Journal of Engineering and Applied Science *Volume 4, September 2012*

MEASUREMENT OF RADIATION EXPOSURE TO PATIENTS DURING CHEST X-RAYS EXAMINATIONS AT LAUTECH TEACHING HOSPITAL, OSOGBO, SOUTH-WEST, NIGERIA.

[1]Ajayi J.O, [1]Adedokun O. and [2]Olabisi O
[1]Department of Pure and Applied Physics
[2]Department of Science Laboratory Technology
Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
E-mail: simpleajayi@yahoo.com

ABSTRACT

Radiation doses received by patients during chest x-ray examinations were measured at the LadokeAkintola University of Technology Teaching Hospital, Osogbo on two different machines. Absorbed doses from full-size radiography were found to be within the acceptable limits for the posterior-anterior (P.A) view in adult and in children. The KV range for the two categories of patients, i.e. the adult and older children were recorded on the two generator types used, i.e. Phillips and Neo Diagnomax. The mean skin-entry doses of the patients x-rayed on the two generator types were obtained to be 64.18mrad and 61.46mrad for adult and children respectively on Philips generator, and 65.08mrad and 61.20mrad for adult and children respectively on Neo-Diagnomax.

Keywords: *Doses, Photoflourographic techniques, standard deviation, Radiography, medical irradiation*

INTRODUCTION

Radiological examination of the chest constitute the most common type of x-ray investigation in many parts of the world and this renders it one of the leading contributors to the collective population dose of medical irradiation, deposits the fact that when performed properly, the dose per examination is usually quite low as carried out in Kenya [5]. A full-size chest examination in which the image receptor is an x-ray film sandwiched between a pair of fluorescence screens in a cassette, delivers typically a skin entry dose of the order to 20mrad (0.2mgy) to an adult in the posterior-anterior (P.A) view, although doses lower than 5mrad can be achieved with more efficient rare-earth intensifying screens or by medium or high-frequency converter-generators. These doses compared with a radiation dose, equivalent to about 200mrad (20mGy) of x-rays received annually by every member of society from natural background radiation as reported [2]. On the other hand, chest imaging using the photoflourographic techniques, in which the subjects image is first projected onto a fluorescent screen and then optically photographed, recording the final image on miniature size x-ray film not in contact with the screen, has been shown to be associated with considerably higher doses as well as interior image quality. Despite these drawbacks, photofluorography (PFG) without image in densification is still practiced quite extensively in some countries, because of its cheaper film costs, the possibility for rapid patients' turnover while large numbers of patients have to be examined and its easy adaptability to mobile facilities.

METHODOLOGY

Radiation doses were monitored during chest x-ray examination at LaokeAkintola University of Technology Teaching Hospital, Osogbo on two different machines; viz-a-viz: Philips and Neo-Diagnomax both having source to image receptor distance (SID) of 180cm. The examinations were monitored on 160 adults and 70 children (Note that children considered are within the age range of 7 to 14 years). In both the two categories of patients, adult and children, posterior-anterior views were taken with the patients erect, and their KV range recorded. The numbers of patients monitored at each x-ray machine are shown in the tables 1 and 2.

Measurement and Data Calculation

The mean skin-entry doses for both adult and children were calculated and the respective standard deviations were also calculated.

Table 1a: Measurement for Phillips Generator (Adult)

KV range	Frequency (F)	Mid Value (Xm)	Xmf	Xm^2	Xm^{2}f
60-61	25	60.5	3660.25	9150.25	1512.5
62-63	21	62.5	3906.25	82031.25	1312.5
64-65	22	64.2	4160.25	91525.50	1419.0
66-67	20	66.5	4422.25	88445.00	1330.0
68-69	17	68.5	4792.25	79768.25	1164.5
Total	105			433276.25	6738.5

$$Mean, \quad \bar{x} = \frac{\Sigma xmf}{n} = \frac{6738.5}{105}$$

$$\therefore \ \bar{x} = 64.18mrad$$

Also, the standard deviation = $\sqrt{\left[\frac{\Sigma x^2 mf}{n} - \bar{\boldsymbol{x}}^2\right]}$

$$\Rightarrow \sqrt{\left[\frac{433276.25}{105}\right] - 641.8^2}$$

$$\sqrt{4126.11 - 4119.07} = \sqrt{7.37}$$

$$\therefore \mathrm{S.D} = 2.7$$

Table 1b: Measurement for Philips generator (Children)

