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Original

Assessing of Environmental and Personal Exposure to X-rays on Radiologists Working in Hospitals of Medical Sciences in Bandar Abbas

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Abstract

Background: X-ray is a type of radiation that their harmful effects on human health have been confirmed. The use of radiation in hospitals and medical centers for diagnostic, therapeutic, and research tasks is inevitable and is developing. So, it is essential to measure, evaluate, and control the amount of dose received by radiologists. **Methods:** In the first phase of this study, using the checklist to study the results of badge film and how to use individual protective equipment in hospitals surveyed in this investigation and in the second phase, using the Radiometer (05-MKS) TERRA model of the x-ray in different departments of the study hospitals was measured. **Results:** The maximum dose measured in different departments of hospitals studied by 19 micro Sievert/hour was reported, and in none of the hospitals, the dose has been exceeded. Also, after reviewing the reports of the badge film, it was found that there were no suspicious cases that indicate an excessive receiving dose. The use of protective equipment was as in a way that 52.6 % said they were always using protective equipment, and 43.4 % said they sometimes use it. 3.9 % said they did not use X-ray protection equipment. **Conclusion:** Considering that the dose measured in all hospitals of the study is less than the recommended limit proposed by the International Commission for Environmental Protection and the Technical Committee of Iran's Professional Health. So, it is concluded that the radiation protection program is well executed.

Keywords: X- rays; Hospital; Interpersonal Confrontation; Environmental exposure; Radiologist

Introduction

The use of radiation has become more frequent by developing science and technology. Today, the application of Radionuclides resources and equipment in industries, agriculture, and medicine has a special place, and, in particular, the use of them in hospitals and medical centers for diagnostic, therapeutic, and research tasks are inevitable and is being developed every day. One of the most widely used radiations in hospitals and medical centers is X-ray.[1] This radiation is used due to high penetration power for imaging and detects radiological

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wastages, diseases, and even treatment.[2-5] A study conducted in Ireland was found to be subject to the highest dose of diagnostic radiology staff and those performing industrial Radiography.[6] In the Cohort Study have confirmed the existence of a positive relationship between occupational exposure to Ionizing radiation and other types of cancer[7-8] The somatic effects of X-ray include partial and temporal disorders in some physiological functions to serious dangers such as shortening the life, decrease in the body's potential against disease, reducing reproduction, causing cataracts, leukemia (blood cancer) and other cancers and damage to the developing embryo.[9-11] Therefore, on the one hand, it is inevitable that the loss of it for living and human beings has been proved.[1, 12-13]

In hospitals and other diagnostic and therapeutic centers, besides patients, technicians and people, such as radiologists, nurses, and doctors, may be exposed to X-ray exposure during different processes such as angiography, CT scan, radiology, and radiotherapy. The occupational exposure of these individuals is mainly in the face of low doses, and it is found that the risk of cancer is increased due to this exposure to the increase in absorption dose.[14] Therefore, in the absence of safety considerations and recommended standards by national and international organizations, the exposure to such radiation can cause irreversible dangers to them. The basis of protection against radiation avoidance is unnecessary. The Committee for determining the extent of the occupational exposure of physical factors has accepted the proposed values of the International Commission for Radiation Protection (ICRP). And according to that limit, occupational exposure to radiologists is equivalent to 20 millisieverts per year for the average age of 5 and 50 millisieverts per year for just one year.[15-16]

On the other hand, based on the principle of ALARA job positioning, people must be far less determined than the allowable limits. The first and most fundamental pillar of the various organs of health care against Ionizing Radiation and the awareness of the amount of radiation present in the desired environment and determining the amount of light that the Radiographers and the patient, directly and indirectly, receive in the above environment. Then, according to measured doses, the quality and conditions available or based on the Dosimetry are taken, protective measures and health benefits are adopted. Therefore, measuring and determining the amount of radiation that radiologists and patients receive is one of the most essential and unavoidable tasks of health and protection care centers. By the way, due to the importance of the matter and the necessity of measurement, the constant monitoring, and control of the X-ray in the diagnostic and therapeutic centers of hospitals was tried to investigate the extent of the individual and the environmental working in hospitals and other clients referred to X-ray radiology.

