

# COMPARISON OF THE KNOWLEDGE OF IONIZING RADIATION AMONG RADIO-DIAGNOSTIC STAFF OF SECONDARY AND TERTIARY HOSPITALS IN JOS.

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## ABSTRACT

**Background:** Adequate knowledge of not only the benefits in clinical use but also of the potential dangers of ionizing radiation is crucial among staff of radio-diagnostic departments. This balance properly equips the staff and impacts professional practice. The level of such knowledge can be verified among the various cadre of staff in a radio-diagnostic department and comparison made between different tiers of health institutions.

**Methodology:** A cross-sectional study was conducted in 2 tertiary hospitals and 2 secondary hospitals in Jos, Plateau State, Nigeria between August 2019 and October 2019. All staff of radio-diagnostic departments of the 4 hospitals filled up a distributed questionnaire sheet. The semi structured, validated and self-administered questionnaire included parts comprising questions about the socio-demographics of the included subjects and on knowledge of ionizing radiation. The retrieved questionnaires were scored and graded and recorded. The data were analyzed using SPSS version 23.

**Results:** A total of 60 staff of Radio-diagnostic departments of the involved hospitals participated in the study, made up of 47(78.3%) males and 13(21.7%) females with age range between 24 and 57 years and a mean age of  $39 \pm 11.2$  years. Fifty one (85%) of the participants were staff in the tertiary hospitals while 9 (15%) were in the secondary hospitals. Most of the staff who participated in the study had a good knowledge of ionizing radiation (47; 78.3%). The proportion of participants with good knowledge of ionizing radiation was higher among the radio-diagnostic staff in the tertiary hospitals (40/51; 78.4%) compared to those in the secondary hospitals (7/9; 77.8%). This difference between the staff in the two categories of health institutions was however not statistically significant,  $\chi^2=0.0019$ ,  $p=0.965$ .

**Conclusion:** Sufficient basic knowledge of ionizing radiation subsists among the radio-diagnostic staff of secondary and tertiary hospitals in Jos.

**Key Words:** Comparison, Knowledge, Ionizing, Radiation, Secondary, Tertiary, Hospital.

## INTRODUCTION

The discovery of X-rays in 1895 by Wilhelm Conrad Roentgen which won him the Nobel Prize for Physics 6 years later shaped a revolution in the field of medicine.<sup>1</sup> During the following years, the inherent dangers in radiation were brought to the fore with such findings as skin erythema and radiation burn.<sup>2</sup> Owing to the recognized harmful effects on experimental subjects and the health concern to staff and patients, changes in designs and various modifications in the production and use of X-rays had to be instituted for the safety of radiation staff and patients. Workers in a radiation department have an increased risk for radiation

exposure than the general hospital population.<sup>3</sup> These group including Radiologists, Radiographers, Physicists, Biomedical Engineers, Darkroom Technicians, X-ray Assistants and Radiation Nurses also constitute the largest single group of workers occupationally exposed to artificial sources of radiation. Such artificial sources of radiation have also continued to vary and increase over the years with miniaturization units like mobile x-ray and mobile CT-scan machines and multiplication units like multi-slice CT scanner.<sup>4</sup>

It is usually assumed that staff in such department will have adequate knowledge about ionizing

radiation and its effects, acquired during training as part of their academic curriculum or as pre-employment or continuous education/in-service staff training to enhance capacity. Also, an orientation programme is usually organized for new staff on the basics of radiation protection to enable them gain knowledge. However, such expected knowledge by radiation staff remains just an assumption until verified.

The study aims to compare the level of knowledge of ionizing radiation among staff of radio-diagnostic departments of 2 tertiary hospitals - Jos University Teaching Hospital (JUTH) and Bingham University Teaching Hospital (BhUTH), and 2 secondary hospitals- Plateau Specialist Hospital (PSH) and Our Lady of Apostles Maternity (OLAM) all within Jos metropolis.

## METHODOLOGY

JUTH, BhUTH, PSSH and OLAM are about 500, 180, 150 and 100 bedded hospitals respectively. These hospitals together harbor the largest concentration of radiation workers in Plateau State made up of staff of various cadre and units in the Radio-diagnostic departments of the 4 hospitals who were the target population for the study. The staff population of the Radio-diagnostic departments was about 75 in number, made up of 50 staff in JUTH, 10 staff in BhUTH, 10 staff in PSSH and 5 staff in OLAM.

