IRJMETS

e-ISSN: 2582-5208

International Research Journal of Modernization in Engineering Technology and Science

(Peer-Reviewed, Open Access, Fully Refereed International Journal)

Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

THE UNREGULATED USE OF X-RAY DOSE AND THE ASSOCIATED CANCER RISK TO PATIENTS UNDERGOING SOME DIAGNOSTIC X-RAY PROCEDURES IN KEBBI STATES

A. Bello[*1], B. Samaila[*2]

[*1]Department Of Physics, Kebbi State University Of Science And Technology Aliero, Kebbi State, Nigeria.

[*2]Department Of Physics With Electronics, Federal University Birnin Kebbi, Kebbi State, Nigeria.

ABSTRACT

In developing country like Nigeria, monitoring of X-ray technical parameters has not received much attention and this may affect the way personnel adhere to standard practices. The efforts of Nigerian Nuclear Regulatory Authority [NNRA] to control the issue of radiation usage in the country are few because of the low funding by the Government. There is high tendency of deviation from normal practices. The purpose of the research work is to carry out an investigation on how x-ray been used and on-spot determination of exposure parameters applied in X-ray diagnostic imaging within the selected centres in Kebbi State, Nigeria. This would help us know if there was conformity to the standards in the application of dose received by patients, in the process to have very good and clear diagnostic image. Of the two X-ray centers where these study was undertaken, Sir Yahaya Memorial Hospital (SMH), FMC Birnin Kebbi, X-ray are applied based on age, type of body and others. SMH and FMC have a mean entrance skin dose results of 4.41mGy, 3.14mGy, 6.01mGy, and 1.07 mGy for shoulder, femur, Hip, and Upper arm respectively. Similarly for effective dose; 0.19mSv, 0.17mSv, 0.23mSv and 0.45 mSv for shoulder, femur, Hip, and Upper arm respectively. Therefore, there's greater need for justification in some radiological procedures by Nigerian Regulatory body within the studied centres.

Keywords: X-Ray, Mean Effective Dose, Entrance Skin Dose.

I. INTRODUCTION

X-rays are electromagnetic rays of high penetrating ability which means that their use is not completely riskless due to the ionizing nature [1]. The used of X-radiation are potentially dangerous; the radiation dose estimation is used to represent radiation risk. [1].The possibility of harm could estimate by quantifying the radiation received by patients who are undergoing X-ray examinations. The radiation dose estimation and principle of protection have received so much attention in medical applications recently [2]. The goal of radiation protection is to prevent or minimize exposures that have no benefit; therefore, so patient dose measurement is essential in the patients protection and quality assurance programs. Regular control and dosimetry can help the physician and physicist to ensure that the amount of radiation received by the patients is in accordance with the ALARA principle and does not exceed the amount required to obtain favorable radiographic exam [2]. The discovery of X-rays did a lot to science almost in all areas where its applications were used. With this discovery, the radiation especially ionizing radiation start to be applying in imaging the part of the human body that could not be seen in the past [3]. The ionizing nature of the X-rays results in the dissociation of water molecule and subsequently produced the reactive product. If these products react with DNA molecules will cause biological damage [3]. These biological effects are of two types: Somatic and Genetic effects [3]. The somatic effect affect only exposed individual, while the genetic effects affect the offspring of the exposed individual. Furthermore, the features that make ionizing radiation so effective for diagnostic purposes, namely its ability to penetrate tissue and to kill and transform tissue cells, can also make hazardous to health. Therefore Great concern must be shown to prevent unnecessary exposure to radiation during diagnostic imaging. Using radiation in diagnostic radiology, two principles must be concerned with: principles of justification and optimization. The justification for the use of X-radiation in diagnostic radiology must outweigh the detrimental effect and the exposure must be optimized to as low as reasonably achievable to minimize its deleterious effects. That is, there is a need to optimize the technical parameter to identify the radiation parameter that will give the lowest achievable doses and quantitative image simultaneously [3]. These optimization procedures include the manipulation of radiological parameters that are involved in the form of

