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Requesting physicians' knowledge of X-radiation exposure from computed tomography scan examinations: A case study of two Nigerian tertiary hospitals

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ABSTRACT

Objective: Physicians who often request for computed tomography (CT) scan examinations are expected to have sound knowledge of radiation exposure (risks) to patients in line with the basic radiation protection principles according to the International Commission on Radiological Protection (ICRP), the Protection of Persons Undergoing Medical Exposure or Treatment (POPUMET), and the Ionizing Radiation (Medical Exposure) Regulations (IR(ME)R). The aim is to assess the level of requesting physicians' knowledge of ionizing radiation from CT scan examinations in two Nigerian tertiary hospitals.

Materials and Methods: An 18-item-based questionnaire was distributed to 141 practicing medical doctors, excluding radiologists with work experience from 0 to >16 years in two major teaching hospitals in Nigeria with a return rate of 69%, using a voluntary sampling technique.

Results: The results showed that 25% of the respondents identified CT thorax, abdomen, and pelvis examination as having the highest radiation risk, while 22% said that it was a conventional chest X-ray. Furthermore, 14% concluded that CT head had the highest risk while 9% gave their answer to be conventional abdominal X-ray. In addition, 17% inferred that magnetic resonance imaging had the highest radiation risk while 11% had no idea. Furthermore, 25.5% of the respondents have had training on ionizing radiation from CT scan examinations while 74.5% had no training. Majority (90%) of the respondents were not aware of the ICRP guidelines for requesting investigations with very little (<3%) or no knowledge (0%) on the POPUMET and the IR(ME)R respectively.

Conclusion: There is low level of knowledge of ionizing radiation from CT scan examinations among requesting physicians in the study locations.

Keywords: Computed tomography scan, Knowledge, Medical exposure, Physicians, Radiation risk

INTRODUCTION

The computed tomography (CT) is an imaging modality that uses ionizing radiation to reveal internal structures of human body parts, from neonates to adults in a tomographic pattern.[1] At present, the CT scan is the dominant contributor to medical radiation exposure.[2] Ionizing radiation from CT is, however, associated with potentially harmful biological effects as high

doses kill cells while low doses tend to damage or alter the deoxyribonucleic acid of exposed cells.[3,4] Some of the adverse effects include skin erythema, hair loss, sterility, and malignancy with it major concern being cancer induction,[3] but radiation dose administered to patients should be as low as reasonably permissible (ALARP) with CT doses depending on parameters relating to patient age and size, technical factors, and equipment model[5] to minimize the risk.[6] For example, dose of about 10 mSv from CT thorax, abdomen, and pelvis (CT TAP) will induce fatal malignancy in one out of about 2000 patients.[7]

The last two decades have recorded an increase in medical exposure from CT scans[8] as the new multidetector CT scan technology creates highly defined quality image with shorter time but expose patients to higher radiation dose than the older single-detector CT scanners.[5,9]

A recent study suggests that one-third of CT scan examinations can actually be replaced by alternative method of investigation or not performed at all.[10] In pediatrics, for example, radiation exposure from CT is of increasing concern since children are more radiosensitive than adults.[11] Furthermore, the problem of cancer induction has been 2–3 times higher in pediatrics probably due to their rapid cellular growth pattern, body size, and longer period of survival compared to the adults.[4,11] In addition, studies have also questioned the use of CT scan examinations in the United States, particularly as a primary tool in the diagnosis of acute appendicitis in children.[4,10,11]

The Protection of Persons Undergoing Medical Exposure or Treatment (POPUMET) and the Ionizing Radiation (Medical Exposure) Regulations (IR(ME)R) in line with the International Commission on Radiological Protection (ICRP) inferred that health-care professionals be familiar with the aforementioned risks and the thresholds at which any harm may occur, in addition to the different susceptibility of various organs to X-radiation.[12] The POPUMET and the IR(ME)R stipulate that any medical exposure using ionizing radiation, for example, the CT scan, must be performed by a trained professional, deemed competent, and licensed to perform the procedure as requested.[12]

Physicians who often request for CT scan are expected to have sound knowledge and understanding of radiation exposure to patients[13] as it is necessary and very important to consider balancing radiation risk from the examination with patient's benefits, particularly from CT scan examinations. In order words, detriments should be considered in justifying an exposure before referrals are made.[3] This has not been ascertained in our study population, hence, the need to assess the level of requesting physicians' knowledge of X-radiation risks from CT scan examinations in the two Nigerian tertiary hospitals.

