

**ASSESSMENT OF IONIZING RADIATION PROTECTION  
AWARENESS IN DIAGNOSTIC RADIOLOGIC SERVICES  
IN AKWA IBOM STATE, NIGERIA.**



ISSN: 2141 – 3290  
www.wojast.com

**ESSIEN, I. E. AND NYONG, A. B.**

*Department of Physics,  
University of Uyo, Nigeria*

*e-mail [imeessien27@yahoo.com](mailto:imeessien27@yahoo.com)*

**ABSTRACT**

The role of health workers in health care delivering is critical in the improvement of patient management and safety. To improve on this study, the level of radiation protection awareness among health workers in diagnostic radiologic services in Akwa Ibom State, Nigeria was assessed. A four part structured questionnaire was administered on 150 nurses in teaching hospital, school of nursing and a university health centre. Ninety (60%) of the nurses were 78(86.7%) females and 12(13.3%) males. Out of these, 38(42.2%) were student nurses, 23.3%, senior nurses and 34.45 % intern nurses. Seventy (77.8%), 32(35.56 %) and 50 (55.55%) of the nurses are aware that radiation could cause cancer of the skin, affect the intestine, brain, blood and affect pregnancy respectively. The level of awareness of ionising radiation and its effect was appreciable but on radiation protection was low because the nurses were not properly trained on this aspect of diagnostic radiology before being deployed to radiology department. 43% of the nurses wear radiation monitors while 56.67% did not. Again, out of the 39 nurses that wear monitors, 38.46% have it in their hospitals while 61.59% of the nurses do not. Most worrisome is that, 43 (47.78%) of the nurse were aware of the presence of a caution sign for restricted area while 47(52.22%) do not. It is recommended that the nurses should be properly trained and retrained on the job on engagement and principles of radiation safety should form part of their school curriculum. In addition, facility owners should endeavour to provide the necessary protective devices.

**INTRODUCTION**

Application of radiation in diagnostic radiology could be with ionizing or non- ionizing radiation. Ionizing radiation is the radiation capable of producing ion pairs directly or indirectly in biological tissue due to energy deposited in the tissue as they traverse biological systems (NNRA, 2003).

The use of ionizing radiation in medicine is of great concern since it could cause deleterious effect to the body, the benefits of diagnosis and therapy, notwithstanding. As a result, the use of ionizing radiation in medicine as well as in other human endeavour is under regulatory control to ensure that all applications of ionising radiation are conducted under stipulated regulations enacted to assure the practitioners and the public of safety against harmful effects of these radiations. Ultrasound, a non-ionising radiation is also used in medical diagnosis, anxiety of the patients notwithstanding (Antwi, *et al* 2015).

The use of X- rays in hospital and clinics for medical imaging is a global phenomenon and facilities in Akwa Ibom State could not be an exception. However to minimize the occurrence of harmful effects from the use of ionizing radiation in medical diagnosis, continuing education of the allied medical workers in medical facilities, whether tertiary, secondary or stand alone in the state has been advocated (Essien, *et al* 2013). In diagnostic radiology departments, nurses care for patients undergoing diagnosis or therapy with ionising radiations. They could also take part in the preparation of the patients, preparation of working tools and administration of radioactive and non-radioactive materials on the patients in the case of nuclear medicine and

also ensures patient safety (Brown, 2012). It is obvious that the nurses are vulnerable to the harmful effect of these radiations no matter how low the doses could be. Therefore it is pertinent that the nurses have proper knowledge of the occupational hazards due to the exposures from these radiation emitting devices.

Studies have been conducted on the level of awareness of knowledge of ionising radiation on different categories of workers in health institutions, these include awareness of radiographers (Mojiri and Moghimbeigi, 2011, Kamara-Briggs, *et al* 2013), awareness of medical students (Mubeen *et al* 2008), awareness of medical staff and awareness of medical technologists (Duriye *et al* 2005).