KV range (Children)	Frequency (F)	Mid Value(Xm)	Xmf	Xm^2	Xm^{2}f
60-61	26	60.5	1573	3660.25	95166.5
62-63	24	62.5	1500	3906.25	93750.0
Total	50		3073		188916.5

$$Mean, \quad \bar{x} = \frac{\Sigma xmf}{n} = \frac{3073}{50}$$

$$\therefore \ \bar{x} = 61.46mrad$$

Also, the standard deviation = $\sqrt{\left[\frac{\Sigma x^2 mf}{n} - \bar{\boldsymbol{x}}^2\right]}$

$$\Rightarrow \sqrt{\left[\frac{188916.5}{50}\right] - 641.8^2}$$

$$= \sqrt{3778.33 - 3777.33} = \sqrt{1.0}$$

$$\therefore \mathrm{S.D} = 1.0$$

Table 2a: Measurement for Neo-diagomax generator (Adult)

KV range	Frequency (F)	Mid Value(Xm)	Xmf	Xm^2	Xm^2f
62 – 63 64 – 65 66 – 67 68 – 69	17 15 13 10	62.5 64.5 66.5 68.5	1062.5 967.5 864.5 685.0	3906.25 4160.25 4422.25 4692.25	66406.25 62403.75 57489.25 46922.5
Total	55		3579.5		233221.75

$$Mean, \quad \bar{x} = \frac{\Sigma xmf}{n} = \frac{3579.5}{55}$$

$$\therefore \ \bar{x} = 65.08 \, mrad$$

Also, the standard deviation = $\sqrt{\left[\frac{\Sigma x^2 mf}{n} - \bar{\boldsymbol{x}}^2\right]}$

$$\Rightarrow \sqrt{\left[\frac{233221.75}{55}\right] - 66.08^2}$$

$$= \sqrt{4240.40 - 4235.41} = \sqrt{4.99}$$

$$\therefore \mathrm{S.D} = 2.23$$

Table 2b: Measurement for Neo-diagomax generator (Children)

KV range (Children)	Frequency (F)	Mid Value(Xm)	Xmf	Xm^2	Xm^2f
60 – 61 62 – 63	13 7	60.5 62.5	786.5 437.5	3660.25 3906.25	47583.25 27343.75
Total	20		1224.0		74927.00

$$Mean, \quad \bar{x} = \frac{\Sigma xmf}{n} = \frac{1224}{20}$$

$$\therefore \ \bar{x} = 61.20 \, mrad$$

Also, the standard deviation = $\sqrt{\left[\frac{\Sigma x^2 mf}{n} - \bar{\boldsymbol{x}}^2\right]}$

$$\Rightarrow \sqrt{\left[\frac{233221.75}{55}\right] - 66.08^2}$$

$$= \sqrt{3746.35 - 3745.44} = \sqrt{0.91}$$
$$\therefore S.D = 0.9$$

RESULTS

Skin-entry doses are shown in the tables 3 – 4 for both adult and children for the posterior-anterior view.

