eISSN:2708-888X
http://journals.khalijedental.com.ly/index.php/ojs/index

Original article

Evaluation of the Safety Rate in the Diagnostic Radiology Departments in Alkhoms City, Libya

Alhmmali Abdalla[1]*, Hana Alarefee[2], Mawadah Alwerfaley[2], Enas Kribat[2], Namark Yosif[2]

[1]*Department of Pharmacy, School of Medical Sciences, Libyan Academy for Postgraduate Studies, Janzur, Libya.*

[2]*Faculty of Pharmacy, Elmergib University, Alkhoms, Libya.*

***Corresponding Email**: alhmmali.abdalla@academy.edu.ly*

ABSTRACT

Diagnostic radiation such as X-rays and CT scans play a central role in the diagnosis of diseases. Excessive radiation exposure poses a high risk for healthcare providers as well as patients, which may cause serious diseases such as cancer. Providing protection requirements in the radiation departments and continuous inspection to prevent radiation leakage is the right way to provide human protection. The current study aimed to evaluate the safety rate in the diagnostic radiology departments in Alkhoms City. The questionnaire designed for the study in Arabic language, presented to experts for verification and review, then distributed to eleven medical centres in the Alkhoms region containing many relevant questions regarding the radiology department such as the name and address of a medical centre, in-formation about users and safety. Lead plates are present in 91% of health centres 36% of health centres installed lead plates for 1-5 years, 27% for 6-10 years, and 36% for 21 years or more. Lead plates are inspected once in 27%, three times in 9%, and four times or more in 9% of medical centres, on the other hand, 56% of medical centres didn't inspect lead plates since installed. The lead plates last examined in 27% of medical centres a year ago, in 9% examined less than five years ago, and in 9% examined less than twenty years ago. On the other hand, 56% of medical centres have not performed any check-ups since installation. Protection glass and lead plates are present in 82% of medical centres, a radiation protection gown is present in 36%, and a dosimeter is present in 9% of medical centres only. Only 18% of health centres have organised a training programme for their radiology department staff. The safety rate in radiology departments in Alkhoms City- Libya is low because most medical centres lack protective equipment, and if they do, there is no regular inspection or testing of this equipment.

Key words: X-rays, Radiation, CT, Risk of radiation, Dosimeter.

Citation: Abdalla A, Alarefee H, Alwerfaley M, Kribat E, Yosif N. Evaluation of the Safety Rate in the Diagnostic Radi-ology Departments in Alkhoms City, Libya. Khalij-Libya J Dent Med Res. 2024;8(2):254–259.
https://doi.org/10.47705/kjdmr.248215

