BIO Web of Conferences **116**, 06009 (2024) https://doi.org/10.1051/bioconf/202411606009
EBWFF 2024

Skin dose estimation in adults undergoing diagnostic chest X-ray examinations at Al-Zahra Teaching Hospital in Wasit Governorate, Iraq

Ali Saeed Jassim[1], *Zahraa Saad* Hamza[2], *Hussien Abid Ali Bakir* Mraity[1], *Ali Abid* Abojassim[1*], and *Rana Fadhil* Mousa[3]

[1]University of Kufa, Al-Najaf, Iraq
[2]College of Health and Medical, University of AL-Zahraa for Women, Karbala, Iraq
[3]University of Kerbala, Karbala, Iraq

Abstract. This research intended to calculate skin dose (mgy) was determined in 30 adult patients. The average value of the Tube's potential kVp range from 72 kVp To 100 (kVp) is 9.646±1.76 kVp. The average value of the SSD (cm) range from 100 cm to 180 cm is 22.558±4.118 cm, and the average value of the Tube load (mAs) range from 3 MAs to 16 MAs is 3.727±0.680. Additionally, the SKIN DOSE was from 0.06 mGY to 0.57 mGY, with an average of 0.120 mGY. It was found that the dose results were within the prescribed range of 0.4 mGy; this is recommended by international organizations that protect against radiation. Except for a few instances, the frequency of quality assurance (QA) and quality control (QC) was higher. As a result, the skin dose to patients who have chest exams at Al-Zahra Teaching Hospital in Wasit Province was equivalent to the Global standard.

1 Introduction

Ionizing radiation has long been used for medicinal purposes, where it is acknowledged to improve patient care and have real health advantages [1].The dosimetric measurement and the diagnostic picture quality are inextricably linked in radiology [2]. The quality of radiographic pictures determines the usefulness of diagnosis [3]. Since 0% risk is nearly unachievable, radiation protection of imaging patients appears to be an emergency scenario that calls for extra care in practice [4]. The provided dose must not be increased without a valid cause and must be routinely verified for comparison with diagnostic reference values [5]. To account for variations in dosage and these irradiation characteristics, regulatory actions might need to be taken into consideration [6]. Furthermore, diagnoses that rely on the quality of the image data could not be relevant or might be used in place of DRL. The concepts of rationality and optimization serve as the foundation for radiation protection for medically exposed people [7]. A Diagnostic Reference Level, or DRL, is described as "a dose value in diagnostic practice in medical radiology or, in the case of radiopharmaceuticals, an activity value in a standard examination of a typical patient

* Corresponding author: ali.alhameedawi@uokufa.edu.iq

population or a typical brain over a wide range of installation types" [8]. Respect for reference values is not a prerequisite for excellent behavior in and of itself. The primary objective that cannot be separated from dosimetry is the image's diagnostic quality [9]. Determining the dosage depending on the degree of asymmetry is crucial to understanding these doses. Since 75% of the population receives doses below this, the calculation of these values must be based on statistical techniques that measure the 75th percentile of the dose distribution [10-12]. The high radiation dose necessary for the patient and improper use of radiological equipment are common causes of dosimetry issues [13]. Features associated with process standardization should be included in optimization and dosage determination approaches [14]. In routine radiography, factors that affect patient dosage can be divided into the following groups [10]. To calculate the dosage at skin penetration, a number of computer methods have been put forth. Our approach, nevertheless, makes advantage of power estimates [15]. The radiation field's magnitude. The value of DAP is independent of the observed distance due to two principles of physics: the reciprocal of the square of the distance and Taylor's theorem in geometry [16]. This study's objective was to quantify the skin dosage that adult patients at Al-Zahra Teaching Hospital in Wasit Governorate received during diagnostic PA chest X-ray scans. By examining the variables that affect skin dosage, this study aimed to offer useful information for optimizing radiation dose for patients having chest X-ray exams.

2 Materials and methods

The radiography records of fifty patients who had chest exams at Al-Zahra Teaching Hospital in Wasit Governorate between April and July 2023 provided the information on skin dosages. Peak tube voltage (kVp), exposure duration (mAs), and focus-film distance (SSD) were the reported characteristics. These variables were used to an empirical connection that is described as follows in order to determine the skin dose:

$$\text{Skin does(mGy)}=418\ (\text{kVp})^{1.74}.\ \text{mAs}.\ (1/T+0.114)/(\text{SSD})^{2} \quad \ldots\ldots(1)$$

where kVp is the peak voltage, which determines the penetration quality, mA is the lamp current, which determines the number of electrons emitted by the filament, SSD = FFD - thickness of the patient, where SSD is the distance from the source (cm) to the skin. where (T) is the total filtration of the X-ray beam, which was kept constant in this study (2.5 mmAl) since all devices considered are from the same manufacturer; ShiMADZU. [17, 18]. The above equation was formulated in a simple program using Matlab to facilitate the process of mathematically calculating patient skin radiation dose. Table 1 shows the distribution of sociodemographic factors among patients participating in this study. To correctly understand the results of radiological examinations and dosimetry, these anthropometric data (sex, age, and weight) must be provided. The full set of measurements was obtained from 30 adult men and women. Additionally, the age range was 28 to 55 years, with a mean age of 28.5 years and a standard deviation of 5 years.