Nurses are expected to be aware of the basics of radiation protection, and risks from medical exposures so as to offer first-hand information about it to the patients and members of the public, since the nurses are assumed to be closer to the patients than other radiation workers in the preparation of patients for diagnosis and administration of therapy. The principle of radiation protection in diagnostic radiology is governed by the principle of As Low As Reasonable Achievable (ALARA) which involve the use of minimum radiation dose for maximum diagnostic benefits. Nurses receive doses of radiation though, not from the direct beam, could be from scattered radiation and residual radiation after operation of the emitting device. Although the dose received by nurses is low in principle, it is proportional to patient dose obtained from the direct beam. The dose received is quantified using Equation 1.

$$D = d \times t \quad 1$$

Where D is the dose received by the nurse from radiation of dose rate d and t is the period of exposure. Equation 1 shows that the dose accumulated by a person working in an area having a dose, rate is directly proportional to the length of time he spends in the area. Hence to reduce dose the nurse should spend less time in the controlled area after irradiation. The dose is also inversely proportional to the square of the distance r between the source of the radiation to the receptor. Equation 1 is thus modified as

$$D = \frac{d \times t}{r^2} \quad 2$$

Equation 2 shows that the farther the nurse is from the source of radiation the less the radiation risk and protective clothing is required by the nurse for their protection against scattered radiation. Equally the Maximum Permissible Dose (MPD) of radiation which is age related is also given as in Kamara-Briggs and Erondu (2012)

$$MPD = 5(N - 18) \quad 3$$

Equation 3 implies that no person should have occupational exposure within 18 years of age.

Nurses in the area of study Akwa Ibom State, Nigeria are predominantly women therefore the principle of 10-day and 28-day rule to minimize the risk of radiation to women of reproductive age is quite inevitable (Alotaibi, *et al* 2012)

The aim of this study is to assess the awareness of nurses providing diagnostic radiologic services in Akwa Ibom State.

## MATERIALS AND METHOD

In this survey, a questionnaire was used as the tool to obtain information from the nurses. The nurses were both female and male, who included student nurses, intern nurses and long standing nurses practicing in hospitals in Akwa Ibom State. The nurses investigated were in the University of Uyo Teaching Hospital, a General Hospital which houses the School of Nursing and nurses in a University of Uyo Health centre. The questionnaire was in four parts;

Part A obtained demographic data such as age, gender, department, years of experience and professional status. Part B assessed the level of confidence of the nurses on their knowledge of

ionising radiation. Part C was on their awareness on the detrimental effect of ionising radiation. Part D was on awareness of the concept of radiation protection and organs sensitivity to radiation. Completed questionnaires were analysed and presented in percentages.

## RESULTS

The questionnaires were administered on 150 nurses in the various medical establishments. Out of 90(60%) seventy eight (86.7%) were females while 13.3% were males. Amongst these were 20(22.2%) were senior nursing officers, 33.3%, interns' nurses and 44.5% student nurses. It was also gathered that 40(44.4%) were in General Nursing, 10(11.1%) in Community Health, 25(27.78%) in Midwifery and 16.67% in Radiology Department. The demographic details of the respondents are presented in Table 1.

Table 1: Demographic detail of respondents

Details		Frequency	% score
Professional status	Senior officers	21	23.33
	Interns nurses	31	34.45
	Student nurses	38	42.22
Years of professional experience	2-5 years	35	38.89
	5-10 years	30	33.33
	10-15 years	15	16.67
	Above 15 years	10	11.11
Age	18-30 years	40	44.44
	30-50 years	45	50.00
	Above 50 years	5	5.60
Sex	Male	12	13.33
	Female	78	86.67
Department	General nursing	40	44.44
	Community health	10	11.11
	Midwifery	25	27.78
	Radiology	15	16.67

The highest respondents were student nurses (38) (42.22%) while 31 (34.44%) were interns, relatively more experienced than the students nurses. Table 1 also show variations in the year of experience of the respondents. 38.89% were of 2 - 5 years, likely student nurses, 45 (50%) were between 5 – 15 years while 10 (11.11%) had experience above 15 years. 40 (44.44%) were young while 50 (55.6%) were between 30-50 years and 5 (5.60%) were above 50 years.