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

image in diagnostic radiology. Over the years, medical application represents largest artificial source of exposure to ionizing radiation. This medical exposure accounts for 98% of the contribution to the population dose worldwide, representing approximately 20% of the total [3]. It was estimated that diagnostic radiology and nuclear medicine contributed 96% to the collective effective dose from artificial source in the UK. It is estimated that diagnostic radiology and nuclear medicine contributed 88% to the collective effective dose from artificial source in the US, whereas in the UK similar contribution was 96% [3]

The increasing knowledge of the hazards of unregulated medical use of ionizing radiation has led to the need for radiation dose assessment of patients during diagnostic X-ray examinations. The ICRP Defined the stochastic radiation effects as a lethal cancer or a mutation expressed in the first two post-irradiation generations. Diagnostic imaging has an increasing role in medicine with approximately 5% growth per year with worldwide annual per caput dose of 0.4 mSv. The developments of practical methods for patient's dose estimation is desirable since Quality Assurance Programs (QAPs), including patient dosimetry, are a legal requirement now-a-days in most countries, including Nigeria.

II. MATERIAL AND METHOD

This work was aimed to estimate radiation dose received by the patients and the Effective Dose (ED) for several kinds of exposures of adult patients. Measurements were performed in hospitals by using different X-ray equipment and examination techniques. The most common types of examinations included in this research are Femur, Hip joint, Upper arm and Shoulder. Patients involved in the study were preselected by age (above 20 years) [4]. All patients who certified the above criteria and who underwent a particular examination at the time of the study. For good statistical analysis, reference was needed for 10 patients (minimum) at each X-ray unit for every examination. For each patient and X-ray equipments, the following parameters were recorded: sex, age, focus-to-skin distance, kVp and mAs [4].In order to increase the speed and efficiency of patient dosimetry process, a windows based computer program, called Cal Dose_X 5.0 was applied in the research. This software has been developed to generate the ESAK, BSF INAK as well as the ED. The combination of ESAK and BSF were used to estimate ESD. The programme is fast and enables the processing of a large volume of data and serves as a realistic alternative method toThermoluminescent Dosemeters (TLDs) measurements calculating the ESD and ED from exposure factors recorded at the time of examination [4]. The results of ESD and ED for the two centres were statistically computed and presented in the tables given below.

III. RESULT AND DISCUSSION

Table 1: Comparison of Mean Exposure parameters with other studies

[redacted]						
	Upper arm AP	34.10	101.30	87.36	62.10	18.20
	Shoulder AP	44.00	100.60	84.20	73.27	23.18
SMH	Hip Joint AP	42.00	102.08	77.28	75.67	21.83
	Femur AP	34.00	100.60	82.50	64.80	18.20
	Upper arm AP	34.00	101.40	86.78	62.10	12.11
	Shoulder AP	35.00	101.00	74.10	77.60	29.20
FMC	Hip Joint AP	44.00	104.90	79.93	78.30	33.60
	Femur AP	42.00	109.00	89.23	77.38	32.03
[5]	Hip AP	-	103.47	-	80	18.67

IRJMETS

e-ISSN: 2582-5208

International Research Journal of Modernization in Engineering Technology and Science

(Peer-Reviewed, Open Access, Fully Refereed International Journal)

Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

Table 2: Comparison of ESD [mGy] of two centres with national and international studies

Examination	This studies	Other Studies	
	SMH & FMC	[10]	[5]
Shoulder AP	4.41	0.46	--
Femur AP	3.14	0.39	--
Hip Join AP	6.01	--	0.57
Upper arm	1.07	0.27	--