Methods

The present study is a cross-sectional study that, in 2018 with the aim is to protect the health of radiologists employed in radiology centers and at the request of vice-chancellor of the University in five hospitals of the University of Medical Sciences in Bandar Abbas. The sampling method was conducted as a census, and the samples included all X-ray emitters at the above-mentioned centers. In the first phase of this study, we investigated the results of the badge film and the use of personal protective equipment by radiologists in hospitals studied in this investigation. For this purpose, after coordination with the department of health physics of the medical sciences of Hormozgan due to the use of the checklist, the required information was collected. The analysis criteria for examining the relationship between the application of protective equipment with gender and marital status were tests of chi-square. In the second phase of the study, the X-ray levels were measured in different departments of the study hospitals (including the control room, the patient's waiting room, radiologists resting room, the waiting room of the patient's companions).

A device that was used in this study to measure X-ray was (05-MKS) TERRA. The measurements were carried out in two phases, the first stage when the X-ray generator was switched off, and this was done in order to measure the dose, and the second stage was at the time of the machine activity. To do so, after specifying the workstations, the operator was asked to set the machine on the maximum of the beamforming method that normally runs with the radiology. Then they were asked to be at the workplace and light radiation to measure their exposure. It was tried at least three measurements per station in this way, the error rate is lower, and the measurement is more reliable in terms of accuracy.

Dosimetry determined the amount of radiation that the radiologist person received after each time of the process, and then the number of radiation performed in a month was counted and recorded. Therefore, the amount of radiologists is calculated over a month and is extended to a single chapter

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in accordance with the existing standard. The above - standard dose points were determined by comparing the results obtained from measurements, with national standards, and finally, needed recommendations and control strategies were presented.

Results

In general, 76 radiologists employed in different departments of five public hospitals of the University Of Medical Sciences Of Hormozgan were examined in this study. 64.5 % of them were females (mean age 3.8 ± 34.5), and 35.5 % of them were male (mean age of 4.2 ± 38.5). Of all the radiologist participants in the study, 32.9 % were single, and the others were married. The status of the radiologists' distribution in hospitals of the medical science of Hormozgan is presented in Figure 1. As can be seen, most radiologists are in the Department of General radiology, and the lowest in the Department of Nuclear Medicine.

The results of the survey were conducted by film badge of radiologists who work in the angiography, radiology, CT scan, medicine nuclear and Radiation Therapy department from Five Public Hospitals Studied (consisted of Shahid Mohammadi Hospital, Pediatric Hospital, Khalij-e-Fars Hospital, Valiasr Hospital, and Omid Radiotherapy Center) no suspicious cases were indicating that there were excessive doses. After measuring a local dose of X-ray at 12 stations of Valiasr Hospital, eight stations of Khalij-e-Fars Hospital, ten stations of Shahid Mohammadi Hospital, six stations of Pediatric Hospital, and eight stations of Omid Radiotherapy Center are estimated the maximum amount of measured dosage in the station NO. 3 Crusher machine in the Khalij-e-Fars Hospital at 10 hr/µSv. In none of the stations, the measured doses were not exceeded 25 hr/µSv.

X-ray levels were measured in five areas, including the control room, the patient's waiting room, the radiologists resting room, and the secretary's workplace in each of the five hospitals. The results are shown in Table 1. As can be seen, the maximum dose measured in different departments of hospitals in the case study was 19 hr/µSv that in comparison with the standard in none of the cases it was not more than 25 hr/µSv.

