

## RESEARCH ARTICLE

## ASSESSMENT OF LEVEL OF RADIATION SAFETY AWARENESS AMONG NON-RADIOLOGY STAFF IN SELECTED HOSPITALS IN IBADAN, OYO STATE, NIGERIA

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## ABSTRACT

Radiation safety awareness is crucial in healthcare to safeguard both patients and staff from ionizing radiation hazards. While radiologists receive specialized training on radiation safety, non-radiologists often lack this vital knowledge. This disparity can lead to preventable risks in hospital environments where radiation is regularly used. This study aims to evaluate the level of radiation safety awareness among non-radiology staff in healthcare facilities, underscoring the need for comprehensive, universal education on radiation safety for all hospital personnel. A cross-sectional survey was conducted among non-radiology staff at Adeoyo State Hospital and Ring Road State Hospital. A structured questionnaire gathered data on their knowledge, attitudes, and practices related to radiation safety, targeting doctors, nurses, general practitioners, and support staff. Descriptive statistics and chi-square tests were applied to analyse awareness levels across different demographics and professional roles. The study identified a significant awareness gap between radiology and non-radiology staff. While radiology staff displayed high knowledge of radiation risks and protective measures, many non-radiology staff showed limited understanding of these concepts. Factors contributing to this gap included insufficient training and limited access to radiation safety resources among non-radiology personnel. Addressing these issues is essential to creating safer healthcare environments. The study highlights a pressing need for universal radiation safety training across healthcare roles. Implementing these measures could reduce risks and enhance safety standards, presenting a novel approach to radiation protection in diverse healthcare settings.

## KEYWORD

Healthcare Worker Education, Hospital Safety Protocols, Ionizing Radiation Protection, Non-Radiology Healthcare Staff, Radiation Safety Awareness, Ibadan, Oyo State

## 1. INTRODUCTION

Radiography, often considered the "eye of modern medicine," originated from Wilhelm C. Roentgen's discovery of X-rays on November 8, 1895. This groundbreaking discovery revolutionized diagnostics, allowing physicians to view the internal structures of the human body non-invasively and ultimately advancing both diagnostic and therapeutic capabilities in healthcare. Beyond medicine, X-rays found significant applications across diverse fields, including industry, agriculture, and commerce. However, during the initial phase of radiation diagnostics, the adverse effects of ionising radiation on living organisms were not yet understood. Despite its undeniable benefits, ionising radiation posed considerable health risks, especially to radiology pioneers exposed to high radiation doses, resulting in various conditions such as skin disorders, blood abnormalities, cataracts, and even cancer (Szurowska, 2015). Early radiologists faced substantial exposure, with estimated doses reaching up to 1Gy annually, leading to serious health consequences (Szurowska, 2015).

The recognition of X-ray-induced adverse effects prompted scientific investigations into radiation protection, giving rise to essential safety protocols and personal protective equipment. These protocols were soon codified in regulations that established limits for radiation exposure to safeguard both medical staff and patients (Szurowska, 2015). As the use of

ionizing radiation expanded in recent years with advancements in diagnostic technology, the field of radiology has continued to evolve for diagnostic and therapeutic applications. Consequently, radiation safety has become increasingly critical in ensuring the health and well-being of healthcare professionals, patients, and the broader society. Enhanced diagnostic imaging technologies, particularly the development of multi-detector computed tomography (CT), have greatly expanded diagnostic capabilities but also substantially increased radiation exposure levels, accounting for roughly 50% of the medical radiation burden (Smith-Bindman, 2009; Griffey and Sodickson, 2009). This increase in diagnostic procedures has led to a corresponding rise in radiation exposure for healthcare providers administering these processes (Zekioglu and Parlar, 2021). Research further indicates a correlation between increasing exposure to man-made ionizing radiation sources and an elevated lifetime cancer risk (Guleria et al., 2019; Haylock et al., 2018; IAEA, 2018; Schauer and Linton, 2009; Tang and Loganovsky, 2018).