The sample size was determined using the formula for comparison of proportions when conducting a comparative cross sectional study with the minimum sample size calculated to be 32 for each group. However, total sampling was applied in view of the small sample size and all available and willing staff of radio-diagnostic departments in the named hospitals (totaling 60) participated in the study.

An anonymous, semi-structured, self-administered questionnaire was designed and validated following review of templates of previous validated studies.<sup>5,6</sup> The objectives of the study were explained to the participants before distribution of the questionnaire. The questionnaire included parts comprising questions about the demographics of subjects including their educational qualification, place of work and years in service, as well as parts on questions about the knowledge of ionizing radiation among the staff. Responses to the questions on knowledge of ionizing radiation were

to be provided on a Likert-style scale in which the respondents were to select and tick only one box. The scale ranged from "Agree Strongly" (AS), "Agree" (A), "Not Certain" (NC), "Disagree" (D), and "Disagree Strongly" (DA).

All filled questionnaire were retrieved from the various Radio-diagnostic departments. The responses were scored and graded. The points were awarded for ticked boxes as AS-5; A-4; NC-3; D-2; DS-1, for appropriateness of the responses starting from the left and AS-1; A-2; NC-3; D-4; DA-5, for appropriateness of the responses starting from the right. No response attracted 0 point. This gives a minimum score of '0' and a maximum score of '30' points. The participants that scored 21 points (70%) and above were considered as having 'good' knowledge, while those that scored less than 21 were graded as having 'poor' knowledge.

Data analysis was performed using software SPSS version 23. Definite variables are shown as percentages and frequencies and results were presented in Tables. All levels of significance were set at  $p < 0.05$ .

Ethical approval was obtained from the Ethical boards of all the included hospitals.

## RESULTS

A total of 60 staff of Radio-diagnostic departments of the involved hospitals participated in the study. These are made up of 47(78.3%) males and 13(21.7%) females. Fifty one (85%) of the participants were staff in the tertiary hospitals (JUTH 46; BhUTH 5) while 9 (15%) were in the secondary hospitals (PSSH 6; OLAM 3). The age of the participants ranged from 24 years to 57 years with a mean age of  $39 \pm 11.2$  years. There were more respondents in their fifth decade in the secondary hospitals (4/9; 44.4%), while the modal age group of the respondents in the tertiary health facilities was the third decade (16/51; 31.4%). More staff with years in service of less than 10 years participated in the study (33; 55%) with most in this category found working in the tertiary hospitals. Those with less than 10 year stay in the present department were also found more in the tertiary centers (37; 61.7%). The highest educational qualification among respondents in the secondary hospitals was Higher Diploma while it was a Post graduate Medical Fellowship in the tertiary hospitals. The highest cadre staff in the

secondary hospitals were the Radiographers (3; 33.3%) and the highest cadre staff in the tertiary hospitals were the Consultants (7; 13.7%) (Table 1)

**Table 1: Socio-demographic Characteristics**

Socio-demographics	Health Facility		Total ( % )	X <sup>2</sup>	P - Value
	Secondary	Tertiary			
<b>Age (Years):</b>					
21 – 30	1	16	17(28.3)	5.2108	0.266
31 – 40	1	14	15(25.0)		
41 – 50	4	14	18(30.0)		
51 – 60	3	6	9 (15.0)		
>60	0	1	1 (1.7)		
<b>Gender:</b>					
Female	3	10	13(21.7)	0.8491	0.357
Male	6	41	47(78.3)		
<b>Qualification:</b>					
SSCE	1	2	3 (5.0)	14.1363	0.049*
Technician	3	4	7 (11.7)		
OND	4	8	12((20.0)		
Degree/HND	1	19	20(33.3)		
MBBS	0	12	12(20.0)		
Fellowship	0	6	6 (10.0)		
<b>Professional Cadre:</b>					
X-ray Assistant	4	2	6 (10.0)	30.2148	0.000*
Darkroom Technician	2	12	14(23.3)		
Physicist	0	3	3 (5.0)		
Resident Doctor	0	8	8 (13.3)		
Intern-Radiographer	0	18	18(30.0)		
Radiographer	3	1	4 (6.7)		
Consultant	0	7	7 (11.7)		
<b>Years in Service:</b>					
< 10	2	31	33(55.0)	4.5963	0.032*
? 10	7	20	27(45.0)		
<b>Years in Department:</b>					
< 10	2	37	39(65.0)	8.5168	0.004*
? 10	7	14	21(35.0)		

Mean age: 39 ± 11.2 years

Differences in Academic qualification and Professional cadre between staff of secondary and tertiary health facilities, significant at 5%, were noted. Significant difference was also seen in the number of years in service and years spent in the present department between the two hospital categories, with more of the staff serving and staying longer than 10 years found in the secondary hospitals.