Received: 28/08/24; **accepted**: 31/10/24; **published**: 10/11/24

تلعب الأشعة التشخيصية مثل الأشعة السينية والأشعة المقطعية دوراً محورياً في تشخيص الأمراض. ويشكل التعرض المفرط للإشعاع خطراً كبيراً على مقدمي الرعاية الصحية وكذلك المرضى، مما قد يسبب أمراضاً خطيرة مثل السرطان. إن توفير متطلبات الحماية في أقسام الأشعة والتفتيش المستمر لمنع تسرب الإشعاع هو الطريقة الصحيحة لتوفير الحماية البشرية. هدفت الدراسة الحالية إلى تقييم معدل الأمان في أقسام الأشعة التشخيصية في مدينة الخمس. تم تصميم الاستبيان للدراسة باللغة العربية، وعرض على الخبراء للتحقق والمراجعة، ثم تم توزيعه على أحد عشر مركزاً طبياً في منطقة الخمس يحتوي على العديد من الأسئلة ذات الصلة بقسم الأشعة مثل اسم وعنوان المركز الطبي، ومعلومات حول المستخدمين والسلامة. توجد لوحات الرصاص في 91٪ من المراكز الصحية، 36٪ من المراكز الصحية قامت بتركيب لوحات الرصاص لمدة 1-5 سنوات، 27٪ لمدة 6-10 سنوات، و 36٪ لمدة 21 سنة أو أكثر. - يتم فحص لوحات الرصاص مرة واحدة في 27% من المراكز الطبية، وثلاث مرات في 9%، وأربع مرات أو أكثر في 9% من المراكز الطبية، ومن ناحية أخرى فإن 56% من المراكز الطبية لم تقم بفحص لوحات الرصاص منذ تركيبها. وتم فحص لوحات الرصاص آخر مرة في 27% من المراكز الطبية قبل عام، وفي 9% تم فحصها قبل أقل من خمس سنوات، وفي 9% تم فحصها قبل أقل من عشرين سنة. ومن ناحية أخرى فإن 56% من المراكز الطبية لم تقم بأي فحوصات منذ تركيبها. ويوجد زجاج حماية ولوحات رصاص في 82% من المراكز الطبية، ويوجد رداء حماية من الإشعاع في 36%، ويوجد جهاز قياس الجرعات في 9% فقط من المراكز الطبية. وقد نظمت 18% فقط من المراكز الصحية برنامج تدريبي لموظفي قسم الأشعة لديها. ومعدل الأمان في أقسام الأشعة في مدينة الخمس- ليبيا منخفض لأن معظم المراكز الطبية تفتقر إلى معدات الحماية، وإذا كانت موجودة، فلا يوجد فحص أو اختبار منتظم لهذه المعدات.

eISSN:2708-888X
http://journals.khalijedental.com.ly/index.php/ojs/index

INTRODUCTION

Ionizing radiation types that are normally important to health are alpha particles, beta particles, X-rays, and gamma rays. Alpha and beta particles are small, fast-moving bits of atoms that a radioactive atom changed into another substance. X-rays and gamma rays are types of electromagnetic radiation that have an extremely short wavelength of less than 100 Å (angstroms) and have a high penetrating rate. These radiation particles and rays carry enough energy to take away electrons from atoms and molecules by the ionization process [1]. An X-ray may be used for diagnosis of bone fractures, infections (such as pneumonia), calcifications (like kidney stones or vascular calcifications), some tumours, arthritis in joints, bone loss (such as osteoporosis), dental issues and heart problems (such as congestive heart failure). X-rays have been used in the medical field for almost 130 years, but the introduction of computed tomography (CT) in the 1970s was revolutionary. The use of CT has increased rapidly and it now become one of the most popular examinations owing to recent technical advancements, such as multi-detector CT and hybrid imaging [2-4].

Many types of X-rays are used to diagnose conditions and diseases such as normal X-rays, mammography, computed tomography (CT), and fluoroscopy [4,5]. Radiation may be classified as primary radiation (emitted directly from the X-ray tube used for patient imaging) and secondary radiation (scattered from the patient and objects such as imaging hardware and leakage radiation from the protective housing of the X-ray tube. A secondary radiation barrier is a wall, ceiling, floor or other structure that will intercept and attenuate leakage and scattered radiation [5].

Dangerous of radiation: High-dose ionizing radiation is associated with predictable deterministic effects, namely hematologic disorders, gastrointestinal symptoms, skin injuries, and central nervous system syndrome. Chronic low-dose radiation exposure, on the other hand, is often related to unpredictable stochastic effects, particularly cancer inductions [6,7]. X-ray is one of ionizing radiations that carry enough energy to free electrons from molecules leading to the formation of free radicals such as hydroxyl radicals, these radicals in turn interact with DNA to cause mutations. Radiation toxicity is affected by many Factors such as the age of the patient, sex, response of the host, X-ray dose, exposure router, type of radiation and staff skills [8].

The protection of employees, patients and members of the public from exceeding radiation exposure need protective equipment such as lead aprons, lead glasses, lead gloves, lead shields, dosimeter, screens and clothing that are protective against radiation [9,10]. Dosimeter: It's a device that measures the dose uptake of radiation. It is a record of the radiation dose received. Personal dosimeters can give a continuous readout of cumulative doses and can warn the wearer with an audible alarm when a cumulative dose is exceeded [11]. This study aimed to evaluate the safety rate in the diagnostic radiology departments in Alkhoms City.