The health risks associated with radiation exposure are a critical concern in modern radiology. Both patients and healthcare providers face preventable risks, which can be mitigated by implementing advanced technologies designed to improve safety standards (WHO, 2023). For example, the average radiation dose exposure for the general population is approximately 2.5 mSv per year, with medical exposure comprising

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almost 15% of this dose (Alotaibi and Muhyi, 2019). In the UK, studies attribute between 100 and 250 cancer fatalities per year to unnecessary medical radiation exposure (Alotaibi and Muhyi, 2019). The biological effects of ionising radiation are classified into two primary types: stochastic effects and deterministic effects. Stochastic effects, such as cancer, are dose-independent and can occur at any radiation level, while deterministic effects are dose-dependent and manifest immediately in high exposures, causing conditions like acute radiation syndrome and radiation burns (Wrixon, 2008; Yucl et al., 2009). A foundational understanding of these risks is essential for healthcare providers to implement radiation protection strategies effectively (Alotaibi and Muhyi, 2019).

Despite technological advancements, gaps exist in the awareness and understanding of radiation safety among healthcare professionals, including those who work with ionizing radiation regularly. Research highlights persistent knowledge deficiencies, especially regarding the biological effects of radiation exposure (Wakeford, 2018). Studies reveal that some healthcare providers lack sufficient knowledge about the specific doses associated with various radiological procedures. This issue is particularly concerning among professionals who underestimate radiation doses in specific imaging procedures (Faggioni et al., 2017; Yurt et al., 2014). Additionally, there are misconceptions about which procedures involve ionizing radiation and which do not, underscoring the need for comprehensive training (Saeed et al., 2018).

Understanding the risks of ionizing radiation among medical staff is critical for developing safe diagnostics and therapeutic protocols. Healthcare professionals' awareness of these risks aids in the planning and execution of radiological procedures, ensuring better protection for both patients and staff. A lack of radiation protection knowledge among professionals working with ionizing radiation not only jeopardizes their safety, but also compromises patient safety. Existing research points to a dearth of studies examining radiation safety awareness among non-radiology staff who may also encounter radiation in the healthcare environment. Assessing these professionals' knowledge of radiation safety during diagnostic procedures is essential to mitigate potential risks.

This study focuses on evaluating the level of knowledge and awareness regarding radiation safety among non-radiology healthcare staff working in various departments at Adeoyo Maternity Teaching Hospital, Yemetu, Ibadan. Despite not using ionizing radiation directly, these staff members may still encounter radiation exposure indirectly, and they should therefore have a foundational understanding of radiation safety. From March to July, the study aimed to evaluate the knowledge and awareness of non-radiology staff about radiation exposure risks and safety protocols in the healthcare setting.

Through this study, insights were gained into the practices and understanding of radiation safety among non-radiology healthcare providers, revealing areas for improvement in their knowledge. The findings underscored the necessity of reinforcing education on radiation safety for these medical professionals. The results suggest that improving awareness and education on radiation safety for non-radiology staff is essential to fostering a safer workplace and reducing preventable risks associated with radiation exposure. By addressing these gaps, healthcare institutions can enhance safety standards, ensuring that all staff members, regardless of their department, possess the knowledge necessary to protect themselves and their patients effectively.

## 2. STUDY AREA

The study area, Ibadan, is the capital and largest city of Oyo State, Nigeria, and the third-most populous city in the country after Lagos and Kano. As of 2021, Ibadan's population is approximately 2,649,000, with its metropolitan area home to over 3 million residents. Located in southwestern Nigeria, Ibadan spans a substantial geographical area and sits around 119 kilometres northeast of Lagos and 120 kilometres east of Nigeria's international border with the Republic of Benin. The city comprises several local government areas, including Ibadan North, Ibadan North-East, Ibadan North-West, Ibadan South-East, Ibadan South-West, Akinyele, Egbeda, Ido, Lagelu, and Ona Ara.

Adeoyo Maternity Teaching Hospital, a tertiary healthcare facility in Ibadan North LGA's Yemetu ward, is affiliated with the University of Ibadan. Specialising in obstetrics and gynaecology, the hospital has a 200-bed capacity and provides services to over 856,988 people in Ibadan North LGA. The hospital offers emergency care, surgeries, and various specialized services; it also functions as a referral center for nearby healthcare facilities. This study will assess the level of radiation safety

awareness among 135 non-radiology staff members at Adeoyo Maternity Teaching Hospital, focusing on knowledge gaps and training needs in this critical area.