MATERIALS AND METHODS

A prospective hospital-based study, which involved the use of an 18-item-based anonymous questionnaire distributed to 141 medical doctors excluding radiologists with status, ranging from house officer to chief consultant aged from 21 years to > 41 years [Table 1] and work experience from 0 to >16 years in the Benue State University Teaching Hospital, Makurdi, and the University of Calabar Teaching Hospital, Calabar, Nigeria, using a voluntary sampling (technique) method. A total of 98 out of the 141 questionnaires were completely filled and returned, giving a return rate of 69.0%. Data obtained were subjected to descriptive statistics at $P < 0.05$ considered to be statistically significant.

RESULTS

There was a significant correlation between work experience and training status of the respondents.

About 25% of the respondents identified CT TAP examination with the highest radiation risk, 22% said that it was conventional chest X-ray, 14% attributed it to be CT head, while 9% inferred conventional abdominal X-ray. Furthermore, 17% inferred that magnetic resonance imaging (MRI) had the highest radiation risk while 11% had no idea.

Where

- Knowledge of the ICRP = 1 point
- Knowledge of the POPUMET = 1 point
- Knowledge of the IR(ME)R = 1 point
- Knowledge of ALARP = 1 point.

Respondents' knowledge of radiation exposure (risk) from CT scan examination was scored using the Likert scale [Figure 1]. The results showed that 39 respondents who were aware of the ICRP provisions and knowledgeable of the POPUMET scored a total of 2 points. Furthermore, 10 of the respondents who were not aware of the ICRP with no knowledge of the POPUMET and the IR(ME)R scored 0 point. Twenty-eight of the respondents who correctly gave the full meaning of ALARP scored 1 point while 15 respondents who were aware of the ICRP with knowledge of the POPUMET and the IR(ME)R scored a total of 3 points. In addition, six respondents who correctly gave the full meaning of ALARA were aware of the ICRP with knowledge of the POPUMET and the IR(ME)R scored a total of 4 points.

Table 1: Age distribution of the respondents.

Age group (years)	*n*	%
21–25	8	8.16
26–30	29	29.59
31–35	36	36.74
36–40	16	16.33
>41	9	9.18

Chi-cal = 27.462; df = 5; $P<0.05$

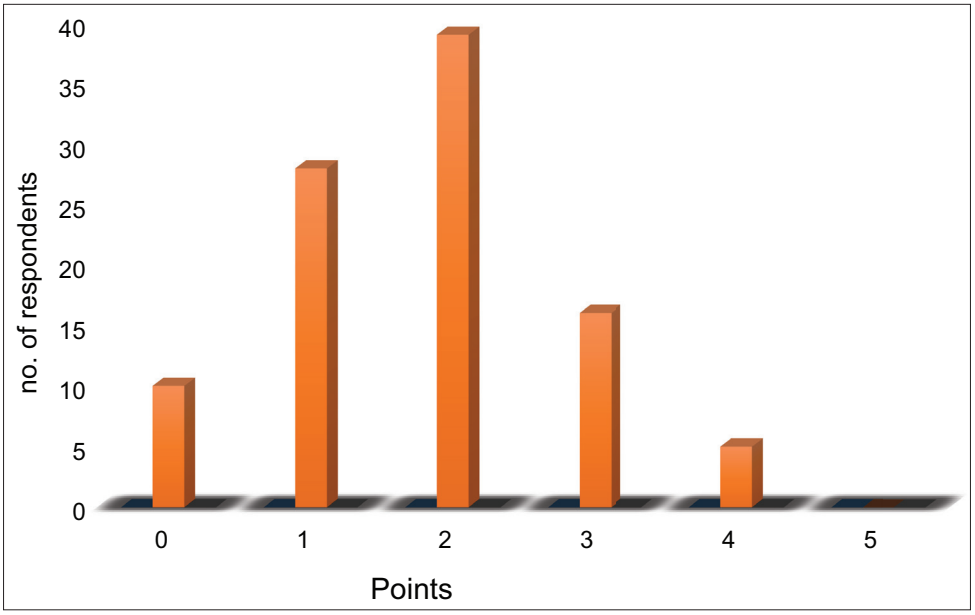

Figure 1: Distribution of points scored by the respondents using the Likert scale.

