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Assessment of Attitude, Behaviours and Knowledge of Health and Medical Staff on Radiation Safety Awareness and Protection Compliance: A Case Study of Two Hospitals in Maiduguri, Nigeria

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Abstract

This research project's sole goal is to evaluate the attitudes, behaviors, and knowledge of health and medical staff—who are frequently exposed to ionizing radiations during diagnostic and treatment procedures—about radiation safety awareness and compliance. There are a number of potential issues with safety culture and radiation protection in radiology departments that need to be addressed. From January to April of 2024, the research project was conducted in two sizable hospitals in Maiduguri, Nigeria's Borno state. This is a descriptive research study that uses the questionnaire technique as one of its research tools. Participants were chosen at random to complete the 16 multiple-choice questions on the self-administered questionnaire, which asks about their knowledge, awareness, and compliance with radiation safety. Using a data analysis computer application, the collected data was statically analysed (SPSS) The research's findings indicate that the average score on an assessment of radiation knowledge and awareness was 92%, and that the rate of use of personal radiation protection equipment (shielding devices) such as lead collars, lead goggles, thyroid collars, and shields was in compliance with radiation safety procedures, 81% of respondents demonstrated good adherence, 15% demonstrated moderate adherence, and 4% demonstrated poor adherence. Additionally, the majority of the X-ray machines in the study centres were not brand-new, although quality assurance (QA) is regularly conducted at both study centres, during the study period, the medical and health professionals at the two hospitals in the study area demonstrated a strong understanding of radiation and adherence to radiation protection measures. Nevertheless, neither facility had enough contemporary radiation protective equipment. The administration of the affected hospitals must provide personnels with more radiation protection equipment so they can shield patients, the public, and themselves from the damaging effects of ionizing radiation.

Keywords: Ionizing Radiation, Protection Compliance, Medical Exposure, Harmful.

Introduction

Since Wilhelm C. Roentgen's discovery of X-rays on November 8, 1985, several hopes have been raised for the new discovery's applications in daily life, including the fields of industry,

agriculture, and medicine (Bushberg *et al., 2012*). The first radiologists were exposed to high doses of ionizing radiation without the use of personal radiation protective equipment during the early stages of the discovery of ionizing radiation and its application in medical procedures for diagnostics.

It was estimated that these pioneers of radiology and science absorbed a dose of ionization radiation of 1 Gy per year, which is leading to various diseases such as haematological disorders, skin disorders, cataract and carcinogenicity, etc. Therefore, when negative consequences of X-ray exposure on humans were observed, radiation protection science was prompted, leading to the development of personal radiation protective equipment like lead gowns and eyeglasses, among other things. Additionally, laws defining the upper limits of exposure for the public, workplace, and medical professionals were passed, and standard international norms were adopted to safeguard patients, the public, and medical personnel from radiation (Arkadiusz Szarmach *et al., 2022*).

The majority of the tasks performed by the medical and healthcare personnel in the radiology department involve ionizing radiation. Therefore, they ought to be familiar with the fundamentals of radiation safety procedures and protection (Margret *et al., 2023*) The International Commission on Radiological Protection (ICRP) stated that understanding and awareness of the hazards of exposure to ionizing radiation and basic radiation protection practices among patients and medical staff can greatly prevent and reduce the unnecessary risks of ionization radiation, as radiation protection is the fundamental of safety for both patients and medical staff (Shiro Hayashi *et al., 2021*).

The application of X-rays in imaging modalities such as conventional radiography, mammography and Computed Tomography (CT scans) to diagnose injury and illness, and use of high energy ionising radiation in radiotherapy unit is on the increase in our modern health care services, the biological effects of exposure to ionizing radiations are of great concern here as evidence shows that medical application of ionising radiations have harmful effects if not properly administered as such the International Commission on Radiological Protection (ICRP) has stated that Medical staff involved in radiation-related procedures should have appropriate Knowledge of radiation and safety procedures (Erkan *et al., 2019*).

Statement of the Problem

Health and medical staff working in radiology department are prone to exposure to ionising radiations during radiological procedures, if adequate and good safety measures were not taken, which can imposes serious adverse effect of exposure to ionising radiation which include radiogenic cancer incidence and other radiation induced health challenges among health workers, this research work is aim to assess the radiation knowledge, safety awareness and compliance of health and medical personnels during medical procedures in the study centres to avoid harmful effects of exposure to ionising radiations.