WEEK1

Table 3a: Skin-entry doses for adult and children for week 1

					kV range		
Centre	Generator type	Total tube filtration	SID	Radiographic view	Range	Adult	Children
LAUTECH TEACHING HOSPITAL	PHILIPS	1.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	2 3 5 2 4	1 5 – – –
	NEO – DIAGNOMAX	2.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	– – 2 4 2	– 2 – – –

WEEK2

Table 3b: Skin-entry doses for adult and children for week 2

					kV range		
Centre	Generator type	Total tube filtration	SID	Radiographic view	Range	Adult	Children
LAUTECH TEACHING HOSPITAL	PHILIPS	1.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	2 3 5 2 4	1 5 – – –
	NEO – DIAGNOMAX	2.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	– – 2 4 2	– 2 – – –

WEEK3

Table 3c: Skin-entry doses for adult and children for week 3

					kV range		
Centre	Generator type	Total tube filtration	SID	Radiographic view	Range	Adult	Children
LAUTECH TEACHING HOSPITAL	PHILIPS	1.0	180	P.A	60 – 61	5	4
					62 – 63	4	2
					64 – 65	7	–
					66 – 67	3	–
					68 – 69	1	–
	NEO – DIAGNOMAX	2.0	180	P.A	60 – 61	–	1
					62 – 63	3	–
					64 – 65	3	–
					66 – 67	2	–
					68 – 69	–	–

WEEK4

Table 3d: Skin-entry doses for adult and children for week 4

					kV range		
Centre	Generator type	Total tube filtration	SID	Radiographic view	Range	Adult	Children
LAUTECH TEACHING HOSPITAL	PHILIPS	1.0	180	P.A	60 – 61	6	7
					62 – 63	5	4
					64 – 65	2	–
					66 – 67	10	–
					68 – 69	3	–
	NEO – DIAGNOMAX	2.0	180	P.A	60 – 61	–	3
					62 – 63	4	–
					64 – 65	3	–
					66 – 67	3	–
					68 – 69	–	–

WEEK5
Table 3e: Skin-entry doses for adult and children for week 5

					kV range		
Centre	Generator type	Total tube filtration	SID	Radiographic view	Range	Adult	Children
LAUTECH TEACHING HOSPITAL	PHILIPS	1.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	3 1 2 1 4	5 9 – – –
	NEO – DIAGNOMAX	2.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	– 5 3 1 3	5 3 – – –

WEEK6
Table 3f: Skin-entry doses for adult and children for week 6

					kV range		
Centre	Generator type	Total tube filtration	SID	Radiographic view	Range	Adult	Children
LAUTECH TEACHING HOSPITAL	PHILIPS	1.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	6 1 2 3 2	8 3 – – –
	NEO – DIAGNOMAX	2.0	180	P.A	60 – 61 62 – 63 64 – 65 66 – 67 68 – 69	– 3 3 1 5	3 1 – – –

Table 4: Table for statistical analysis for skin-entry doses during chest x-ray examinations

Centre	Generator type	Radiographic view	Number of patients	Mean dose (mRad)	Standard deviation
LAUTECH TEACHING HOSPITAL	PHILIPS	P.A P.A	Ad: 105 Ch: 50	64.18 61.46	2.7 1.0
	NEO – DIAGNOMAX	P.A P.A	Ad: 55 Ch: 20	65.08 61.20	2.23 0.95

Keys: Ad = Adult
Ch = Children

CONCLUSION

Statistically, using the coefficient of variability, there is no significant difference between the measurements made on the two different machines, as the coefficient of variability gives percentage difference of 0.78% for adults on the two machines and 0.75% for children. In children examined frequently, consideration could be given to reducing the doses further by using rare-earth intensifying screens.

REFERENCES

Anthony Seibert, Bushburg Jerrold, Edwin Leidholdt and John Boone (2002).The Essential of Physics of Medical Imaging.

Dendy P.P. and Heaton B. (1999). Physics of Diagnostic Radiology.

Fischnach F.T. and Dunning M.B. (2009).Manual of Laboratory and Diagnostic Tests, 8th Ed. Medicalmnemonics.com, Chest X-ray Interpretation 2002.

Novelline Robert (1997). Fundamentals of Radiology. Harvard University Press. 5th Edition.

Tole N.M. (1987). Radiation Exposure to Patients During Chest X-ray Examination: A Survey in Kenya.

www.radiologyinfo.org