**Table 2: Comparison of Knowledge of Ionizing Radiation among Radio-diagnostic staff**

Level of Knowledge	Health Facility				Total (%)	X <sup>2</sup>	P-value
	Secondary		Tertiary				
	PSSH	OLAM	JUTH	BhUTH			
Poor	1	1	10	1	13 (21.7)	0.0019	0.965
Good	5	2	36	4	47 (78.3)		
Total	9		51		60 (100)		

The results showed that most of the Radio-diagnostic staff who participated in the study had a good knowledge of ionizing radiation (47; 78.3%). The proportion of participants with good knowledge of ionizing radiation was higher among the radio-diagnostic staff in the tertiary hospitals (40/51; 78.4%) compared to those in the secondary hospitals (7/9; 77.8%) (Table 2). This difference between the staff in the two categories of health institutions was however not statistically significant,  $\chi^2=0.0019$ ,  $p=0.965$ .

**Table 3: Association between Socio -demographics and Knowledge of Ionizing Radiation in Secondary Health Facilities**

Socio-demographics	Knowledge		Total	X <sup>2</sup>	P - Value
	Poor	Good			
<b>Age (Years):</b>					
21- 30	0	1	1	5.1429	0.162
31 - 40	0	1	1		
41 - 50	0	4	4		
51 - 60	2	1	3		
>60	0	0	0		
<b>Gender:</b>					
Female	0	3	3	1.2857	0.257
Male	2	4	6		
<b>Qualification:</b>					
SSCE	1	0	1	5.1429	0.162
Technician	1	2	3		
Diploma	0	4	4		
Degree/HND	0	1	1		
MBBS	0	0	0		
Fellowship	0	0	0		
<b>Professional Cadre:</b>					
X-ray Assistant	2	2	4	3.2143	0.200
Darkroom Technician	0	2	2		
Physicist	0	0	0		
Resident	0	3	3		
Inter-Radiographer	0	0	0		
Radiographer	0	0	0		
Consultant	0	0	0		
<b>Years in Service:</b>					
< 10	0	2	2	0.7347	0.391
? 10	2	5	7		
<b>Years in Department:</b>					
< 10	0	2	2	0.7347	0.391
? 10	2	5	7		

No significant association was found between the socio-demographics and knowledge of ionizing radiation in the secondary hospitals.

**Table 4: Association between Socio-demographics and Knowledge of Ionizing Radiation in Tertiary Health Facilities**

Socio-demographics	Knowledge		Total	X <sup>2</sup>	P - Value
	Poor	Good			
<b>Age (Years):</b>					
21- 30	2	14	16	3.9202	0.417
31 - 40	3	11	14		
41 - 50	3	11	14		
51 - 60	3	3	6		
>60	0	1	1		
<b>Gender:</b>					
Female	4	6	10	2.498	0.114
Male	7	34	41		
<b>Qualification:</b>					
SSCE	0	2	2	13.0145	0.072
Technician	2	2	4		
Diploma	4	4	8		
Degree/HND	2	17	19		
MBBS	2	10	12		
Fellowship	0	6	6		
<b>Professional Cadre:</b>					
X-ray Assistant	1	1	2	10.547	0.103
Darkroom Technician	6	6	12		
Physicist	1	2	3		
Resident Doctor	1	7	8		
Inter-Radiographer	1	17	18		
Radiographer	0	1	1		
Consultant	1	6	7		
<b>Years in Service:</b>					
< 10	5	26	31	1.3827	0.240
? 10	6	14	20		
<b>Years in Department:</b>					
< 10	7	30	37	0.5594	0.454
? 10	4	10	14		

No significant association was found between the socio-demographics and knowledge of ionizing radiation in the tertiary hospitals.