Table 2 shows responses of the nurses on confidence level in their knowledge of ionizing radiation. Analysis of their responses shows that 21(23.33%) were Very Confident (VC), 45.56 % were Moderately Confident (MC) while 31.11 % were Not Confident (NC).

Table 2.0: Level of confidence in the knowledge of ionizing radiation

Items	Rating	Frequency	% score
How confident are you in your knowledge of ionising radiation used in radiologic services	VC	21	23.33
	MC	41	45.56
	NC	28	31.11
	NA	Nil	Nil
How important is the knowledge of ionising radiation	VI	32	35.56
	MI	22	24.44
	NI	31	34.44
How did you know about ionising radiation	Seminar	37	41.11
	Tutorials	20	22.22
	Training	28	31.11
	Private discussion	5	5.56
If you were to have a choice which method of education do you think would help	Training	24	26.67
	Workshop	23	25.56
	Combination of two above	43	47.78

Rating of their awareness on the importance of ionising radiation reveals that 32(35.56%) of the nurses accepted that it is Very Important (VI) to have knowledge of ionising radiation, 22(24.44%) say it is Moderately Important (MI) while 34.44% attached No Importance (NI) in knowing ionising radiation. In addition, 41.11% of the nurses knew ionising radiation through seminar, 22.22% through tutorials and 28 (31.11%) through training. Consequently, 43 (47.78%) of the nurses chose training and workshop as the better method of knowing ionising radiation.

The level of information of the nurses on the detrimental effect of ionising radiation is presented in Table 3. On the effect of frequent x-ray examination, 30(33.33%) of the respondents confirmed that it is harmful, 55 (61.11%) said it is beneficial and while 5.56 % were not sure.

Table 3: Knowledge of the detrimental effect of ionising radiation:

Items	Rating	Frequency	% score
Frequent x-ray examinations is	Harmful	30	33.33
	Beneficial	55	61.11
	Not sure	5	5.56
Ionising radiation causes cancer of the skin	True	70	77.78
	False	13	14.44
	Not sure	7	7.78
X-ray could affect the intestine, brain and blood	True	32	35.56
	False	33	36.67
	Not sure	25	27.77
Are you attached to an x-ray department?	Yes	35	38.89
	No	55	61.11
At what age were you engaged in the x-ray unit	Below 18 years	Nil	Nil
	Above 18 years	20	57.14
	Above 30 years	15	42.86
How long do you stay in the x-ray room after irradiation	10 -20 mins	13	37.14
	20-60 mins	17	48.57
	1-5hrs	5	14.29
Radiation affects pregnancy	Yes	50	55.56
	No	15	16.67
	It may	25	27.77
If yes she should be relieved of her duties until after delivery	Yes	20	22.22
	No	45	50.00
	After six months of pregnancy	22	24.44
	Some months before delivery	13	14.44

70 (77.8%), 32(35.56 %) and 50 (55.55%) of the nurses know that radiation could cause cancer of the skin, affect the intestine, brain, blood and affects pregnancy respectively. In addition, 14.44%, 36.67 % and 16.67% respectively say it is false while 7 and 25 nurses were not sure of the effect of radiation on the skin and intestine, blood etc. It could also be obtained from Table 3 that none of the nurses was employed below 18 years of age while 22.22 % and 16.67% were engaged above 18 and 30 years respectively. Nurses respond on the sensitivity of vital human body organs to ionising radiation is reported in Table 4. It shows that on the sensitivity of ovary and testes to ionising radiation, 35(38.89%), 19(21.11%) and 5(5.56%) responded as Moderately Sensitive (MS), Very Sensitive (VS) and Moderately Insensitive (MI) respectively while 34.44% did not know (IDK) if it was sensitive. Furthermore, 20(22.22%), 35(38.89%) and 5.56% saw the human breast as being moderately sensitive, very sensitive and moderately insensitive respectively to ionising radiation. Most of the nurses (44.44%) did not know if the liver, bladder and kidney were sensitive to ionising radiation.