Table 1. The distribution of sociodemographic factors among patients participating in this study.

Radiography	gender	Age (years)	Weight (kg)
Chest	M 15 F 15	(25-55) (28-53)	(62-87) (55-82)

M: male. F: female

3 Results

Table 2 shows the numerical values of the main patient exposure parameters: kVp, mAs, and SSD, and the skin dose results calculated from these parameters at Al-Zahra Teaching Hospital in Wasit Governorate. the value of Tube potential kVp from 72 kVp To 100 (kVp) is the average of 9.646±1.76 kVp. the value of SSD (cm) from 100 cm to 180 cm is an average of 22.558±4.118 cm and the value of Tube loading (MAs) from 3 MAs to 16 MAs is an average of 3.727±0.680. also the SKIN DOSE from 0.06 mGY to 0.57 mGY an average of 0.120±0.021 mGY (Fig. 1).

Table 2. Exposure factors and calculated skin radiation doses for the eight examinations considered at Al-Zahra Teaching Hospital in Wasit Governorate.

No. Patient	Tube potential (kVp)		SSD (cm)	Tube loading (mAs)	Skin DOSE(mGy)
1	80		137	5	0.13
2	75		100	5.5	0.24
3	70	100	6	0.23	
4	70	100	4.5	0.17	
5	80	100	10	0.49	
6	75	150	15	0.290	
7	78	140	11	0.26	
8	73	138	16	0.35	
9	85	153	12	0.28	
10	90	137	10	0.32	
11	80	170	9	0.15	
12	100	165	7	0.18	
13	100	135	14.5	0.57	
14	85	133	15	0.46	
15	100	175	3.5	0.08	
16	95	178	3	0.06	
17	87	180	7	0.12	
18	86	136	9	0.27	
19	96	141.5	11	0.37	
20	100	145	4	0.14	
21	90	160	7	0.16	
22	72	155	8	0.13	
23	76	135	9	0.22	
24	82	166	12	0.22	
25	85	158	16	0.35	
26	90	140	13	0.40	
27	93	139	6.5	0.21	
28	100	170	8.4	0.21	
29	80	166	10	0.18	
30	75	133	11.5	0.28	
the average	9.646±1.76	22.558±4.118	3.727±0.680	0.120±0.021	

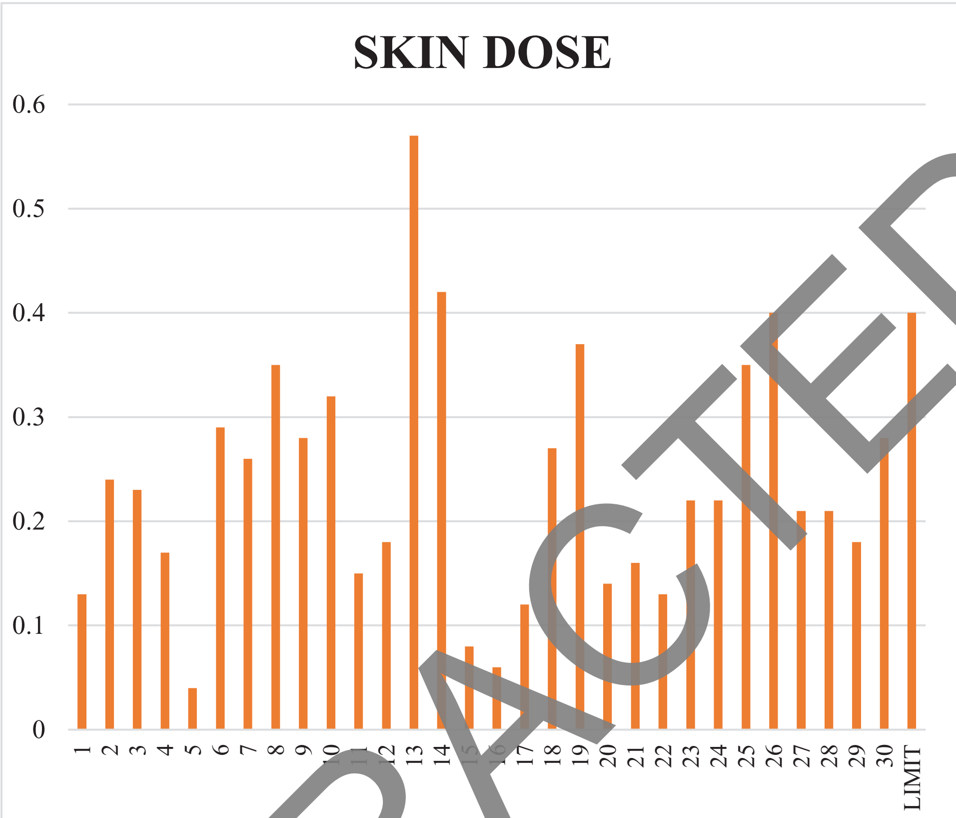

Fig. 1. Comparing the results of SKIN DOSE(mGY) at Al-Zahra Teaching Hospital in Wasit Governorate with global limit.