Objectives of the Study

1. To assess radiation knowledge and safety awareness of health and medical staff.
2. To evaluate radiation safety compliance of the personnels in the radiology department of the study centres.
3. To ascertain the condition of the facilities in the radiology department.

Material and Method

Descriptive research is being conducted at the radiology departments of two major hospitals in Maiduguri, Nigeria's Borno state: Federal Neuro-Psychiatric Hospital (FNPH) and University of Maiduguri Teaching Hospital (UMTH). A cross-sectional study was conducted using self-administered questionnaires, and 286 people in all were evaluated. The necessary data was collected from medical and health workers using a well-designed, self-administrated questionnaire with 16 questions. Questions 1-4 asked participants for their age, educational background, and employment history. Question 5-10 investigates the participant radiation knowledge/awareness, while question 11- 16 assess radiation safety compliance of the participants (rate of wearing of radiation protection equipment) such as Lead Aprons, Thyroid collars, Gonads shielding, TLD barge, proper exposure parameters, Collimation and Cone, the participants were randomly selected. The details of the questionnaire are shown in table 1.

Table 1. (Questionnaire Sample)

QUESTIONS	ANSWERS
1. What is your gender?	a) Male b) Female
2. How old are you?	a) Twenties b) Thirties c) Forties d) Fifties e) Over sixty
3. What is your job title?	a) Medical Doctor b) Radiographer c) Medical Physicist d) Technologist e) Medical Record Officers
4. How many years of career experience do you have?	a) 1 – 5 b) 6 -10 c) 11 – 15 d) 16 – 20 e) Over 21 years
5. Do you operate the X-ray machine?	a) Yes, b) No
6. Have you ever attended a basic lecture on radiation exposure?	a) Yes, b) No
7. Do you know the three basic principles of radiation protection?	a) Yes, b) No

8. Do you know the difference between Deterministic and Stochastic Effects?	a) Yes, b) No
9. Does exposure to low doses of ionising radiation increase the chances of cancer incidence in future?	a) Yes, b) No
10. Do you know the key principles for use of ionising radiation?	a) Yes, b) No
11. Do you always wear a lead apron?	a) Yes, b) No
12. Do you always wear a thyroid collar?	a) Yes, b) No
13. Do you always wear lead glasses?	a) Yes, b) No
14. Do you always wear a radiation dosimeter?	a) Yes, b) No
15. Do you follow dosimeter controls?	a) Yes, b) No
16. Do you have radiation hazard warning signs in your work area?	a) Yes, b) No

The obtained data were analysed using computer program for data analysis (SPSS).

Results

The questionnaire responses indicate that 198 (69%) of the 286 participants who were evaluated for the research study were male, and 88 (31%) were female. The mean age of the participants was determined to be 34 years old. The results are displayed in Table 1.1 below, along with the gender distribution of the research participants and the participants' years of career experience, which ranges from 1 to 5 years (32%) As shown in Fig 1.1, the age ranges are as follows: 6–10 years (23%), 11–15 years (20%), 16–20 years (15%), and 21 years and above (10%). According to Fig. 1.2, the participants' fields of expertise and occupations are as follows: 63 are medical doctors (22%), 129 are radiographers (45%), 25 are nurses (09%), 31 are radiology technicians (11%) 15 are medical physicists (05%), and 23 are medical and record officers (08%).

Table 1.2 presents the participants' knowledge and awareness of radiation exposure. On average, 92% of the participants have strong knowledge and awareness of radiation, whereas 8% lack fundamental understanding.

Table 1.2 presents the rate at which participants wear radiation protective equipment. It indicates that, on average, 231 participants wear radiation protective equipment always, 44 participants wear it occasionally, and 11 participants never wear it. Based on these data, Table 1.3 scores the participants' adherence to radiation protection practices: 81% of participants show good adherence, 15% show moderate adherence, and 4% show poor adherence.