## 3. MATERIALS AND METHODS

### 3.1 Materials and Sample Size

This study used a cross-sectional questionnaire survey at Adeoyo Maternity Teaching Hospital, Yemetu, Ibadan, designed to assess the radiation safety awareness among non-radiology healthcare workers. The sample size was determined based on Yamane's (1973) formula, which calculates sample size with a specified margin of error. With a total population of 135 healthcare workers, a 5% margin of error was applied, resulting in a sample size recommendation of 105 participants for adequate statistical power. Participants were selected using a simple random sampling method to ensure a representative sample across various healthcare roles outside the radiology department. Inclusion criteria required participants to be healthcare workers not employed within the Radiology department, with each participant providing informed consent prior to participation. Individuals working directly in radiology or those not employed as healthcare workers were excluded.

### 3.2 Data Collection and Ethical Considerations

Primary data was collected through a 26-question, self-administered questionnaire distributed offline to participants. The questionnaire included Likert scale items assessing awareness of radiation safety protocols; familiarity with ionizing radiation use in medical imaging; and knowledge of radiation protection devices commonly used in hospital settings. Additionally, questions addressed the availability of radiation protective equipment at the hospital, any previous radiation safety training, and interest in future training opportunities. Ethical approval for the study was obtained from the Oyo State Ministry of Health, Agodi Secretariat, Ibadan, ensuring compliance with ethical standards and participant confidentiality.

### 3.3 Data Analysis

Data was analysed using descriptive statistical methods. Quantitative variables, such as the mean and standard deviation, were calculated for continuous data, while categorical data was represented through frequencies and percentages. Participants' knowledge scores were determined by summarising the number of correct responses to knowledge items and then compared against the total number of possible correct answers. Statistical significance was calculated using a p-value of  $\leq 0.05$  at a 95% confidence interval. SPSS version 23.0 was employed for all data analysis, facilitating a comparison of knowledge levels across different healthcare roles and an examination of awareness disparities within the hospital's non-radiology staff. Findings will inform future training initiatives, emphasizing the importance of improving radiation safety awareness and equipping non-radiology staff with the necessary knowledge to protect themselves and their patients from potential radiation exposure.

## 4. RESULTS AND DISCUSSION

This section presents the results and discusses the findings of the study on radiation safety awareness among non-radiology staff at Adeoyo Maternity Teaching Hospital, Yemetu, Ibadan. The findings provide insights into the demographics of participants, their training in radiation safety, awareness of radiation risks, and their attitudes towards radiation protection.

### 4.1 Demographic Information

The demographic data of the study participants is crucial for contextualizing the results. The distribution of workers by hospital, as shown in Table 1, indicates that a significant majority (76.2%) of participants were from Adeoyo State Hospital, while 23.8% were from Ring Road State Hospital, Ibadan. This distribution suggests that the Adeoyo State Hospital has a larger workforce engaged in the study, which can influence the overall results.

Hospital	Number of Workers	Percentage
Ring Road State Hospital	25	23.8%
Adeoyo State Hospital	80	76.2%

The demographic profile further reveals a gender distribution skewed towards females, with Table 2 illustrating that 61.9% of participants were female compared to 38.1% male. This gender imbalance may affect the perspectives shared in the study, highlighting the necessity for gender-sensitive approaches in future educational programs.

Gender	Number of Workers	Percentage
Male	40	38.1%
Female	65	61.9%

Age distribution data presented in Table 3 indicates that the largest age group among participants was 21-30 years, accounting for 42.9% of the total. This finding suggests a relatively young workforce, which may be indicative of newer entrants into the healthcare profession.

Age Group	Number of Workers	Percentage
21-30	45	42.9%
31-40	20	19.0%
41-50	25	23.8%
51-60	10	9.5%
>61	5	4.8%

The professional cadre distribution reveals diversity in the roles of the participants, with doctors (23.8%) and physiotherapists (19.0%) representing the most significant portions of the sample. This diversity in professional background is essential, as different roles may have varying levels of exposure to radiation and associated training needs.

Professional Cadre	Number of Workers	Percentage
Doctor	25	23.8%
Nurse	16	15.2%
Medical Laboratory Scientist	14	13.3%
Management	5	4.8%
Pharmacist	15	14.3%
Physiotherapist	20	19.0%
Public Health	10	9.5%

The years of practice data in Table 5 indicate that a significant proportion of participants (42.9%) have 1-5 years of experience in the field, suggesting that many are in the early stages of their careers. This demographic factor is important for understanding the participants' level of experience and knowledge concerning radiation safety.