4 Discussion

We are fully aware of the difficulties that arise when doing an evaluation without access to the dose measurement itself. However, access to the measured dose is required in order to inform the user about the direction that technological innovation is heading. If these results are more in line with the real dosage, they could even assist calculate the "reference" values more properly. These results demonstrate that the use of pulmonary chest exposure measures varies significantly. The wide range of irradiation settings for a given morphotype might be attributed to this diversity of technical techniques. In contrast, our values are lower than those calculated in [17], despite the variations noted; yet, they are comparable to the DRLs for chest radiography. This feature demonstrates the patients' embryonic stage of radioprotection in radiology departments. The lack of dosimetric values and operating procedures in the examination room might be used as a separate explanation for these differences between results obtained elsewhere and with international standards.On the other hand, radiological processes need to be controlled and optimized through the use of DRLs and international standards. In actuality, needless radiation may be avoided by putting these on display and using them, and it should become standard procedure to regularly assess the dosages that were administered. As a result, the dosages used in order to achieve the thorax are not well grasped. These distinctions lead us to believe, as [5] does, that, in contrast to industrialized nations, work procedures urgently need to be optimized. The establishment of a regulatory framework requiring the designation and training of individuals qualified in radioprotection could greatly enhance the effectiveness of dose optimization given to patients. This would allow for the regular establishment of dosimetric standards and control, as well as the improvement of patient and personnel radioprotection. One possible factor contributing to patient exposure might be the staff members' lack of regular training on radiation safety procedures. This finding is still very concerning because it shows that a significant number of radiology trainees, who find work protocols unavailable and are frequently pressured to produce images that could be exploited, are radiological manipulators despite their professional profiles—nurses and caregivers—not matching their "background." Because of this, they either don't know anything about radiodiagnostics best practices or just have a vague understanding of it, much alone patient radiation safety. These findings allow us to confirm with [5].

5 Conclusions

The mean dosage that patients receive from a chest x-ray is expected to be less than 0.4 mGy, which is less than the threshold that various radiation safety organizations have established for this operation. This finding implies that there are most likely no serious technical problems with the X-ray apparatus. t is highly recommended tha Every three months, X-ray units are put through periodic quality control evaluations to ensure correct operation and the absence of application errors. Further research is highly advised to monitor the patients dose periodically.

References

1. H. A. A. Mraity, H. A. Harees, IOP Conference Series: Materials Science and Engineering **928(7)**, 072058 (2020)
2. H. A. Lafta, et al., Journal of Physics: Conference Series **2432(1)** (2023)
3. J. Gray, American Association of Physicist in Medicine **24**, 9-10 (1999)
4. A. B. de González and S. Darby, “The Lancet **363(9406)**, 345–351 (2004)
5. R. M. K. M. Ali, H. A. A. B. Mraity, B. H. Hadi, S. H. Dana, Medico-Legal Update **20(4)** (2020)
6. R. Azzoz, K. M. ElShahat, R. A. MonemRezk, and R. Monem, IOSR Journal of Applied Physics **6(5)**, 29–34 (2014)
7. H. Beauvais-March, M. Valero, A. Biau, et al., Radioprotection **39(4)**, 493–511 (2004)
8. G. A. Monnehan, K. J. Anouan, D. P. Onoma, et al., Revue Internationale des Sciences et Technologies **14**, 45–53 (2009)
9. Y. S. Cordoliani, P. Grenier, H. Beauvais, et al., Médecine Nucléaire Imagerie Fonctionnelle et Métabolique **26(5)**, 241–246 (2002)
10. H. Beauvais-March, A. Biau, M. Bourguignon et al., Office de Protection Contre les Rayonnements Ionisants-Société Française de Radiologie, pp. 17–46 (2000)
11. C. J. Olowookere, I. A. Babalola, N. N. Jibiri, et al., The Pacific Journal of Science and Technology **13(1)**, 87–495 (2012)
12. V. Tsapaki, I. A. Tsalafoutas, I. Chinofoti, et al., The British Journal of Radiology **80(950)**, 107–112 (2007)

13. M. Gholami, N. Fataneh, and V. Karami, Iranian Journal of Medical Physics **12(2)**, 85–92 (2015)
14. M. H. Beauvais, A. Biau, M. Bourguignon, et al., Rapport Scientifique et Technique **4(5)**, 143–151 (2002)
15. S. Kothan and M. Tungjai, American Journal of Applied Sciences **8(9)**, 923–926 (2011)
16. M. Carlo and O. Bar, Société Française de Cardiologie, pp. 1–54 (2015)
17. I. R. Edmonds, The British Journal of Radiology **57(680)**, 733-734 (1984)
18. S. Traoré, "Étude comparative de la dose patient a la dose de référence dans le service de radiologie et d'imagerie médicale de l'hôpital gabriel touré (HGT) à propos de 70 cas," Université de Bamako, Faculté de Médecine, de Pharmacie et d'Odontostomatologie (FMPOS), Bamako, Mali, 2006, Thèse de Doctorat Médecine