## DISCUSSION

There were much more staff participants in the tertiary health institutions than in the secondary counterparts (51 and 9 respectively). This apparently relates to the employer capacity in our setting. While the two tertiary institutions are government owned and funded, the two secondary hospitals are privately owned and funded. Jos University Teaching Hospital (JUTH), a Federal Government parastatal, alone, provided 46 (76.7%) of the respondents in the study. The import of this however is that limited hands are left to render middle level radio-diagnostic services to the teeming population of patients expected in the secondary hospitals with the attendant heightening of the radiation related health risks and hazards to the few staff.

The mean age of the respondents in the study was  $39 \pm 11.2$  years with a range of 24 to 67 years, both extremes being associated with the tertiary health facilities. The presence of younger staff participants who were engaged in internship programs and also of the senior cadre staff saddled with the teaching and training that go on in these institutions account for this.

Staff who have spent more than 10 years both in service and in stay in the present department were found to be more in the secondary hospitals than for tertiary hospitals (Table 1). This again corroborates the comparative youthfulness of the staff population in the tertiary hospitals and the transitional characteristics, with an appreciable number of staff in this training centers spending between one year and six years for their internship and residency programs. The more permanent nature of the engagement in the secondary hospitals should spur continuous improvement in knowledge and risk management measures by staff of radio-diagnostic departments.

The highest cadre of staff in the secondary hospitals were the Radiographers (3; 33.3%) while the highest cadre of staff in the tertiary centers were the Consultants (7; 13.7%). Other cadre of staff that were found in the tertiary hospitals but not in the secondary centers include the Resident Doctors and the Medical Physicists. The compliment of staff of various cadres in the tertiary hospitals should ostensibly translate to better integration and quality in service in the radio-diagnostic units including projection and adherence to set rules in radiation protection. This may however not be the case as other complicating factors may play out in our

limited resource setting.

The results showed that most of the radio-diagnostic staff who participated in this study had a good knowledge of ionizing radiation (78.3%). The proportion of participants with good knowledge of ionizing radiation was higher among staff in the tertiary hospitals (78.4%) compared to those in the secondary hospitals (77.8%). There was however no statistically significant difference in the knowledge of ionizing radiation between radio-diagnosis staff of secondary and tertiary hospitals  $\chi^2=0.4151$ ,  $p=0.519$  (Table 2) Same basic knowledge of ionizing radiation and its effects is expected to be taught in the certified institutions involved in the training of the various cadre of radio-diagnostic staff irrespective of geographical location. Unanticipated disruptions in the school calendar and curriculum not infrequently seen in developing nations as in our setting may however play a negative role in the knowledge base of individual staff. Radiation workers need training and re-training on diagnostic and therapeutic uses of ionizing radiation in medicine as applicable in their work environment as these workers sometimes do not have sufficient knowledge about the risks of being exposed to radiation and the criteria that should be taken into consideration to minimize those risks.<sup>7</sup> Findings from a number of studies have emphasized on continuous occupational education for medical radiation workers to improve their knowledge and capacities of radiation protection issues and appropriately manage radiation exposure.<sup>8,9</sup> A high level of knowledge was found among radiographers regarding the dangerous effects of ionizing radiation in the study carried out in Lagos, Nigeria.<sup>10</sup> Another study involving radio-diagnostic nurses showed a high level of knowledge and attitude among the experienced nurses toward radiation hazards and protection.<sup>5</sup>

No significant association was found at p-value of 5% between any of the specific socio-demographics and knowledge of ionizing radiation among the respondents in secondary health facilities and in the tertiary health facilities. (Tables 3 and 4) This is an interesting finding in view of other reports to the contrary. Shabani et.al<sup>11</sup> found that the place of practice affected the knowledge, attitude and practice level of radiation protection among the staff of Interventional radiology units in Iranian health care centers. Awosan et.al<sup>12</sup> reported that a significantly higher proportion of

professionals such as doctors, nurses and imaging scientists had a good knowledge of radiation hazards compared with administrative and other supporting staff. However, Famurewa et.al<sup>3</sup> reported poor level of awareness of the basic principles of radiation protection and patients' exposure in a study among doctors in Ile-Ife, Nigeria, while Booshehri et.al<sup>14</sup> reported poor knowledge of radiation protection among dentists in Yazd dental office.

## CONCLUSION

Sufficient basic knowledge of ionizing radiation subsists among the radio-diagnostic staff of secondary and tertiary hospitals in Jos. Though the proportion of participants with good knowledge of ionizing radiation in the study was higher among staff in the tertiary hospitals when compared to those in the secondary hospitals, the difference was however not statistically significant.

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