Table 4: Organs sensitivity to radiation and radiation protection

Items	Rating	Frequency	% Score
Sensitivity of ovary/ testes to ionising radiation	MS	19	21.11
	VS	35	38.89
	MI	5	5.56
	I don't know(IDK)	31	34.44
Breast	MS	20	22.22
	VS	35	38.89
	MI	5	5.56
	I don't know (IDK)	30	33.33
Liver/kidney/bladder	MS	26	28.88
	VS	31	34.44
	MI	13	14.44
	I don't know (IDK)	40	44.44
Do you wear any radiation monitor?	Yes	39	43.33
	No	51	56.67
If yes, which one do you wear	Film badge (FB)	10	25.64
	TLD	1	2.56
	Google (GOG)	9	23.08
	Protective covering (PC)	18	46.15
Do you have it in your hospital?	Yes	15	38.46
	No	24	61.59
Do you know restricted area caution sign?	Yes	43	47.78
	No	47	52.22
Do you know of the 10-day and 28 day rule for women?	Yes	40	44.44
	No	31	34.44
	No idea	19	21.11
Are you aware of the presence of NNRA?	Yes	10	11.11
	No	75	83.33
	No idea	5	5.56

On the use of radiation monitors, it was revealed that 43.33% of the nurses wear radiation monitors while 56.67% did not. Again, out of the 39 nurses that wear monitors 38.46% have it in their hospitals while 61.59% of the nurses do not have it in their facilities. Table 4 also revealed that 43 (47.78%) of the nurse were aware of the presence of a caution sign for restricted area while 47(52.22%) do not. Moreso, a greater number (83.33%) of the nurses were not aware of the presence of a regulatory body in Nigeria on the use of ionising radiation in Nigeria, Nigerian Nuclear Regulatory agency.

### DISCUSSION

Nurses are categorized as radiation workers in diagnostic radiologic services, because in the course of their routine participation in radiologic services they may likely receive radiation dose in excess of 1mSv per year for the whole body.

This level of exposure to ionising radiation though low should be of concern in diagnostic radiology profession because of the resultant stochastic and deterministic effect (BIER V. 1990, Kondo, 1993). Furthermore this study is necessary because nurse performance is fundamental to patient safety in health care delivery system as enshrined in International Council of nurses (ICN) code of ethics, (ICN code of ethics for nurses, 2012, Kohibrenner, *et al* 2011).

The result obtained shows that most of the nurses who participated in the survey were not very confident in their knowledge of ionising radiation and its consequent harmful effects. This observation could be caused by their source of information on ionising radiation as only 31.11% got it through formal training. However greater number of them accepted the importance of ionising radiation in diagnostic radiology. This could come from their age long idea about the use of x-rays in hospital for taking photographs but not as a professional, as this

could also explain why 61.11% of the nurses states that frequent x-ray examination is beneficial, cumulative harmful effect and the consequent increased dose notwithstanding. Conversely it has been reported that the probability of carcinogenic effect of radiation doubles as radiation dose doubles (Kondo, 1993). Poor knowledge of the nurses on the relationship between their duration of interaction with radiation, the dose of radiation and the effect of radiation also is identified with some spending much time in the x-ray room after irradiation. Rather it is expected that a radiation worker should not stay longer in an x-ray room after the machine has been switched off to avoid effect of dark current from x-ray emission. It was also observed that none of the nurses was employed in the radiology department below the age of 18 years. This is a good radiation protection practice by facilities owners because it is in keeping with standard regulation of no radiation worker should be engaged below 18 years as explained in Equation 3 (ICRP, 1996).

On radiation protection awareness, most of the nurses (43.38%) do wear radiation monitors; though among them only 38.46 % have them in their hospitals. The inadequate supply of these protective devices exposes our radiation workers to radiation risk.