After reviewing the application of the X-ray protective equipment, it was found that none of the hospitals had been used in protective roof curtains. As shown in Table 2, the method of using individual protective equipment is not the same in this study by participants. To evaluate the use of lead apron, goggles, and thyroid shield 23, 79, and 12 percent were reported, respectively. In general, 52.6 percent of the participants in the study said they were always using appropriate protective equipment when working with X-ray, and only 3.9 % said they had n 't been using the equipment. Others, 43.4 %, said that they sometimes use X-ray protection equipment. As shown in Table 2, marital status and gender were significant with the use of individual protective equipment. Ladies in comparison to men and single people concerning married people observed most of the safety concerns of the radiations.

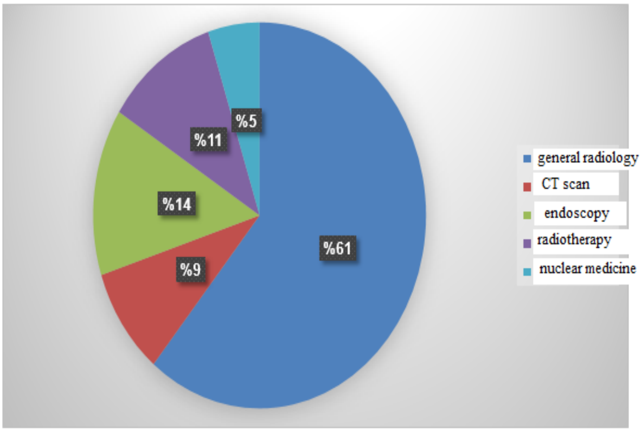

Figure 1. The condition of the distribution of staff working in hospitals of medical sciences of Hormozgan

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Table 1. Rate of measured doses (hr / µSv) in different parts of the case study.

	Shahid Mohammadi Hospital		Children Hospital		Khalij-e-Fars Hospital		Omid Radiotherapy Hospital		Valiasr Hospital	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Control room	0.17	0.03	0.19	0	0.12	0.01	0.16	0.03	0.19	0.03
Waiting room for sick companions	0.14	0	0.16	0.01	0.90	0.007	0.15	0.01	0.16	0.02
Rest room for radiant	0.17	0.04	0.16	0.02	0.14	0.09	0.19	0	0.15	0
Secretary Workplace	0.10	0.05	0.17	0	0.11	0	0.11	0.06	0.12	0.09

Table 2. shows the use of X-ray protection equipment and the link between gender and marital status

How to use protective equipment Variable		Permanent use		Occasional use		non-use		*P*-value
		Number	Percentage	Number	Percentage	Number	Percentage	
gender	male	7	25.9	17	63	3	11.1	*<0.001
	female	33	67.3	16	32.7	0	0	
Marital status	single	28	70	11	27.5	1	2.5	*<0.001
	married	12	33.3	22	61.1	2	5.6	

*There is a significant difference (*P*-value<0.05)

Discussion

According to the obtained results, the number of measured doses of all the body for x-ray in any of the stations located in different departments of the University of Medical Sciences in Hormozgan educational hospitals is more than recommended. The International Commission for Radiation Protection (ICRP) and the technical Committee of Professional Health of Iran (20 millisieverts per year for the average age of 5 years and 50 millisieverts per just one year). The reasons for this can be attributed to appropriate areas of the room, and the implementation of the safety regulations of the radiation protection in hospitals studied. Similar studies have been made in Kenya, Saudi Arabia, Kuwait, Ghana, Poland, and Pakistan, to measure and compare the occupational exposure of radiologists working in treatment centers with the limits offered by the International Commission for Radiation Protection(ICRP) that in all cases the exposure has been less than the recommended one. [17-23]

Results of film badge- related reports showed that all of the radiologists had been studying the film badge. Second, the dose received by none of them has been exceeded, the results of the studies of Jabin et al., agree with our results.[15] Eivaz Zadeh et al. also achieved similar results in a study conducted in Tehran's military hospitals.[24] But in a survey conducted by Constantina et al., to determine the status of occupational exposure of radiologists to Lithuanian medical centers. It was found that 2 % of them received higher than 20 millisieverts per year. They pointed out the reason they received too much on non - job topics, including placing or putting badge film in the vicinity of prohibited areas.[25] Another study conducted by Hussein et al. aimed at monitoring the occupational exposure of staff working in Japanese medical centers. It was found that during 92 years, there was no evidence that X-ray exposure was beyond the recommended limit of the International Commission for Radiation Protection (ICRP).[26]

