ORIGINAL ARTICLE

RADIATION PROTECTION: AN INITIAL ASSESSMENT OF LEVEL OF KNOWLEDGE AND COMPLIANCE AMONGST RADIATION WORKERS IN AHMADU BELLO UNIVERSITY TEACHING HOSPITAL ZARIA, NIGERIA

Lawal S, Ibrahim MZ, Igashi JB, Muhammad HM, Bello N

Departments of Radiology, Ahmadu Bello University
Ahmadu Bello University Teaching Hospital Zaria, Nigeria.

Correspondences and Reprint to: Suleiman Lawal, Radiology Department
Ahmadu Bello University Teaching Hospital Zaria, Nigeria;
Email: talksuleiman@yahoo.com Telephone number: +2348065900241

ABSTRACT

Background: Medical use of ionizing radiation can result to deleterious effects such as undesirable somatic and genetic modifications, although less radiation dose is involved in diagnostic radiology. This necessitates the need for radiation safety practices, to bring to the barest minimum possibility of these risks. This study was aimed at assessing the knowledge and radiation safety practices amongst radiation workers in Ahmadu Bello University Teaching Hospital(ABUTH) Zaria, Nigeria. Method: The study was conducted amongst radiologist, radiology resident doctors, radiographers, nurses, and technicians, with the use of questionnaire for assessment of knowledge, attitude and covert monitoring of personnel for assessment of implementation. Data was analyzed with Statistical Package for Social Sciences (SPSS) for Windows® version 20. Results: Assessment of knowledge was quite impressive with average score 91% and 78% for the radiologists / residents and the radiographers respectively, while the group of "Others" (i.e. nurses and technician) was abysmal with a score 42%. Radiation protection gadgets were either lacking or obsolete. Application of shielding devices such as gonad shield for protection and thermoluminiscent devices (TLDs) were neglected by about 56% of the personnel. The x-ray imaging machines were quite old with no quality assurance tests performed for quite some time. Conclusion: Excellent knowledge of radiation protection was exhibited by the majority of radiation workers in ABUTH, though from self-efforts. However, compliance with the standard radiation protection guidelines is appalling. The need for improved and sustained efforts by both the management and the personnel in radiation protection can never be over emphasized in order to avoid deleterious effects of radiation on both the personnel and patients.

Keywords: Radiation protection, Compliance, X-ray, Radiation personnel / worker

INTRODUCTION

Radiation protection involves all those activities aimed at protecting man and his environment from the deleterious effects of ionizing radiation. In medical practice, it is all those processes followed to ensure minimal but optimal radiation exposure to both the patient and the radiation worker duringa radiological procedure.[1]The ultimate aim of radiation protection is to protect the human race against the potential risks of ionizing radiation.[2]Despite the fact that less radiation dose is involved in diagnostic radiology, medical diagnostic use of ionizing radiation can result to deleterious effects such as undesirable somatic and genetic modifications. This necessitates the need for radiation safety practices, to bring to the barest minimum possible, these risks.[3]

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Diagnostic imaging encompasses conventional x-ray imaging, fluoroscopy, mammography, ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), and nuclear medicines (NM). These are essential diagnostic

tools of medicine. Regarding radiation protection we are concerned with all the above modalities except MRI and ultrasound which do not use ionizing radiation. In the hospital settings the radiation workers have an increased risk for radiation exposure than the general hospital population.[4]

Radiation protection is based upon the basic principles of justification (for the investigation / procedure), optimization (of technique), and limitation (of radiation dose). These principles are such that:

1. On no occasion should an individual be exposures to ionizing radiation except where a maximum benefit is assured and the possible risk is outweighed (justification).
2. Radiation doses from diagnostic exposures should be kept as low as reasonably achievable just sufficient to achieve the needed diagnoses (optimization), and
3. Reducing the patients' exposure time to ionizing radiation (limitation). These are means of achieving radiation protection, and hence inculcate the use of tissue compressors, immobilizes, positioning aids, collimators, so also are the make and state of the machines of utmost importance in radiation protection.[5] Availability of installed radiation protection instruments, namely area survey meters and personnel dosimeters for staffs and periodic quality assurance checks on the x-ray machine are also essential part of radiation protection measures.