METHODS

Study area

This study conducted in Alkhoms city in northwestern Libya.

Study population

Data collected from eleven medical centres in the Alkhoms region, including three public hospitals, two health centres and six private polyclinics. This region has a population of more than 200,000 people.

Data collection

The questionnaire designed for the study in Arabic language, presented to experts for verification and review, then distributed containing many relevant questions regarding the radiology department such as the name and address of a medical centre and information about users and safety.

eISSN:2708-888X
http://journals.khalijedental.com.ly/index.php/ojs/index

RESULTS

Departments of radiation presented in the medical centres.

Radiation departments are distributed in Alkhoms city according to the number of visited medical centers as follows, X-ray in 91%, CT in 55%, fluoroscopy in 36%, mammography in 27%. These results are illustrated in Figure 1

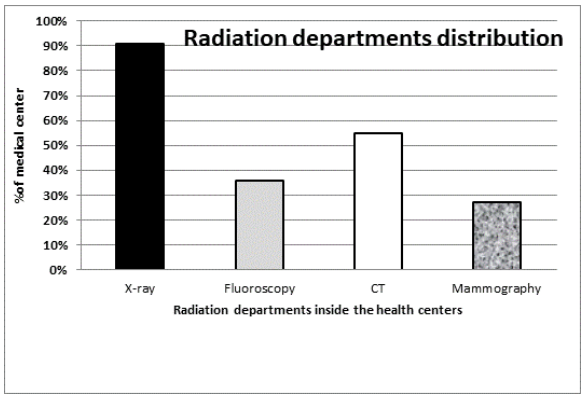

Figure 1: Departments of radiation presented in a medical centre

Lead plates

lead plates are present in 91% and absent in 9% of medical centres. These results are illustrated in figure 2

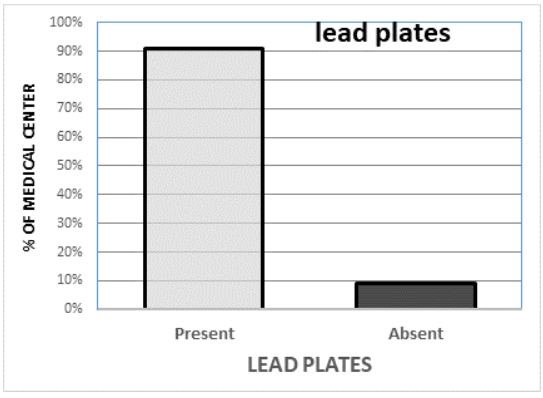

Figure 2: Lead plates

Installation date of the lead plates

Thirty-six % of medical centres installed lead plates for 1-5 years, 27% of medical centres for 6-10 years, and 36% for 21 years or more. These results are illustrated in figure 3

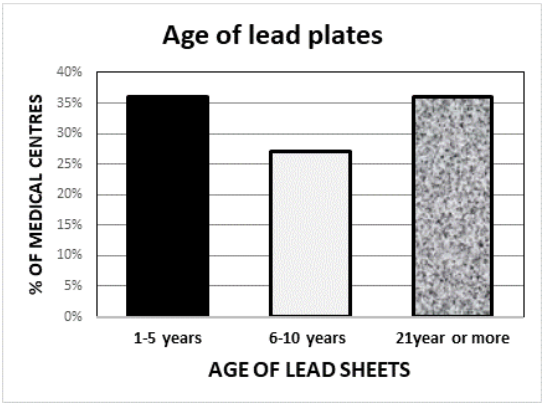

Figure 3: Installation date of the lead plates

Number of lead sheet inspections.