After reviewing the application of X-ray protective equipment, it was found that the method of using individual protective equipment was not the same in participants of this study. Many of the radiologists did not use appropriate personal protective equipment, which is an undesirable condition compared to similar reviews.[27, 28] The lack of availability of radiologists working in hospitals to study these devices, as well as the lack of strict monitoring by the safety and health inspectors, can be cited in terms of its reasons. In some studies, lack of sufficient knowledge of the radiologists in relation to the safety of the radiation and their low understanding of the risk arising from exposure to the Ionizing Radiation as one of the reasons for no use or inadequate use of the protection equipment against the beams. In a study conducted by Jindal et al. It was found that the majority of Urology Residents were unable to use personal protective equipment due to lack of knowledge that is the way many of them did not use lead gloves or protective eye goggles when they encountered X-ray, or very few of them used Thyroid protector.[29]

Harris et al., also expressed in their study that although Urologists are exposed to X - ray exposure, but their knowledge is weak in relation to the safety of the lights and

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the ways of protecting them, and holding formal training courses to address this shortcoming is necessary.[30] In a study conducted by Yunus et al., it was observed that despite the poor level of awareness and knowledge of nurses working in the nuclear medicine unit, the relation with the safety of the radiation was enhanced, but after holding their training courses, their knowledge and knowledge were promoted to the medium level.[31] The undesirable condition of the use of appropriate personal protective equipment provided by the radiologist participants in this study can be attributed to two major reasons.

A) Lack of access to appropriate equipment of radiologists; it is suggested that the Committee on Safety and Technical Protection of Hospitals after performing a job analysis should provide appropriate protective equipment tailored to any responsibility and after learning about how they are applied, put them at radiologists' disposal.

B) Lack of adequate and regular use of protective equipment by radiologists; it is suggested that training courses are aimed at improving the vision and culture of radiation for all radiologists working in hospitals, and then take strict monitoring on how they behave, especially regarding the application of appropriate personal protective equipment.

Despite the fact that the occupational exposure of staff in the study hospitals was below the recommended x - ray of the limits by International Commission on Radiation Protection (ICRP). However, it should be noted that this is based on the theory of certain effects of radiation, while many cancers and genetic damage caused by X- rays are caused by the probable effects of these rays. It may happen at all levels of exposure and it is believed that these effects are the most important risk of exposure in low doses used in diagnostic radiology and nuclear medicine[32-34] Therefore, considering that 47.4 per cent of the participants in the study have stated that they do not use protective equipment or occasionally they employ them, suggesting an increasing increase in the use of x - ray in the form of diagnostic and therapeutic approaches. The assessment process and risk management of occupational accidents working in hospitals are regularly and continually, according to the radiation monitoring program proposed by ICRP.[35] The main limitation of this study was not allowed to publish details of the results from the examination of the survey were conducted by film badge of radiologists who work in Angiography, Radiology, CT Scan, Nuclear Medicine and Radiotherapy Departments from five government hospitals.

Conclusion

Dose rate measured in all the studied hospitals were less than the recommended ICRP and National limits. It is suggested to establish a continuous environmental and individual X-ray monitoring system to prevent radiologists from encountering high-intensity X-rays due to the possible failure of the X-ray machine.