Table 1.1: Shows Gender Distribution of the Research Participants

Sex	Frequency	Percentage (%)
Male	198	69
Female	88	31
Total	**286**	**100**

Table 1.2: Radiation knowledge/Awareness of the participants (n = 286)

Questions	Responses	
	Yes	No
Have you ever attended a basic lecture on radiation exposure?	No. =281 (98%)	No. = 7 (2%)
Do you know the three (3) basic principles of radiation protection (shield, time & distance)?	No. = 266 (93%)	No. = 22 (8%)
Do you know the difference between Deterministic and Stochastic Effects?	No. = 250 (87%)	No. = 36 (13%)
Does exposure to low doses of ionising radiation increases the chances of cancer incidence in future?	No. = 278 (97%)	No. = 8 (3%)
Do you know the key principles for use of ionising radiation (justification, optimisation & compliance to limits)?	No. = 243 (85%)	No. = 43 (15%)

The participants' knowledge and awareness of radiation is displayed in Table 1.2; on average, 92% of them have an excellent understanding of radiation, while 8% only lack the basic understanding of it.

Table 1. 3: Radiation Protection Practice among the Participants

Rate of wearing of Radiation Protective Equipment.	Response of the Participants (n=286)					
	Always		Sometimes		Never	
	No.	Percentage	No.	Percentage	No.	Percentage
Do you always wear a lead apron?	238	83%	39	13.6 %	9	3.1%
Do you always wear a thyroid collar?	234	81%	41	14.3 %	11	3.8%
Do you always wear lead glasses?	229	80%	45	15.7%	12	4.2%
Do you always wear a radiation dosimeter?	225	79%	47	16.4%	14	4.8%
Do you follow dosimeter controls?	229	80%	48	16.8%	9	3.1%

The radiation protection practices of the participants are displayed in Table 1.3 above. It was discovered that, on average, 81% of participants always used radiation protective equipment, 15% did so occasionally, and 4% never did.

Table 1.4: Scoring of the Adherence to Radiation Protection Practices among the Participants

Adherence to Radiation Protection Practice	Participants (n = 286)	
	No.	Percentage.
Good adherence	231	81%
Moderate adherence	44	15%
Poor adherence	11	4%

Table 1.4 presents the results of the participants' adherence to radiation protection techniques. Of the 231 individuals, 81% demonstrate good adherence, 15% demonstrate moderate adherence, and 4% demonstrate poor adherence to radiation protection.