Lead plates are inspected once in 27% of medical centres, three times in 9% of medical centres, and four times or more in 9% of medical centres, on the other hand, 56% of medical centres didn't inspect lead plates since installed. These results are illustrated in Figure 4

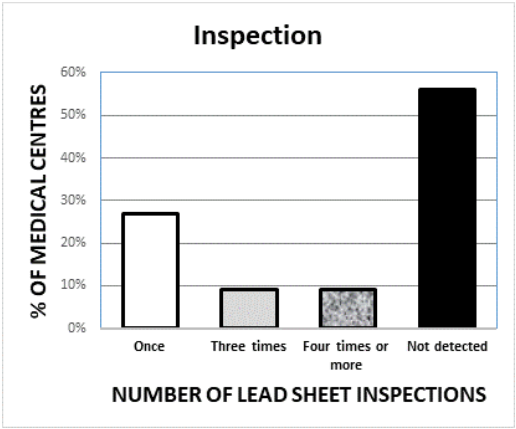

Figure 4: Number of detections

Last inspection of lead sheets.

The lead plates last examined in 27% of medical centres a year ago, in 9% of medical centres examined less than five years ago, and in 9% of medical centres examined less than twenty years ago. On the other hand, 56% of medical centres have not performed any check-ups since installation. These results are illustrated in Figure 5

eISSN:2708-888X
http://journals.khalijedental.com.ly/index.php/ojs/index

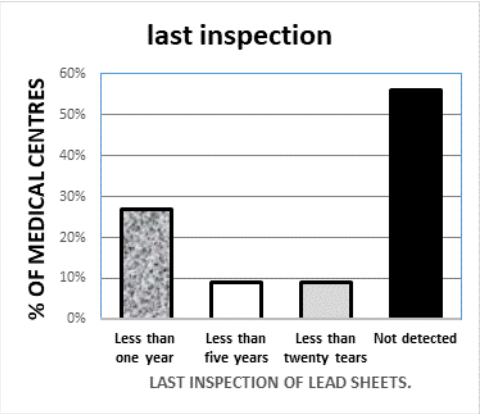

Figure 5: Last inspection of lead sheets.

Protection requirements

Through inspecting the radiology departments to ensure safety requirements, we found that the protection glass and lead plates are present in 82% of medical centres, a radiation protection gown is present in 36% of medical centres, a dosimeter present in 9% of medical centres only, and 9% of medical centres only given a special diet. These results are illustrated in Figure 6

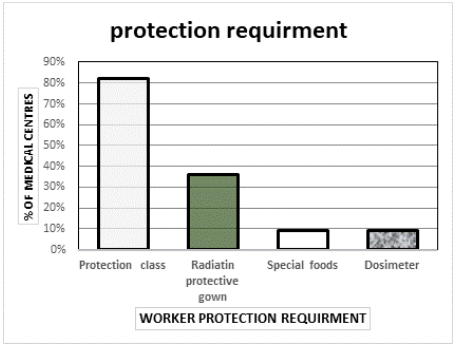

Figure 6: Protection requirements

Training programs

Only 18% of medical centres have organised a training programme for their radiology department staff, while 82% have not conducted any training programme. These results are illustrated in Figure 7