Majority of the hospital-basedstudies on the level of radiation safety awareness and compliance amongst radiation workers in Nigeria were carried out in Southern parts of Nigeria.[3,6]To the best of my knowledge, only few of such studies have been carried out in Northern Nigeria.[7]This study was, therefore, carried out to determine radiation workers awareness and compliance about radiation safety in Ahmadu Bello University Teaching Hospital Zaria Nigeria and also to assess the work place safety gadgets.

MATERIALS AND METHODS

This descriptive, cross-sectional study was conducted in Ahmadu Bello University Teaching Hospital (ABUTH) Zaria in North-western Nigeria. ABUTH is the largest tertiary hospital in region and second largest in Nigeria after University College Hospital Ibadan. A total of 41 respondents which comprises of 19 Doctors (4 Radiologists and 15 resident doctors),16 Radiographers (including interns) and others (namely technicians (4) and nurses (2)) were involved in the study.

The questionnaire focused on six major research questions. focused on the following issues:

1. Radio biology;
2. Relative radiation dose of various imaging modalities;
3. Use of individual TLD badges by workers;
4. Participation in annual training courses;
5. Utilization of lead shields for patients and use of mechanical support for immobilizing patients during radiographic procedures, if necessary; and
6. Adherence to the ten-day rule in radio biology.

A covert monitoring of personnel for assessment of implementation was conducted. Three conventional radiography rooms were involved in the study.

A checklist was completed with respect to the availability of the following devices in each radiography room: 1) Lead glass windows, 2) Lead aprons, 3) Lead goggles, 4) Lead gloves, 5) Gonad shields, 6) Thyroid shields, 7) Patient immobilization devices, 8) Radiation area flashing signs / lights, 9) Illuminated signs indicating "no entry", 10) Safety written policy, 11) Safe lead doors / walls, 12)Personnel monitoring records,13) Environmental monitoring records.

Responses to questionnaires from participants were analyzed and data analysis was done using SPSS version 20 (SPSS, Chi, Ill, USA).

RESULTS

A total of 41 respondents aged between 22 – 57yearsparticipated in the study. The respondents were 19 Doctors(4 Radiologists and 15 Resident doctors), 16 Radiographers, 2 Nurses and 4Technicians.There were 34 males and 7 females in the study (table 1). The youngest professional group was found amongst the radiographers with a mean age of 32.4 years; the oldest group was noted in the "Others"with mean age of 54.3years while the group consisting of Radiologists and Resident doctors had a mean age of 38.8years. Sixty-one percent (61%) of the respondents are aged between 30-40 years while 85% were aged less than 40years.About 75% of the respondents were 10years or less as radiation personnel / workers.

The result for knowledge of radiation safety revealed the doctors scoring 91%, the Radiographers 78% and Others scoring 42%.While that on attitude showed the Doctors scoring 95%, Radiographers 83% and Others 76%.However, the recorded scores on practice were 16%, 62% and 83% for the Doctors, Radiographers and Others respectively, as depicted in figure1. However, the scores for practice were based on covert monitoring of wearing of TLDs in the department. In the appropriate section for radiation safety practice in the questionnaire only three respondents (about 7.3%) responded negatively to appropriate and regular use of TLDs. Assessment checklist of the radiation protection devices and gadgets within the three radiography rooms in the department were subjected to a checklist of radiation protection devices and gadgets as depicted in table 2.

Table 1: Distribution of Respondents by Profession and Sex.

Profess		Doctors		Radiographers		Others	
		Radiol	Resid	Radiog	Intern	Nur	Technici
Sex	M	4	12	4	9	1	4
	F	0	3	0	3	1	0
Total		19		16		6	

Figure 1: Bar chart showing the Knowledge, Attitude and Practice amongst Radiation Workers in ABUTH.