Most of the nurses (86.67%) were female of child bearing age (11-55 years) and their responds to the effect of radiation on pregnancy reveals that 55.56% were sure that exposure to radiation could affect the foetus while 44.44% were not sure and this knowledge deficits on radiation protection of pregnant radiation workers is seen in their lack of knowledge of the 10 day or 28 day rule of radiation safety of pregnancy. This rule stipulates that before performing x-ray examination on a female patient of child bearing age, that radiological examination of the pelvic area should be taken in the ten periods following the onset of menstruation since the risk of pregnancy is very small during that period (Phillip, 1999). This inadequate information on radiation safety of female of child bearing age by the nurses portend a great danger in health care delivery because they would not properly advise a female patient who presents herself for radiological examination.

In Nigeria, the nuclear energy application regulator, the NNRA stipulates that for the safety of the public and radiation workers areas within the hospital that accommodates radiation emitting devices be restricted and designates as either supervised or controlled area. These areas should be restricted with a clearly and conspicuously placed warning sign (NNRA, 2003). Unfortunately, our survey reveals that 52.22% of the respondents were not aware of the presence of warning sign which could lead them into radiation risk by being exposed to radiation above dose limit. The poor knowledge on radiation protection issues among radiation worker is not limited only to nurses but is reported among other paramedics, medical students and referring physicians (Mojiri and Moghimbeigi, 2011, Sarah, *et al* 2011,). It could be assumed that the cause of this deficit in the knowledge of ionising radiation is inadequate information from their source as only 31% of them were properly trained while others got their information through seminars, tutorials and private discussions (Fig 2).

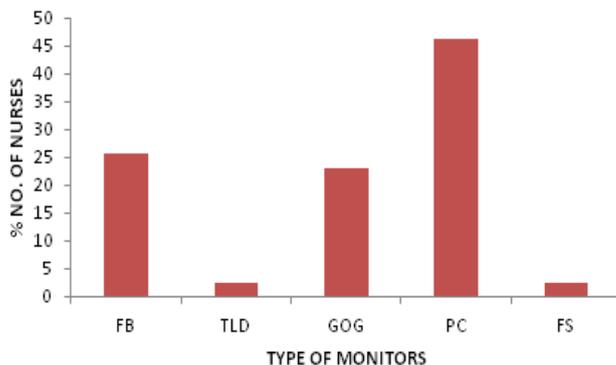


Figure 1: Number of personnel per type of monitor

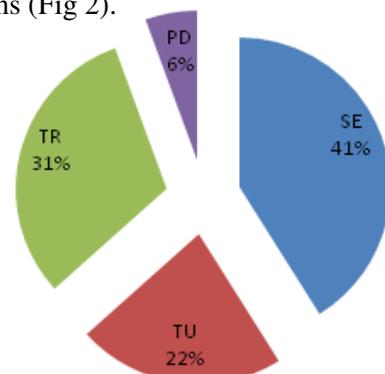


Figure 2: Percentage of nurses and method of awareness

This knowledge deficit is not peculiar to nurses engaged in radiologic services in Akwa Ibom State only as it is reported elsewhere, (Ohno and Kaori 2011). However, all the nurses showed interest in learning about ionising radiation and radiation protection properly (Table 1). This is consistent with studies elsewhere.

Figure 3.0 shows the rating of sensitivity of organs to radiation. It is good that most of the nurses state that, these organs are very sensitive to ionising radiation but 40% were confused if liver, kidney and bladder could be affected by radiation. This could be because these organs are embedded in the body such that it could be difficult for radiation to get to them.