Table 3: Comparison of mean ED of the two centres [mSv] with other studies

Examination	Effective Dose [mSv]	National and International Studies on Effective Dose [ED] in mSv			
	This studies	[6]	[7]	[8]	[9]
Shoulder AP	0.19	0.01	0.03	--	0.002
Femur AP	0.17	--	--	--	--
Hip AP	0.23	0.70	0.86	0.90	0.03
Upper Arm	0.45	---	--		

Table 4: Risk of Cancer Incidence

SMH	Upper arm AP	0.29
	Shoulder AP	1.63
	Hip Joint AP	0.90
	Femur AP	0.64
FMC	Upper arm AP	0.29
	Shoulder AP	2.18
	Hip Joint AP	1.53
	Femur AP	1.25

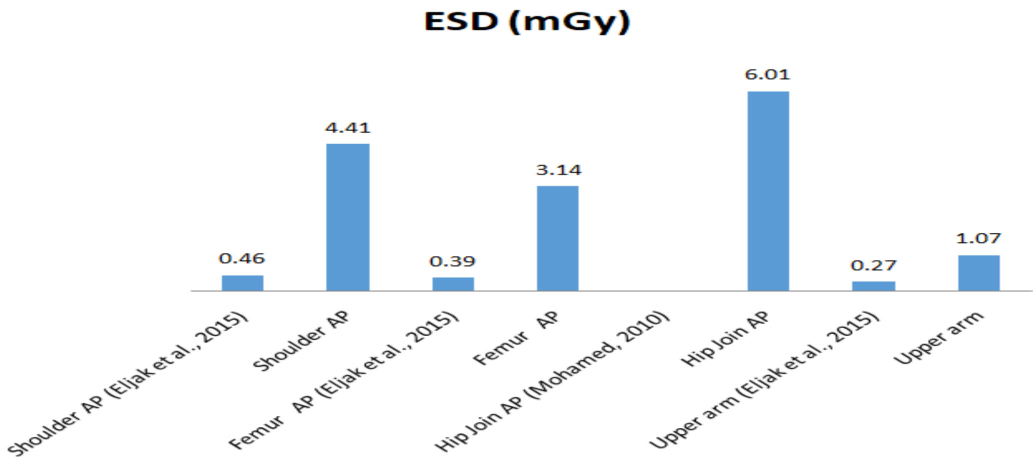

Figure 1: Entrance Skin Dose

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

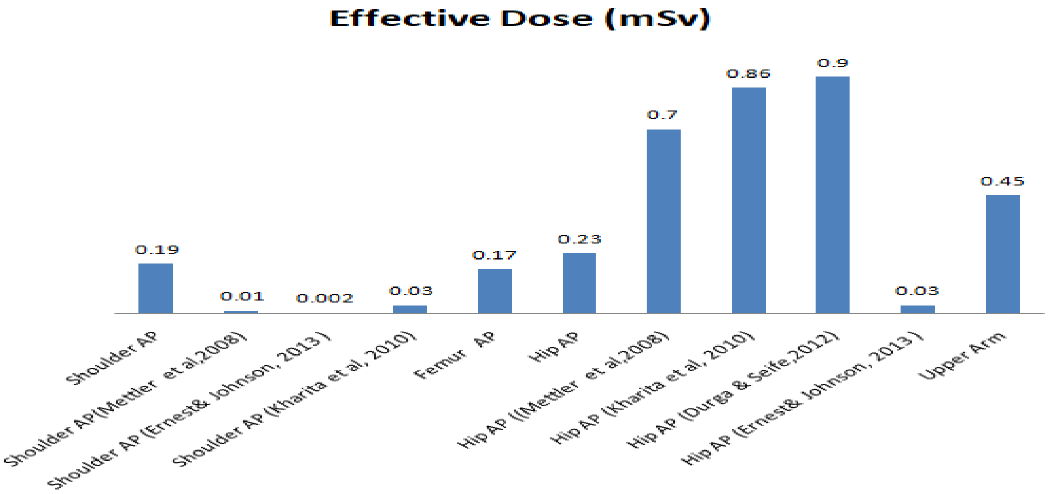

Figure 2: Effective Dose

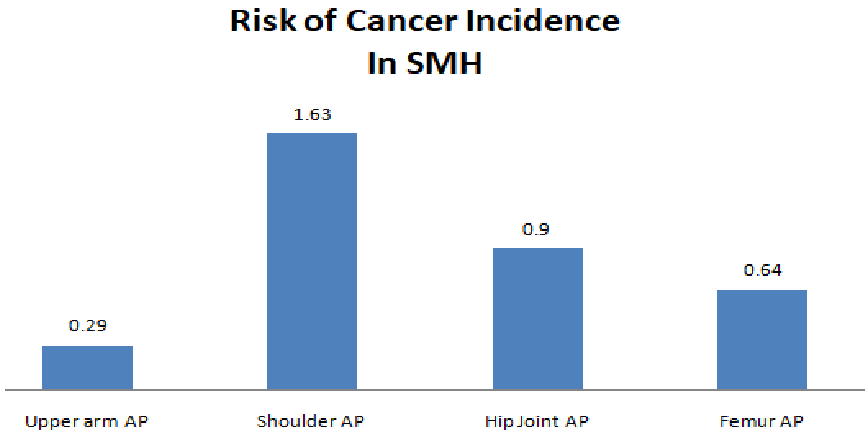

Figure 3: Risk of Cancer Incidence in SMH

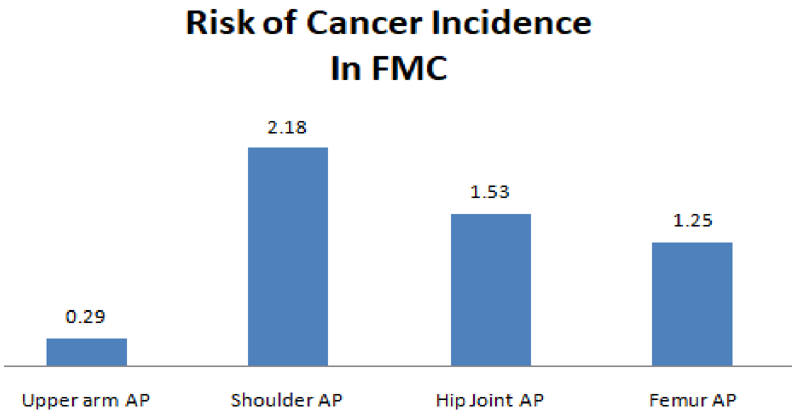

Figure 4: RCI in FMC

IV. DISCUSSION

A number of dose assessment research has indicated that patients dose variation for same type of x-ray examinations observed [3].In this research, biographical data such as patient age, sex, and machine parameters such as kV, FFD, FSD and mAs were recorded in table 1. The standard weight of the patients was used in the assessment. The maximum radiation dose recorded is 6.01mGy; these may be attributed to the patients' body thickness or ages which were also high. Table 2 show the mean entrance skin dose of two hospitals and results of other studies. The ESD for all the procedures performed in two centres were remarkably high compare to the work of [10] and [5] respectively. Figure 1 depicts the results of table 2 and indicate variation of ESD to patients between the procedures. The ESD found to be higher than the other studies as indicated in figure 1. The X-ray procedures with highest ESD are Hip joint AP and shoulder AP. The order of magnitude of ESD are Hip (6.01 mGy) > Shoulder (4.41 mGy) > Femur (3.14 mGy) > Upper arm (1.07 mGy). This shows that Justifications are highly require to minimizing the unregulated exposure of patients to radiation. The mean values of effective dose were obtained as shown in table 3. The results was well compared with the results of [6,7,8 and 9] and found to be remarkably high but lower than NNR of 1 mSv for one year. The maximum effective dose recorded in this research is 0.45 mSv and 0.19 mSv for Upper arm and shoulder respectively depicted in figure 2. As in indicated in the figure 2, ED are much lower than the results of other studies. This is an indicator that patients are at safer side of radiation-induced Cancer probability in the near future. Table 4 indicates the Risk of Cancer Incidence of the four procedures performed. The highest RCI obtained is for shoulder procedures in the FMC hospitals followed by SMH. In figure 3 & 4, indicated radiation risk of cancer incidence is remarkably high in shoulder procedure. This means that 1.63 cases per 100,000 people can develop cancer in their life time due to their exposure to X-radiation. It is very minimal. The order of magnitude are Shoulder > Hip > Femur > Upper arm.

