most likely NM to be requested by the participants was the Technetium-99m (^{99m}Tc)-labelled diphosphonate bone scan (88%), thyroid scan (7%), multi-gated acquisition scan MUGA (3%) and others (1%).

Table 3- Attitude of participants towards nuclear medicine

Socio- demographic characteristics	How often do you consider using NM services? n (%)				Fisher's exact test	p
	Always	Frequently	Occasionally	Never		
Age (years)						
= 30	0 (0)	2 (3.8)	0 (0)	1 (1.9)	9.13	0.368
31- 40	5 (9.6)	9 (17.3)	12 (23.1)	1 (1.9)		
41- 50	4 (7.7)	8 (15.4)	5 (9.6)	1 (1.9)		
=51	1(1.9)	3 (5.8)	0 (0)	0 (0)		
Rank						
Registrar	3 (5.8)	4 (7.7)	5 (9.6)	3 (5.8)	12.09	0.133
Senior Registrar	2 (3.8)	8 (15.4)	6 (11.5)	1 (1.9)		
Consultant	5 (9.6)	9 (17.3)	6 (11.3)	0 (0)		
Duration of practice (years)						
= 5	2 (3.8)	4 (7.7)	8 (15.4)	4 (7.7)	14.69	0.51
5- 10	4 (7.7)	12 (23.1)	8 (15.4)	0 (0)		
= 11	3 (5.8)	5 (9.6)	1 (1.9)	1 (1.9)		

DISCUSSION

The study was a national survey conducted amongst radiation oncologists practicing in Nigeria. Despite this, only 101 potential participants were identified for the survey, out of which 52 participated in the study. This finding is a reflection of the very few numbers of radiation oncologist specialists and those in training in the country.(17,18)

The Association of Clinical and Radiation Oncologists in Nigeria (ARCON), which is the National body of practicing clinical oncologist in the country, estimated that there are about a hundred clinical oncologists in Nigeria (specialists and in doctors in training) as at 2018.(19)

Overall, the study participants had very good knowledge of NM and its applications. There were no significant differences in knowledge across age, gender, rank and years of experience. This study found a higher level of knowledge than a previous study among consultants, resident doctors and medical students at the inception of nuclear medicine practice in the first centre in Nigeria.(8) This may imply that there is adequate exposure and training received by radiation oncologists on nuclear medicine and its applications despite its poor availability for use.

Also, the knowledge level was found to be higher than a similar Iranian study on nuclear medicine staffs, which also found that knowledge varied significantly with gender (males > females) and years of practice.(20) This was contrary to findings in this study where, despite its poor availability in the country, there was an overall adequacy in the knowledge with no significant difference across gender or years of practice.

In a similar manner, there was a positive attitude to NM procedures application amongst overwhelming majority of participants in this study, which was also higher than that of the Iranian

study.(20) However, this study found no significant difference in attitude across age, gender, rank and years of practice, just like the Iranian study. which was guided mainly by the availability of the facilities close to the participants and patients' needs.(20)

The possible explanation for very high level of knowledge and attitude towards nuclear medicine application in this study is that participants were strictly doctors who were receiving/ had received some sort of formal training on nuclear medicine, unlike other studies amongst doctors from all specialties(8) who may have had no formal training or non-doctors.(20)

Despite very good knowledge and attitude, the actual referral of patients for nuclear medicine procedures was poor. Interestingly, the decision to refer patients was significantly left for consultants and those with more than 10 years practice experience. This implies that ordering NM imaging for patients was not a routine, it is requested by those with more clinical experience and expertise in oncology practice to make critical decisions. The referral pattern of participants was determined by availability of the services, as most participants would request for the NM imaging only when it is available in the country at the time of request.

Over 90% of requested scans were Technetium-99m (99mTc)-labelled diphosphonates bone scan and this also reflects the available options as at the time of the study, this further buttress the many challenges of nuclear medicine practice in Nigeria and corresponds with a study which showed 88% of scans performed for oncologic indications were bone scans.(9) The low utility of NM scans could be partly explained by the shortage of NM centres and poor accessibility of services as 92% of the participants are willing to consider sending their patients for NM imaging. Distance from the available centres did not affect the utilisation by oncologists as over 85% of participants will still refer patients regardless of the distance from the

NM imaging facility (65.4% were willing to do so if available anywhere in the country and 21.2% of participants would consider sending their patients abroad to access NM imaging such services). Thirteen (13%) will only request for NM when it is within the location of practise. Many of the studies have highlighted the challenges of nuclear practice in low and middle income countries and the index study has shown similar pattern.(2,5,9,21)

CONCLUSION

This study found acceptable level of knowledge and attitude towards Nuclear medicine applications amongst radiation oncologists in Nigeria. The poor utilisation was mainly due to non-availability and poor access. It is therefore expected that with increase in government and private investment in technology ensuring fair distribution of nuclear medicine centres across the geographical regions of the country there would be an increase in the appropriate use of nuclear medicine services by radiation oncologists in the country.

Conflict of Interest

The authors declare no conflict of interest in carrying out this study.

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