DISCUSSION

The study assessed the knowledge of requesting physicians of X-radiation exposure from CT examination in two Nigerian tertiary healthcare institutions. Results [Figures 1 and 2] showed that majority of the respondents (>90%) had very little or no knowledge of X-radiation exposure from CT scan examinations. This agrees with the works of Kada (2010) who studied general practitioners' knowledge of ionizing radiation from diagnostic imaging examinations with emphasis on quality in primary care.[14] Results of the present study are also in tandem with the work of Madrigano *et al.* who evaluated non-radiology physicians' knowledge on aspects relating to ionizing radiation in imaging.[5] In addition, the results corroborate the findings of Brenner and Hall, who revealed an increasing source of radiation exposure.[10]

The basic radiation protection principles as inferred by the ICRP are justification, optimization, and limitation of individual doses. The principle of justification means that any activity involving radiation must be justifiable relative to other alternatives and should yield a net benefit to the patient. The optimization principle establishes that all exposures should be ALARP while the limitation principle put it that the doses for radiation workers and the general public should not exceed a particular limit. In the present study, knowledge was adequate with those who had training on X-radiation exposure from CT scan examinations as there was strong positive correlation between work experience and training status of the respondents ($r = 0.81$). In order words, a significant correlation exists between those who had training and those without training on ionizing radiation from CT scan examinations. The result [Table 2], therefore, agrees with the reports of Madrigano *et al.* and Kada.[5,14]

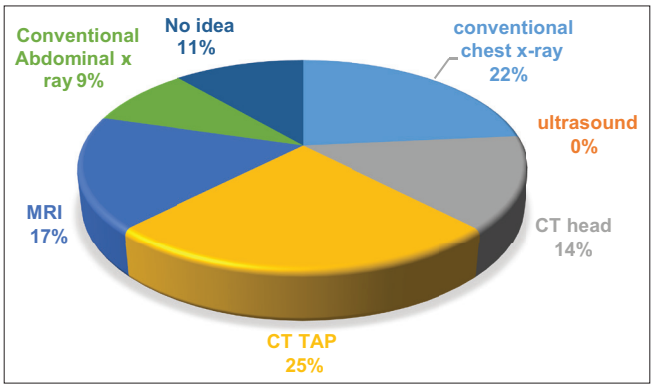

Figure 2: Knowledge of the respondents on radiation (ionizing and non-ionizing) exposure (risks).

The results in Table 3 also revealed that increase in years of practice (work experience) was directly proportional to increase in knowledge gained, as practitioners with work experience >16 years demonstrated fair knowledge and understanding on the effects of X-radiation exposure (risks) from CT scan examinations which agree with the popular dictum "practice makes perfect." This could probably be due to their level of training and improved awareness of X-radiation exposure from CT scan examinations. The results thus support the report of Keijzers and Britton (2010) who researched on doctors knowledge of patient radiation exposure from diagnostic imaging request in the emergency department.[6]

Meanwhile, 17% of the respondents inferred that MRI uses ionizing radiation, 25% identified that CT TAP examination with the highest radiation risk while 22% said that it was conventional chest X-ray. Furthermore, 14% attributed it to be CT head while

Table 2: Respondents training on radiation exposure (risks) from CT examinations.

Training status	*n*	%
Doctors trained on radiation exposure from CT examinations	25	25.51
Doctors without training on radiation exposure from CT examinations	73	74.49

Pearson correlation coefficient r=0.81. CT: Computed tomography

Table 3: Respondents work experience.

Work experience (years)	*n*	%
0–5	50	51.02
6–10	19	19.39
11–15	9	9.18
>16	20	20.41

Chi-cal = 24.264; df = 4; P<0.05

9% thought that it was a conventional abdominal X-ray [Figure 2]. Majority (>90%) of the respondents were not aware of the ICRP provisions and had very little (<3%) or no knowledge (0%) of the POPUMET and the IR(ME)R. Similarly, only 6% of the respondents correctly gave the full meaning of ALARP and were also aware of the ICRP provisions in addition to being knowledgeable on the POPUMET and the IR(ME)R. This result is in keeping with a similar work by Paulinus *et al.* on the evaluation of nurses' knowledge of radiation protection practice in Calabar, Nigeria, where majority of the nurses had very little or no information (knowledge) about radiation protection.[15]

CONCLUSION

Based on this study, it can be concluded that there is low level of knowledge of ionizing radiation from CT scan examinations among requesting physicians in the study locations which suggests the need for improved knowledge. This may be achieved by conducting regular CPDs.

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Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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