Fig. 1.1: Distribution of Years of Career Experience of Participants

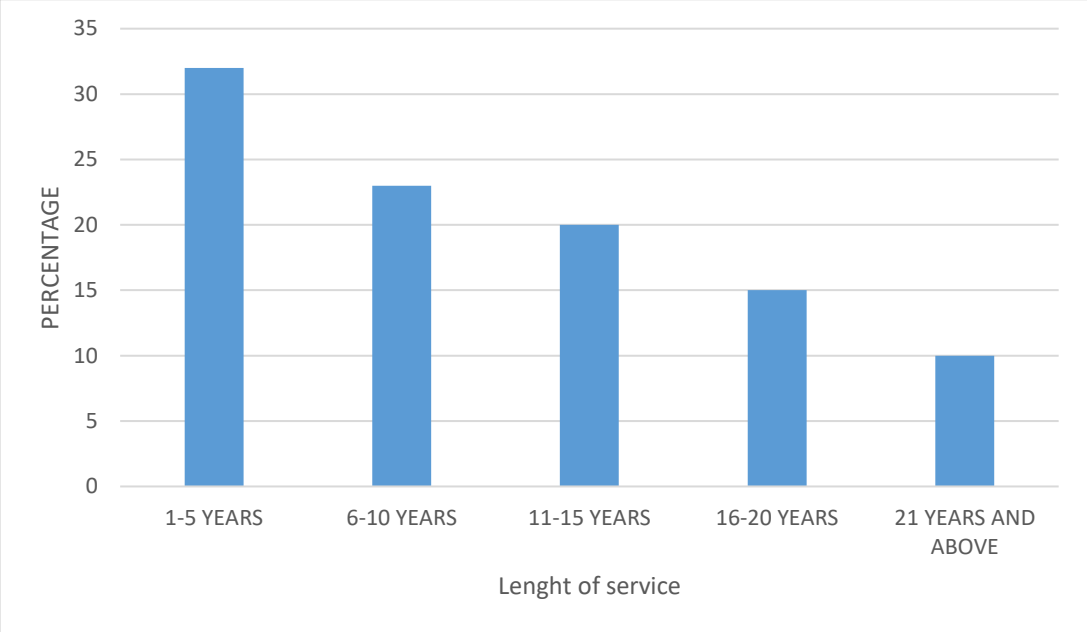

Fig 1.1 Shows distribution of years of career experience of the participants, the lowest age group is 21 years and older, at 10%, while the highest age group is 1 to 5 years, at 32%. The range of ages is 16 to 20 years, 11 to 15 years, and 6 to 10 years, respectively.

Fig. 1.2: Distribution of the Profession (Job Title) of Participants

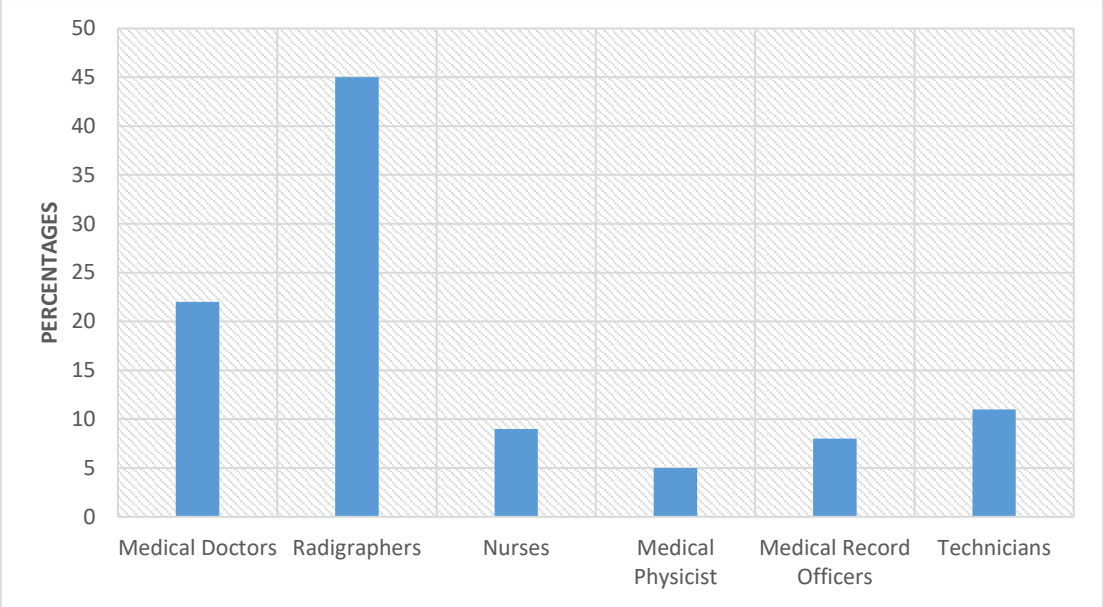

Fig 1.2 Displayed Distribution of the Profession (Job Title) Of the Participants, Medical physicists make up the least number of workers (5%), followed by medical record officials (8%), nurses (9%), radiology technicians (11%), physicians (22%), and radiographers (45%).