Years of Practice	Number of Workers	Percentage
<1 year	10	9.5%
1-5 years	45	42.9%
6-10 years	20	19.0%
11-15 years	25	23.8%
>15 years	5	4.8%

In summary, the demographic information presents a predominantly young and female workforce with a diverse range of professional roles. This demographic context is crucial for interpreting the results regarding radiation safety awareness and training needs.

#### 4.2 Radiation Safety Training and Knowledge

A critical finding of the study is the lack of radiation safety training among participants. As illustrated in Table 6, a staggering 93.3% reported not having received any formal training in radiation safety, highlighting a significant gap in their professional education. This lack of training is concerning, given the potential risks associated with radiation exposure in healthcare settings.

Response	Number of Workers	Percentage
Yes	7	6.7%
No	98	93.3%

Despite the absence of training, the knowledge demonstrated by some participants is promising. For instance, Table 7 shows that 81.9% correctly identified ultrasound as an investigation without ionizing radiation risk. This indicates that, although formal training may be lacking, some level of awareness exists regarding specific imaging modalities.

Investigation	Number of Workers	Percentage
Ultrasound	86	81.9%
MRI	15	14.3%
Echocardiogram	4	3.8%
Doppler Studies	0	0.0%

Moreover, when asked to identify the investigation with the highest ionizing radiation risk, Table 8 shows that 42.9% of participants recognized fluoroscopy as the highest risk modality. This demonstrates an important understanding of the varying risks associated with different imaging techniques, suggesting that participants have absorbed some relevant information despite lacking formal training.

Investigation	Number of Workers	Percentage
CT Scan	25	23.8%
Fluoroscopy	45	42.9%
PET Scan	15	14.3%
Mammography	20	19.0%

Participants were also aware of the radiological investigations that pregnant women should avoid, with Table 9 showing that 42.9% identified CT scans as unsafe. This awareness is crucial for protecting vulnerable populations and indicates a level of caution in practice among the non-radiology staff.

Investigation	Number of Workers	Percentage
X-ray	35	33.3%
CT Scan	45	42.9%
PET Scan	10	9.5%
Nuclear Medicine Scans	15	14.3%

Overall, the findings indicate a significant gap in formal radiation safety training, but also suggest that some participants possess critical knowledge regarding specific imaging procedures and their associated risks. This discrepancy highlights the need for targeted educational programs to enhance awareness and understanding of radiation safety among healthcare professionals.

#### 4.3 Radiation Protection Awareness

The study revealed that participants have varying levels of awareness regarding radiation protection measures. As shown in Table 10, only 42.9% were aware of the red light indicator outside radiation imaging rooms, which serves as a critical safety measure to alert staff and patients about potential radiation exposure. A majority (57.1%) were unaware, indicating a significant knowledge gap that could lead to safety risks.

Response	Number of Workers	Percentage
Yes	45	42.9%
No	60	57.1%

In terms of recognized methods of radiation protection, Table 11 indicates that lead aprons were the most acknowledged method by 42.9% of respondents, followed by time management strategies (33.3%). However,

only a small percentage (8.6%) recognized lead shields as a protective measure. This suggests that while some protection methods are recognized, overall awareness is still inadequate.

**Table 11: Methods of Radiation Protection**

Method	Number of Workers	Percentage
Lead Apron	45	42.9%
Lead Shields	9	8.6%
Distance from Source	16	15.2%
Time Management	35	33.3%

Participants displayed a good understanding of the principles of distance and time management concerning radiation exposure, as indicated by Table 12 and Table 13. A significant majority (92.4% and 81.9%, respectively) recognized the importance of these factors, demonstrating an awareness of fundamental radiation protection principles.

**Table 12: Effect of Distance on Radiation**

Response	Number of Workers	Percentage
Yes	97	92.4%
No	8	7.6%

**Table 13: Effect of Time on Radiation**

Response	Number of Workers	Percentage
Yes	86	81.9%
No	19	18.1%

Overall, these findings highlight the need for improved education and training on radiation safety and protection among non-radiology staff. A comprehensive training program could enhance awareness, mitigate risks, and promote a culture of safety in healthcare settings.

#### 4.4 Attitudes Towards Radiation Safety

The attitudes of participants towards radiation safety are also essential in understanding the implications of their knowledge and awareness levels. The survey results show that a majority (87.6%) agree that radiation safety training should be mandatory for all healthcare staff, reflecting a collective acknowledgment of the importance of training in promoting safety. This aligns with global standards and recommendations for ongoing education in radiation safety.