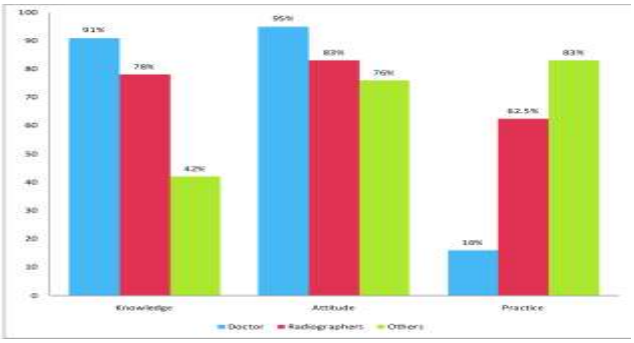

Table 2: Assessment of work place safety requirement in Radiology Department ABUTH.

Parameters	Room	Room	Room
Personal monitoring records	No	No	No
Environmental monitoring	No	No	No
Lead lined walls & doors	Yes	Yes	Yes
Lead glass windows	Yes	No	No
Lead aprons	Yes	Yes	Yes
Gonadal shields	Yes	No	No
Written safety policy	No	No	No
Radiation warning signs	Yes	Yes	Yes
Caution lights	Yes	No	No
Thyroid shields	Yes	No	No
Lead gloves	Yes	No	No
Lead goggles	Yes	No	No
Patient immobilization devices	Yes	Yes	Yes

DISCUSSION

The increasing use of ionizing radiation technologies in medical practice exposes radiation workers to increased radiation related hazards; hence knowledge of radiation safety can never be over emphasized.[8] Radiation protection is based upon the basic principles of justification, optimization and limitation. Such that on no occasion should an individual be exposures to ionizing radiation except where the maximum benefit is assured and the possible risk is outweighed. Radiation doses from diagnostic exposures should be kept as low as reasonably achievable, just sufficient to achieve the needed diagnosis and reducing the patients' exposure time to ionizing radiation.[9,10]

This study was aimed at assessing the radiation workers in knowledge, attitude and practice of

radiation safety in ABUTH Zaria. The results showed an impressive performance with regards to knowledge especially amongst the doctors and radiographers. The least impressive performance was observed in the 'Others' group which comprises of mainly of technicians and nurses. This observation was due to the facts that the earlier two groups are populated with resident doctors who are in a rigorous training to become specialists and are actively in search of knowledge, and the intern radiographer who just graduated and the knowledge was still fresh. However, on the other hand the technicians and nurses were amongst the oldest staff in the department, who after their qualifying certificate course several years ago, have not had any formal training on radiation safety hence rusty of knowledge. Evaluation of attitude also follow a similar trend as the knowledge, however, there was improvement to a satisfactory level on the attitude of radiation safety amongst the 'Others' when compared to the knowledge of the same group. This indicated an impressive attitude to work in radiation environment, and this finding was similar to the findings of Adejumo *et al* in their study amongst radiographers in Southwestern Nigeria.[3] Although the group in which belonged the nurses showed a satisfactory result in its attitude to radiation protection, it was the least of the three groups. Similar studies on nurses working in cardiac catheterization laboratories[11] and mobile diagnostic radiology[12] showed an abysmal result as they downplay the potential health hazards of radiation exposure and hence careless about safety measures. Failure of the human senses to perceive radiation energy in the diagnostic range and the fact that majority of the deleterious effects of radiation more often than not, arise after protracted exposure, some workers indeed find it difficult to relate them to the exposure.[7,8] These are the major source of the false impression about radiation.[7,8,13] All these culminate into undue ignorance, failure to adhere to radiation protection principles and concerns or fear of radiation, with a consequent negative influences on the quality of health of both the radiation workers and their patients.[8] Although in-service training was almost non-existent amongst the respondent which was responsible for the low level of knowledge and attitude amongst the group of "others" in this study, but on contrary the group of doctors which comprises of mainly resident doctors and the young graduate interns were more than satisfactory. This finding depicted the importance of continuous professional development on radiation protection for the staff. This assertion also corroborated Alavi *et al* findings on medical radiation workers.[8] The most important aspect in medical radiation is the adherence to radiation protection principles and this cannot be achieved except after acquiring adequate knowledge of the mechanisms and provisions of radiation safety. Therefore, constant tutoring for medical radiation workers to improve their knowledge and capacities of radiation safety issues, and also aptly manage radiation exposure can never be over emphasized.[8,14]

