

Radiation Protection and Dose Awareness Among Doctors in a Nigerian Teaching Hospital: A Preliminary Study

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ABSTRACT

Background: Medical imaging using ionizing radiation is an essential tool for diagnosis. Ionizing radiation has adverse biological effects on living organisms and the risk of adverse effects increases with higher doses of radiation. It is the duty of the requesting doctor to balance the risks and benefits of imaging tests involving the use of ionizing radiation. However, previous studies reveal that doctors' knowledge regarding the radiation doses incurred during diagnostic radiological procedure is inadequate. **Aims:** To assess doctors' knowledge about the guiding principle of radiation protection (As Low as Reasonably Possible (ALARA)) and their knowledge of the radiation doses their patients receive during some common radiological procedures. **Materials and Methods:** We adapted the questionnaire used in a previous study and circulated it among 120 doctors from different specialties and cadres. There were questions about cadre, years in medical practice, specialty, and attendance at any training on radiation protection. We asked about nonmedical sources of radiation, the full meaning of ALARA, and the effective doses of ionizing radiation that patients receive during common radiological investigations proportional to chest X-ray. Responses were scored out of a total of 10 marks. **Results:** One hundred and twenty doctors participated in the study; 27 radiologists and 93 nonradiologists. The total scores ranged from 1 to 7 marks (mean score=3.38, median score=3.0). Overall, the doctor's total scores were significantly affected by their specialty and exposure to previous training on radiation protection, with $P=0.001$ and $P=0.001$, respectively. Scores were not significantly affected by number of years post qualification. **Conclusion:** Level of awareness about the basic principle of radiation protection and patients' exposure is poor among our study population

Key words: Awareness; doctors; dose; radiation

Introduction

Medical imaging using ionizing radiation is an accepted and fundamental part of medical practice, it is an essential tool for diagnosis however, and ionizing radiation has been shown to have adverse biological effects on living organisms.^[1] While there is controversy over the extent of cancer risk associated with exposures to radiation from medical imaging, there is broad agreement that steps can and should be taken to reduce unnecessary radiation exposure.^[2]

The risk of adverse sequelae following medical radiation

exposure increases with higher doses of radiation. It is the duty of the requesting doctor to balance the risks and benefits of imaging tests, particularly those that involve the use of ionizing radiation. In order to do this optimally, the doctor requires the knowledge of the radiation dose the patient receives from the radiological examination being ordered for and the attendant risk.

However, increasing concern is being expressed in literature that doctors' knowledge regarding the radiation doses incurred during diagnostic radiological procedure is inadequate.^[3]

The demand for imaging, especially computerized tomography, has increased globally over the past 20 years.^[1-3] The same is true in Nigerian hospitals including our hospital (Obafemi Awolowo University Teaching Hospital), where computerized tomography has only recently become readily accessible.

The aim of this study is to assess doctors' knowledge about the guiding principle of radiation protection (ALARA) and

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their knowledge of the radiation doses their patients receive during some common radiological procedures.

Materials and Methods

We adapted the questionnaire (Appendix 1) used in a previous study^[4] on the subject and circulated it among a convenience sample of 120 doctors from different specialties and different cadres. Among them were 27 radiology residents who were evaluated during a revision course (on renal imaging), which took place in our hospital.

All the doctors agreed to complete the questionnaire. The questionnaire included questions about status, number of years in medical practice, the specialty of the respondents, and whether respondents have had specialized training on radiation protection. We tested general knowledge of nonmedical sources of radiation and the full meaning of the acronym for “As Low as Reasonably Possible” (ALARA).

Finally, the doctors were asked about the effective doses of ionizing radiation that patients receive during common radiological investigations (in Nigeria) proportional to chest X-ray. The doses for the various imaging procedures were compared to the number of chest X-ray equivalents (i.e., if the effective dose received during a chest X-ray is considered to be one unit, how many equivalent units are received during each of the listed procedures?).

In assessing the questionnaires, a correct answer was given one mark and an incorrect answer no marks. If the respondent gives no answer or ticks the option that says “don’t know,” no marks were allocated for that question. We drew correct answers from available literature.^[4,5] The questionnaires were scored out of a total of 10 marks.

Limitation of the study: Effective doses vary with the technique and equipment used during radiological examinations; however, we attempted to compensate for this by giving a wide range in each option.

Results

One hundred and twenty doctors participated in the study among which were 27 radiologists and 93 nonradiologists. There were 33 house officers, 75 resident doctors, and 12 consultants. Ninety nine of the doctors have had less than 10 years post qualification (basic medical degree) experience, while 21 have had more than 10 years post qualification. Only 15 of all the doctors have attended any training on radiation protection [Table 1].