**Table 14: Attitude Towards Mandatory Radiation Safety Training**

Response	Number of Workers	Percentage
Agree	92	87.6%
Disagree	13	12.4%

Furthermore, when asked about their comfort level in working around radiological equipment, the majority (73.3%) expressed feeling uncomfortable. This discomfort underscores the necessity for enhanced training programs to foster confidence among non-radiology staff regarding their safety and operational competence.

**Table 15: Comfort Level in Working Around Radiological Equipment**

Response	Number of Workers	Percentage
Comfortable	30	28.6%
Uncomfortable	77	73.3%

In conclusion, the attitudes of non-radiology staff towards radiation safety reflect a growing recognition of the importance of formal training and awareness programs. By addressing these concerns through structured training initiatives, healthcare institutions can cultivate a more informed and safety-conscious workforce.

#### 4.5 Limitations of the Study

Despite the valuable insights gained from this study, several limitations must be acknowledged. Firstly, the sample size was limited to two hospitals, which may not fully represent the perspectives of all non-radiology staff in Ibadan or Nigeria as a whole. Additionally, the reliance on self-reported data may introduce bias, as participants might

underreport or overreport their knowledge and experiences regarding radiation safety.

Secondly, the cross-sectional nature of the study limits the ability to draw causal inferences regarding the impact of training on awareness levels. Longitudinal studies could provide more robust evidence of the effectiveness of educational interventions over time.

Lastly, the study focused primarily on non-radiology staff, which may overlook the experiences and training needs of other healthcare professionals who also interact with radiological equipment. Future research could include a broader range of healthcare workers to develop a comprehensive understanding of radiation safety awareness across different professional groups.

## 5. CONCLUSION

This study critically assessed radiation safety awareness among non-radiology staff at Adeoyo Maternity Teaching Hospital in Yemetu, Ibadan. The findings reveal a mixed landscape of knowledge and practices, indicating both strengths and significant areas for improvement. Encouragingly, there is a foundational awareness of radiation safety among staff. Most participants demonstrated basic knowledge of key concepts, such as the importance of maintaining distance and minimizing time to reduce radiation exposure, as well as recognition of common safety symbols like the radiation logo. This foundational awareness is essential for ensuring a safe working environment in healthcare settings where radiation is utilized. However, significant gaps exist, particularly concerning formal training and detailed knowledge of radiation protection measures. Alarmingly, 93.3% of participants reported having no formal training in radiation safety. This lack of education is critical, as it leaves healthcare professionals vulnerable to radiation risks that could be mitigated through proper training. Although participants were generally aware of procedures involving ionizing radiation, there was uncertainty regarding protective measures. Only 42.9% identified the red light indicator outside radiation imaging rooms, and a similar percentage recognized lead aprons as essential protective equipment. Additionally, many staff members remain undecided on critical aspects of radiation safety. For instance, 33.3% were uncertain about the risks of radiation exposure to vulnerable populations and the basic principles of radiation protection. This indecisiveness underscores the need for more comprehensive and targeted education to solidify understanding and encourage informed practices among all staff members. Despite these gaps, the willingness of staff to undergo further training presents a significant opportunity. Nearly all participants (98.1%) expressed a desire for additional training on radiation safety. This readiness to learn is a positive sign, indicating that the hospital can build on existing foundational awareness to address identified gaps through targeted educational programs. There is a baseline understanding of radiation safety among non-radiology staff at Adeoyo Maternity Teaching Hospital; critical areas require urgent attention. By implementing comprehensive and regular training programs, the hospital can enhance staff radiation safety practices, ensuring better protection for both healthcare workers and patients. This proactive approach will not only improve safety standards but also foster a culture of continuous learning in radiation safety practices. To enhance radiation safety awareness among non-radiology staff, several recommendations are proposed: implement comprehensive training programs, conduct regular refresher courses, promote the use of safety equipment, and increase awareness of radiation indicators. Strengthening policies on radiation safety, ensuring the availability of monitoring devices, and providing specialized training for vulnerable populations are all vital. Establishing feedback mechanisms fosters continuous improvement. Future research should focus on longitudinal studies to evaluate the effectiveness of training, comparative studies across hospitals, and examining the impact of specific safety policies on staff behavior. Addressing barriers to effective practices and integrating radiation safety training curricula will further enhance safety in healthcare settings.

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