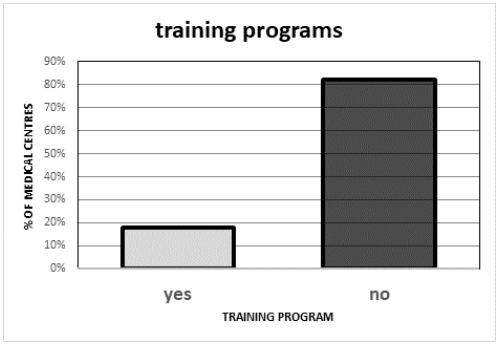

Figure 7: Training programs

DISCUSSION

Ionizing radiation needed for the diagnosis of many diseases poses a significant risk to patients and workers in the radiology departments [12]. These effects of radiation may be stochastic effects or deterministic effects. A stochastic effect is one in which the probability of the effect, rather than its severity, increases with radiation dose such as radiation-induced cancer and genetic effects. On the contrary, deterministic effects occur when radiation dose exceeds a certain threshold [13,14]. Other previous investigations showed that ionizing radiation can lead to biological, physical and chemical changes in organisms on the cellular level, these changes can disrupt the structure of atoms, molecules, cells, and DNA after exposure, and these changes can differ according to the type of radiation, exposure duration and severity [15,16]. Similarly, Burgio et al (2018) [17] showed that long-term uses of high doses of ionizing radiation can damage the DNA chain, and low doses can show a set of harmful effects. In addition, Nurul et al (2018) [18] reported that low doses of ionizing radiation can lead to severe health problems in both the mother and the infant. Previous investigations showed the protection of employees, patients and members of the public from exceeding radiation exposure, ensuring that they constantly limit the number of imaging exposures and use protective equipment [19]. Similarly, Koçyiğit et al., [20] reported that workers should be informed about the use of protective equipment such as lead aprons, lead glasses, lead gloves, and lead shields. screens and clothing that are protective against radiation [20].

In addition, dosimeters should be used and constantly monitored, and the received doses must be checked [21]. Compared to these studies, our current study shows that lead plates are present in 91% and absent in 9% of medical centres, protection glass and lead plates are present in 82% of medical centres, a radiation protection gown is present in 36% of medical centres, and a dosimeter is present in 9% of medical centres only. Therefore, the most important protection equipment such as dosimeters do not exist and therefore it is impossible to know how much radiation the workers were exposed to. In the present study the lead plates were last examined in 27% of medical centres a year ago, in 9% of medical centres examined less than five years ago, and in 9% of medical centres examined less than twenty years ago. On the other hand, 56% of medical centres have not performed any check-ups since installation. These findings disagree with IAEA (2023) [22] which found that quality control tests for radiology departments are used periodically to ensure optimal performance of protective equipment, thus providing diagnostic information of the required quality with the lowest patient exposure. On the other hand, our results are in line with the IAEA (2023) [22], which found that, in many countries, the diagnostic radiology departments are not part of a regular quality assurance program, due to the lack of, professionals trained in quality assurance, dosimetry testing, detailed assessment of the performance of X-ray systems, and relevant guidance. Consequently, most medical centres in Alkhoms city lack protective equipment, and if they do, there is no regular inspection or testing of this equipment.

The present work revealed that only 18% of health centres have organised a training programme for their radiology department staff, these findings disagree with Aljondi et al., (2022) [23] who found that training regarding the rules and instructions for using the ionizing radiation machine is necessary and these training programs should be repeated at certain intervals. Moreover, Naqvi et al., (2019) [24] reported that the personnel must use the X-ray machine based on instructions and with caution, and they must avoid unnecessary imaging procedures.

CONCLUSION

The safety rate in radiology departments in Alkhoms City- Libya is low because most medical centres lack protective equipment, and if they do, there is no regular inspection or testing of this equipment.

Conflict of interest. Nil

REFERENCES

1. Agency for Toxic Substances and Disease Registry, 2021: Ionizing Radiation; page 1s
2. Killewich LA, Falls G, Mastracci TM, Brown KR. Factors affecting radiation injury. Journal of vascular surgery. 2011 Jan 1;53(1):9S-14S.
3. Abdullahi MG, Toriman ME. The effects of x-rays (radiation) on embryonic and fetal during developmental pregnancy stages. J Nucl Med Radiat Ther. 2015 Jun 12;6(231):2.
4. Masaud HB. X Ray in Minor Orthopedic Injuries: Is A Must or There Is Something Else to Trust. AlQalam Journal of Medical and Applied Sciences. 2020 Jul 23:59-65.
5. John P. Cunha, DO, FACOEP Medical Editor: William C. Shiel Jr., MD, FACP, FACR,2020 : X-Rays; Medicine Net; pages 1s.
6. Britt H. Tonnessen, MD, a and Lori Pounds, MD, RVT, bCharleston, SC; and San Antonio, Tex 2011: Radiation physics." J Vasc Surg; 53:6S-8S.
7. Wei Zhou, MD, Stanford, Calif, 2011: Radiation exposure of vascular surgery patients beyond endovascular procedures; Journal of vascular surgery; pages 39S-43S.
8. Brown KR, Rzucidlo E. Acute and chronic radiation injury. Journal of vascular surgery. 2011 Jan 1;53(1):15S-21S.
9. Protection R. Safety in Medical Uses of Ionizing Radiation, IAEA Safety Standards Series No. SSG-46, IAEA, Vienna. 2018.
10. University of Houston-Clear Lake, 2019: X-ray Safety Manual; page 1 of 15.