We also observed that the number of years of practice did not show any significant influence on the level of knowledge and attitude of safety standard, but in fact a negative correlation was established in the group of "Others" who incidentally form the oldest group both in age and practice as radiation workers. This result was possible, as the last entrant as radiation worker amongst the doctors were over two years in training while the fresh graduate intern radiographers who were just about one year in the department have had this training in their undergraduate years. This finding was inconsistent with those of previous studies by Alavi *et al* and Ayoob *et al* which showed a positive correlation,[8,15] However the findings of Adejumo *et al*.[3] in their assessment of radiographers were similar.

The radiographers, *radiologists and resident doctors* who are graduates and postgraduates respectively in the radiology field had better knowledge than other radiation workers who were co-opted from other fields of medicine i.e. nurses and those with lower qualification i.e. the technicians. The study conducted by Alavi *et al*. showed that other medical professionals who are in contact with radiation in the course of their work performed poorly compared to their counterparts who are primarily radiation workers in terms of radiation protection knowledge.[8] We also noted that the more the educational status of the respondents, the better their score in knowledge and attitude about radiation safety. Conversely negative relationship

was, however, noted between practice (wearing of TLD) and levels of education in this study, some other studies also observed a similar trend.[8] Although all the respondents believed in the use of personnel radiation monitors in this case the TLD and its importance, however, on verification only 44% had their TLDs on and were mainly the radiographers and the technicians, the doctors were the worse culprit as only three had their TLDs on them at the time of inspection. Though six of the resident doctors complained that their TLDs have not been return after the last collection for reading about a year now, another set of five revealed that the results of the irregular periodic readings has never been made known to them hence their loss of interest, while a third group of three, were of the opinion that since the breakdown of the fluoroscopy machine they had no direct contact with x-rays hence there was no need to always wear the TLD and the last group had no specific reason for not wearing their TLDs. Radiation regulatory bodies like the Nigerian Nuclear Regulatory Authority (NNRA) and The International Commission on Radiological Protection (ICRP) require that all radiation workers use personnel dosimeter at all times when in radiation areas[9,10] therefore, the various reasons given for not wearing TLDs were unacceptable.

The department has one inactive radiation safety officer; as such no active radiation safety program was in place. The assessment of the three radiography rooms revealed that they all have radiation protective devices such as lead lined walls and doors, lead windows, lead aprons and some mainly improvised immobilizes. However, only one of the rooms had an inbuilt but non functioning caution light, a stiff non flexible lead glove, a clouded lead goggle, thyroid and gonadal shields, while none had environmental

A similar situation was also observed by Ayoob *et al*in their assessments of level of protection in some radiology departments, which is quite hazardous to the radiation worker in his line of duty especially during fluoro scopic examinations.[15]

In a study by Adejumo *et al*[3] in Southwestern Nigeria they reported an impressive institutional provision of radiation protection gadget in private centers while this practice was absent in the government hospitals like our index institution. Several other studies have also reported deficiencies in radiation protection gadgets in radiology departments.[16,17]

These studies considered this bad radiation protection habits to be secondary to the carelessness and negligence of hospital stakeholders to heed to radiation protection principles.[16,17]

CONCLUSION

It's obvious that neither the authorities nor the workers pay enough attention to principles of radiation safety. Although the majority of the respondents had self-training, the lack of in-service training for radiation workers was a probable reason for the lack of knowledge and attitude amongst the other participants. Further aggravated by poor supervision of radiation safety activities by the relevant regulatory agencies and non availability of performance feedback from supervisors is the bane of the poor compliance especially by both the radiologists and resident doctors despite adequate knowledge.