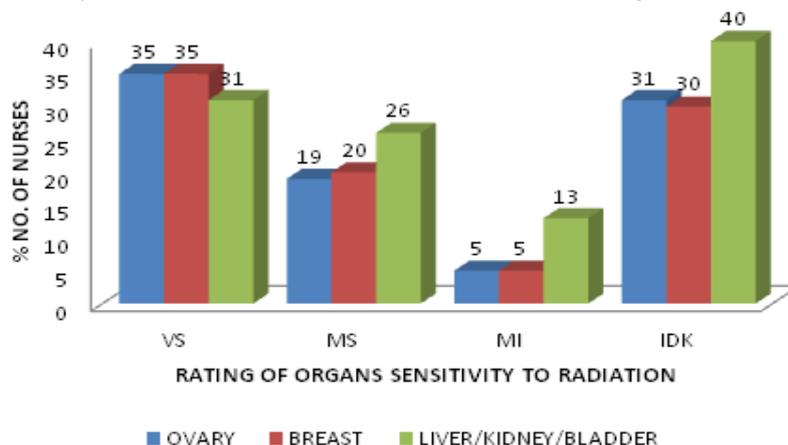


Fig 3: Rating of organ sensitivity to radiation

### CONCLUSION AND RECOMMENDATION

The level of awareness of the principles of radiation protection among our nurses is low. This is because these nurses were deployed to the radiology department without adequate training. As most of them have preferred to be properly trained, the facility owner should encourage and provide them with protective devices. The retraining of the nurses is necessary as the negative impact on the radiation workers and the patient can best be imagined.

### REFERENCES

- Antwi, W. K, Kyei, K. A, Gawugah, J.N, Opoku, S. Y and Ogbuokiri (2015). Anxiety level among patients undergoing ultra sound Examination in Ghana. *International Journal of Medical Imaging*. 3 (1): 6-10
- Alotaibi, M., Al Abdulsalam, A., Bakir, Y. Y and Mohammed, A. M. (2012). Radiation awareness among nurses in nuclear medicine departments. *Australian Journal of Advanced Nursing*. 32 (3): 25-33
- BIER V (1990). *Health Effects of Exposure to Low Level of Ionizing Radiations*, Washington D. C, National academy press.
- Brown, C. D (2012). Improving patients care in the diagnostic imaging department, the role of the nurse navigator. *Journal of Radiology Nursing*, 31(3): 97-100
- Duriye, O., Yaildirim, M., Kaya, V., Parlak, E and Yalcin, Y (2005) Radiation safety awareness in medical staff, *Journal of clinical and analytical medicine*, 6(4): 436-438
- Essien, I. E, Inyang, S. O and Akpan, I. O. (2013), Quality control programmes in diagnostic radiology facilities in Akwa Ibom State, Nigeria, *World Journal of Applied Science and Technology*, 5(2): 232-236
- (ICN)(2012). *The ICN Code of Ethics for Nurses*. International Council of Nurses
- ICRP(1996). *Radiological Protection and Safety in Medicine*, Oxford, International Commission on Radiological Protection Publication

- Kamara-Briggs, M. A, Okoye, P. C and Omubo-Pepple, V. B (2013): Radiation Safety awareness among patients and radiographers in three hospitals in Port Harcourt. *American Journal of Scientific and Industrial Research*, 4(1): 83-88
- Kamara-Briggs, M. A. and Erondu, F. O, (2012): Fundamentals of radiation detection, dosimetry and radiobiology: *Book-Konzult*, Nigeria
- Kohibrenner, J., Whitelaw, G and Cannaday, D (2011), Nurses critical to quality, safety and now financial performance. *Journal of Nursing Administration*, 41(3): 122-128
- Kondo, S. (1993). Health effects of low level radiation, *Kinki University Press*, Osaka, Japan, 50
- Mojiri, M and Moghimbeigi (2011). Awareness and attitude of radiographers toward radiation protection. *Journal of Paramedical Sciences* 2(4), 2-5
- Mubeen, S. M., Abbas, Q and Nisar, N (2008). Knowledge about ionizing and non-ionizing radiation among medical students. *Journal of Ajub Medical College*, Abbottabad, 20(1), 118-121
- Ohno, K. and kaori, T. (2011). Effective education in radiation safety for nurses. *Radiation Protection Dosimetry*. 147(1-2): 343-345
- Phillip, W. B (1999). Radiographic positions and radiologic procedures 7<sup>th</sup> edition, Mosby year Book, incorporated, Chicago, 25
- Sarah, K., Hagi, S. K. and Khafaji, M. A.(2011). Medical students knowledge of ionizing radiation and radiation protection. *Saudi Medical Journal* 32(5) 520-524.
- NNRA (2003). Nigerian basic ionizing radiation regulations, Federal Government Press, Lagos, Nigeria.