11. Srinivasan VS, Pandya A. Dosimetry aspects of hafnium oxide metal-oxide-semiconductor (MOS) capacitor. Thin Solid Films. 2011 Oct 31;520(1):574-7.
12. Saygin M, Yasar S, Kayan M, Balci UG, Öngel K. Effects of ionizing radiation on respiratory function tests and blood parameters in radiology staff. The West Indian Medical Journal. 2014 Jan;63(1):40.
13. ICRP. (2007) Recommendations of the ICRP. ICRP Publication 103. Ann ICRP 37: 1-332.
14. IAEA Safety Standards for protecting people and the environment. Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (Interim edition) General Safety Requirements Part 3, No. GSR Part 3 (Interim).
15. Sherfad M, Shaka M, Alheddad O. Radiation Protection Knowledge, Attitudes, and Practices Among Fluoroscopy-Utilizing Doctors at Misurata Medical Centre, Libya. Alq J Med App Sci. 2024;7(3):664-670.
16. Alkaya Solmaz, F and Öztamer, O. Radiation and toxicity of radioactive substance. Turkiye Klinikleri Journal of Anesthesiology Reanimation. 2012;1:28-34
17. Burgio E, Piscitelli P, Migliore L. Ionizing radiation and human health: Reviewing models of exposure and mechanisms of cellular damage. An epigenetic perspective. International journal of environmental research and public health. 2018 Sep;15(9):1971.
18. Bakar NF, Othman SA, Azman NF, Jasrin NS. Effect of ionizing radiation towards human health: A review. InIOP conference series: earth and environmental science 2019 Jun 1 (Vol. 268, No. 1, p. 012005). IOP Publishing.
19. Yıldız A, Köse E, Demirtaş ÖC. Analysis of precautions taken for protection from X-rays in a hospital in Gaziantep in the context of workplace health and safety. Journal of Radiation Research and Applied Sciences. 2022 Dec 1;15(4):100453.
20. Koçyiğit A, Kaya F, Çetin T, Kurban I, Erbaş T, Ergin A, et al. Pamukkale Medical Journal. 2014;2:137-142.
21. Repplinger MD, Li AJ, Svenson JE, Ehlehbach WJ, Westergaard RP, Reeder SB, Jacobs EA. Emergency department patients' perceptions of radiation from medical imaging. WMJ: official publication of the State Medical Society of Wisconsin. 2016 Feb;115(1):22.
22. International Atomic Energy Agency (IAEA). (2023) Handbook of basic quality control tests for diagnostic radiology. Vienna: February 2023
23. Aljondi R, Alghamdi SS, Alyanbawi S, Alghamdi A, Alshomrani B, Awan Z, Alsafi K, Tajaldeen A, Mattar E, Khazindar AR, Sulieman A. Job belonging among healthcare workers in radiology departments in Saudi Arabia. Journal of Radiation Research and Applied Sciences. 2022 Sep 1;15(3):103-8.
24. Naqvi ST, Batool SW, Rizvi SA, Farhan K. Awareness of hazards of X-ray imaging and perception regarding necessary safety measures to be taken during X-ray imaging procedures among patients in public sector tertiary hospitals of Karachi, Pakistan. Cureus. 2019 May;11(5).