REFERENCE

1.Afaf M T E.Radiation Safety Awareness and Practice in Sudanese Medical Facilities: A Descriptive.Int J of Science and Research 2013: 4(5): 2190-2195.

2. Eze CU, Abonyi LC, Njoku J, Irurhe NK, Olowu O. Assessment of Radiation Protection Practices among Radiographers in Lagos, Nigeria. Niger Med J 2013;54(6):386-91.

*3. AdejumoSB, IrurheNK, OlowoyeyeOA, IbitoyeAZ, EzeCU, Omiyi OD.*Evaluation of Compliance to Radiation Safety Standard Amongst Radiographers in Radiodiagnostic Centres in South West, Nigeria. *World J Med Sci 2012; 7 (3): 194-196.*

*4.*Briggs-Kamara MA, Okoye PC, Omubo-Pepple VB. Radiation Safety Awareness among Patients and Radiographers in Three Hospitals in Port Harcourt. Am J Sci Ind Res 2013; 4:83-88.

5. Fatahi-Asl J, Tahmasebi M, Karami V. The Protection Knowledge and Performance of Radiographers in Some Hospitals of Ahvaz County. Jentashapir J Health Res 2013;4 (5):405-412.

6.Eze K, Nzotta C, Marchie T, Okegbunam B, Eze T. The State of Occupational Radiation Protection and Monitoring in Public and Private X-ray Facilities in Edo State, Nigeria. Niger J Clin Pract 2011;14(3):308-310.

7. Awosan KJ, Ibrahim M, Saidu SA, Ma'aji SM, Danfulani M, Yunusa EU, Ikhuenbor DB, Ige TA.Knowledge of Radiation Hazards. Radiation Proctection Practices and Clinical Profile of Health Workers in a Teaching Hospital in Northern Nigeria. Journ of Clin and Diagn Res. 2016 Aug;10 (8):07-12.

8. Alavi SS, Dabbagh ST, Abbasi M, Mehrdad R. Medical Radiation Workers Knowledge, Attitude, and Practice to Protect Themselves Against Ionizing Radiation in Tehran Province, Iran J Edu Health Promot 2017;6:58.

9. Nigerian Nuclear Regulatory Authority (NNRA), 2003. Nigerian Basic Ionizing Radiation Regulations, TheFederal Government Press, Lagos Nigeria.

10. International Commission on Radiological Protection, 1996. Protection and Safety in Medicine, Publication 73, Pergamon Press, Oxford.

11. Flôr R, Gelbcke F. Radiation Protection and the Attitude of Nursing Staff in a Cardiac Catheterization Laboratory. Texto & Contexto Enferm agem 2013; 2:416-422.

12. Anim-Sampong S, Opoku SY, Addo P, Botwe BO. Nurses Knowledge of Ionizing Radiation and Radiation Protection during Mobile Radiodiagnostic Examinations. Educ Res 2015; 6:39-49.

13. Amis ES Jr., Butler PF, Applegate KE, Birnbaum SB, Brateman LF, Hevezi JM, *et al.* American College of Radiology White Paper on Radiation Dose in Medicine. J Am Coll Radiol 2007; 4:272-284.

14. Lorenzo F, Fabio P, Luca B,Davide G, Davide C. Awareness of Radiation Protection and Dose Levels of Imaging Procedures among Medical Students, Radiography Students, and Radiology Residents at an Academic Hospital: Results of a Comprehensive Survey. European J Radiol 2017; 86:135-142.

15. Ayoob R, Mohammad F, Daryoush F. Evaluation of the Level of Protection in Radiology Departments of Kermanshah, Iran. Iran J Med Phys. 2015;12 (3); 200-208.

16. Tamjidi AM. Status of Principles of Radiation Protection in Radiology Centre of Bushehr Province. Iran South Med J 2001;4(1):47-52.

17. Keikhai FMJ, Mehmandoost-Khajeh-Dad AA, Namayeshi B, Varmal ZN, Mesgarani M. Condition of Observing the Principles of Radiation Protection in Radiology Centres in Sistan and Baluchestan Province of Iran. Int J Cur Res Rev 2013;5(1):82-85.