V. CONCLUSION

The exposure parameters of patients undergoing Shoulder AP, Femur AP, Hip joint AP, and Upper arm AP examinations in two hospitals in Kebbi State, Nigeria, have been monitored. The findings of this research imply that there's an urgent need for justification and optimization of the used of radiation in radiology department by NNRA at the study centres. The training programs should be initiated in the centres in order to regulate radiation doses without loss of image quality. The Program should include Quality assurance, setting of guidelines for various exposures and courses in order to retrain the personnel so, they can be aware of latest developments in the field and protect the patients.

VI. REFERENCES

[1] Sadeka, S.R., Shakilur, R. M., Santunu, P., Kawchar, A.P., Moinul, H. M., and Mamun, A. A. (2014). Measurements of Entrance Surface Dose and Effective Dose of Patients in Diagnostic Radiography. Biomed J Sci & Tech Res, 4 (2), pp: 56-70.

[2] Bas, H., Mor, N. Altinsoy, and I. Söyler (2018). "ESTIMATION OF ADULT PATIENT DOSES FOR CHEST X-RAY EXAMINATIONS AND COMPARISON WITH DIAGNOSTIC REFERENCE LEVELS (DRLS)". Radiation Protection Dosimetry (2018), pp. 1–9 doi:10.1093/rpd/ncy076

[3] Ekeet BC, Akomolafe IR, Emelue HU (2019). A survey of X-ray diagnostic services in Imo State, Nigeria. RadiatProt Environ, 42:159-67

[4] Osibote, O.A., and de Azevedo, A.C.P.,(2008).Estimation of adult patient doses for common diagnostic X-ray examinations in Rio de Janeiro,Brazil. Physica Medica, 24, pp: 21-28

[5] Mohamed Anwar K. A (2010).Patient dose levels for seven different radiographic examination types. Saudi Journal of Biological Sciences, 17, 115–118

[6] Mettlerr, F.A., Terry, T. Y., and Mahadevappa, M. (2008). Effective Doses in Radiology and Diagnostic Nuclear Medicine. Radiologyjournal, 248(1), pp: 100-11

[7] Kharita, M. H., Khedr, M. S., and Wannus, K. M., (2010). Survey of patients doses from conventional diagnostic radiographic examination in Syria, retrieved on 22nd Nov 2020, available at www.radher.jp.

[8] Durga, P.R., and Seife, T.D. (2012). Radiation Exposure of Patients Undergoing Common Diagnostic X-Ray Examinations in Some Major Hospitals in Visakhapatnam, India. Journal of Medical Diagnostic Methods, 1(1), pp: 101-119.

[9] Ernest K, O., and Johnson, D. (2013). A Survey of Organ Equivalent and Effective Doses from Diagnostic Radiology Procedures. ISRN Radiology, pp: 1- 9. Published by Hindawi Publishing Corporation.

[10] Eljak, S.N.A., Ayad, C.E. and Abdalla, E.A. (2015) Evaluation of Entrance Skin Radiation Exposure Dose for Pediatrics Examined by Digital Radiography at Asser Central Hospital-KSA. Open Journal of Radiology, 5, 125-130. http://dx.doi.org/10.4236/ojrad.2015.53019