Fig 1.3: Adherence to Radiation Protection Practices

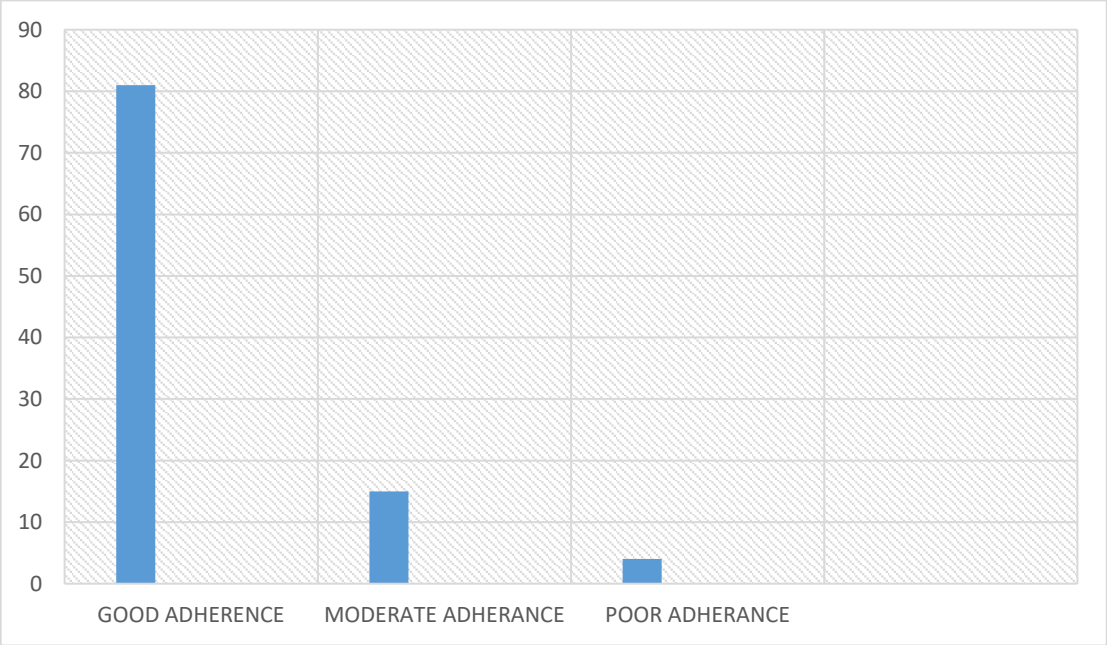

Fig 1.3 Displayed Percentage of Adherence to Radiation Protection Practices of the 231 participants, 81% had demonstrated good adherence to radiation protection, 15% had demonstrated moderate adherence, and 4% had demonstrated poor adherence.

Discussion

In this study, as shown in Table 1.3, the majority of participants (92%), who were aware of the benefits and hazards of ionizing radiation as well as the three basic principles of radiation protection (shield, distance, and time), had good radiation knowledge. This is because medical and health staff working in radiology departments are primarily involved in ionizing radiation-related procedures, and as such, they should have a basic understanding of radiation protection and safety practices (Margret *et al., 2023*). As can be shown in Fig. 1.3 and Table 1.4, 231 participants (81%) demonstrated good safety practices with regard to radiation safety compliance. While 11 participants (4%) shown inadequate safety measures during the procedures, 44 individuals (15%) demonstrated a moderate adherence to radiation protective methods. The research findings indicate that the majority of participants demonstrated strong safety practices and radiation understanding. On the other hand, they operated in compliance with the operational requirements of the International Commission on Radiological Protection (ICRP). Even if a small percentage of participants showed inadequate safety procedures and inadequate radiation knowledge, regular training and awareness on radiation knowledge and safety measures are still necessary to shield participants from the risks of ionizing radiation.

In a similar vein, the International Commission on Radiological Protection (ICRP, 1992) declared that individuals under the age of eighteen are not allowed to work in radiological centres. The findings of this study indicate that, with a mean age of thirty-two, participants in the research study operate in compliance with the ICRP guideline regarding age limits.

Conclusion

The research study's conclusions show that, among participants in the two hospitals in the study area, (92%) have a good understanding of radiation and (96%) adhere to radiation protection practices moderately to well. However, a small percentage of participants (8%) lack even a basic understanding of radiation, and 4% demonstrate poor radiation safety practices during the research study's duration. Additionally, neither of the two hospitals has enough contemporary radiation protection equipment.

Recommendations

- Staff members in radiology departments must get ongoing training and education about the advantages and disadvantages of radiation as well as the significance of following radiation safety procedures.
- The administration of the two hospitals must provide the radiology department employees with more up-to-date radiation protective equipment (TLD Barges,

Lead Aprons, Lead Google, Gonad Shield, Lead Glasses) in order to shield patients, the general public, and themselves from the damaging effects of ionizing radiation.

- As required by the ICRP standard, the federal ministry of health must provide more updated and new radiological equipment, including MRI, CT scan, and X-ray machines, to replace the outdated ones.

Conflict of interest

The authors declare that they have no conflict of interest.

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