The total scores ranged from 1 to 7 points out of 10 (mean score = 3.38, median score = 3.0). For radiologists, total score ranged from 2 to 7 points (mean = 4.5, median = 5.0). For nonradiologists, scores ranged from 1 to 6 points (mean = 3.05,

median = 3.0). A total of 23 doctors scored 5 points and above (6 radiologist and 17 nonradiologists).

Eighty five doctors were able to mention at least one nonmedical source of radiation; 23 out of the 85 are radiology residents. All the radiology residents except 2 and 30 nonradiologists gave the correct full meaning of ALARA.

Only 10 doctors, out of whom 5 were radiology residents, scored more than 50% on the questions relating to the doses of some common radiological procedures relative to a chest radiograph.

Overall, the doctor’s total scores were significantly affected by specialty and exposure to previous training on radiation protection. The scores were not significantly affected by number of years post qualification [Table 2].

Table 1: Percentage distribution of respondents by their characteristics

Personal characteristics	Frequency	Percentage
Specialty		
Radiologist	27	22.5
Non radiologist	93	77.5
Total	120	100.0
Cadre		
House officers	33	27.5
Resident doctors	75 (registrars=46, senior registrars=29)	38.3
Consultants	12	10.0
Total	120	100.0
Length of practice		
Less than 10 years	99	81.7
More than 10 years	21	17.5
Total	120	100.0
Training		
Yes	15	12.5
No	105	87.5
Total	120	100.0

Table 2: Characteristics of respondents by number of those with total score above and below average (50%)

Respondents’ characteristics	Scored above 50% (n=23)	Scored below 50% (n=97)	Total	Statistics P value
Specialty				0.001
Nonradiologist	6	87	93	
Radiologist	17	10	27	
Years post qualification				0.06
Less than 10 years	23	76	99	
More than 10 years	1	20	21	
Previous training				0.001
Yes	10	5	15	
No	13	92	105	

Discussion

This preliminary survey revealed awareness of the fundamental principle of radiation protection (ALARA) among nonradiologists is poor. The doctors are also not knowledgeable enough about the radiation doses their patients receive during common radiological procedures. It confirms the findings of previously published studies on the subject.^[4,5] This lack of awareness means that the doctor may not be able to conform to the ALARA principle in the utilization of medical imaging using ionizing radiation. Consequently, the patient's risk of iatrogenic radiation exposure is increased.

We demonstrated that those who have attended training on radiation protection are better informed. This suggests that radiation safety courses offered to the doctor may increase their level of awareness. However, a study by Shiralkar *et al.*^[6] demonstrated that this may not be enough.

The radiologists in our study scored significantly higher than doctors from other specialties. These results agree with other published studies. This may be because radiologists have ready access to the appropriate information and have received training about ionizing radiation, which assisted them in answering the questions.^[4]

It is surprising to note that the number of years of post qualification had no significant effect on the scores, as one would have expected that the more junior doctors should be able to easily recall what they were taught about ionizing radiation during radiologic postings during medical school more than their senior colleagues.

In conclusion, the level of awareness about the basic principle of radiation protection and patients' exposure is poor among our study population. This reflects an urgent need for radiation protection to be taught as a priority in the medical school and as an integral part of continued medical education programmes.

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Appendix 1

Study questionnaire with correct answers

1. Kindly indicate your cadre
 Consultant _____
 Senior registrar _____
 Registrar _____
 House officer _____
2. Number of years in practice (after graduation from medical school)
 Less than 10 years _____
 More than 10 years _____
3. Have you ever attended a radiation protection course?
 Yes _____
 No _____
4. What is your specialty?
 Medicine _____
 Surgery _____
 Pediatrics _____
 O and G _____
 Orthopedics _____
 Anesthesia _____
 Radiology _____
 Psychiatry _____
 Dermatology _____
 Community medicine _____
 General Practice _____
 Others specify _____
5. State three nonmedical sources of ionizing radiation in Nigeria (3 marks)
 A _____ Sun/Cosmic rays/ozone layer

- B____ Food and Drink
 C____ Nuclear Reactor
 D____ Nuclear Weapons
 E____ Uranium Decay
 F____ Radon Gas
 G____ Earth (gamma ray emission)

H____ Don't know

6. Tick the full meaning of ALARA with respect to ionizing radiation dose to patients? (1 mark)

As low as reasonably achievable_____*****

Allowable administered radiation_____

Assurance limits applied to radiation_____

Not sure_____

7. What is the dose in CXR equivalents of the following radiological investigations? (For a guide, the dose of a CXR = 1 CXR equivalent)
 (Please tick one box for each investigation) (6 marks)

Dose (in chest X-ray equivalents)	1 to 19	20 to 49	50 to 100	100 to 500	Don't know
Abdominal CT				*****	
Abdominal X-ray	*****				
Barium meal		*****			
Barium enema				*****	
Intravenous urography				*****	
Chest X-ray	*****				

Total score/10 marks

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