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References

1. Alves da Silva D, Maia AF, Machado R, Souza de Medeiros Freitas VL, Dal Castel Pinheiro R, Fernanda de Andrade Franco N, et al. Overview of occupational radiation exposure in medical workers in santa catarina, brazil, between 2014 and 2017. Radiation protection dosimetry. 2018;183(3):355-60.
2. Bolus NE. Review of common occupational hazards and safety concerns for nuclear medicine technologists. Nuclear medicine technology. 2008;36(1):11-7.
3. Linet MS, Kim KP, Miller DL, Kleinerman RA, Simon SL, de Gonzalez AB. Historical review of occupational exposures and cancer risks in medical radiation workers. Radiation research. 2010;174(6b):793-808.
4. Ahmad IM, Abdalla MY, Moore TA, Bartenhagen L, Case AJ, Zimmerman MC. Healthcare workers occupationally exposed to ionizing radiation exhibit altered levels of inflammatory cytokines and redox parameters. Antioxidants. 2019;8(1):12.
5. Klein LW, Miller DL, Balter S, Laskey W, Haines D, Norbash A, et al. Occupational health hazards in the interventional laboratory: time for a safer environment. Catheterization & cardiovascular interventions. 2009;250(2):538-44.
6. Colgan PA, Currivan L, Fenton D. An assessment of annual whole-body occupational radiation exposure in Ireland (1996–2005). Radiation protection. 2008;128(1):12-20.
7. Berrington A, Darby SC, Weiss HA, Doll R. 100 years of observation on British radiologists: mortality from cancer and other causes 1897–1997. 2001;74(882):507-19.
8. Matanoski GM, Sartwell P, Elliott E, Tonascia J, Sternberg A. Cancer risks in radiologists and radiation workers. Radiation carcinogenesis: Epidemiology and biological significance.1984;18(22).
9. Dias FL, Antunes LMG, Rezende PA, Carvalho FES, Silva CMD, Matheus JM, et al. Cytogenetic analysis in lymphocytes from workers occupationally exposed to low levels of ionizing radiation.

Environmental toxicology and pharmacology. 2007;23(2):228-33.
10. Maffei F, Angelini S, Forti GC, Lodi V, Violante FS, Mattioli S, et al. Micronuclei frequencies in hospital workers occupationally exposed to low levels of ionizing radiation: influence of smoking status and other factors. Mutagenesis. 2002;17(5):405-9.
11. Sari-Minodier I, Orsière T, Auquier P, Martin F, Botta A. Cytogenetic monitoring by use of the micronucleus assay among hospital workers exposed to low doses of ionizing radiation. Mutation research/genetic toxicology and environmental mutagenesis. 2007;629(2):111-21.
12. Shahabi N, Ghorbani F, Roknian M, Godarzi S. investigation of radiologist tecnicians exposure level in the educational hospital and dental clinic in hamedan city. 4th National Conference on Occupational Health in Iran; Hamedan, 2004. [Persian]
13. Eze KC, Nzotta CC, Marchie TT, Okegbunam B, Eze TE. The state of occupational radiation protection and monitoring in public and private X-ray facilities in Edo state, Nigeria. Nigerian journal of clinical practice. 2011;14(3):308-10.
14. Radiation UNSCotEoA. Effects of ionizing radiation: UNSCEAR 2006 report to the general assembly, with scientific annexes: United nations publications; 2008.
15. Jabeen A, Munir M, Khalil A, Masood M, Akhter P. Occupational exposure from external radiation used in medical practices in Pakistan by film badge dosimetry. Radiation protection dosimetry. 2010;140(4):396-401.
16. Harding LK, Thomson WH. International commission on radiation protection. Nuclear medicine communications. 1990;11(9):585-8.
17. Al-Abdulsalam A, Brindhaban A. Occupational radiation exposure among the staff of departments of nuclear medicine and diagnostic radiology in Kuwait. Medical Principles and Practice. 2014;23(2):129-33.
18. Shadrack AK. Occupational exposure to ionizing radiation in Kenya. International nuclear information system. 2008;42(47).
19. Hasford F, Owusu-Banahene J, Amoako JK, Otoo F, Darko EO, Emi-Reynolds G, et al. Assessment of annual whole-body occupational radiation exposure in medical practice in Ghana (2000–09). Radiation protection dosimetry. 2011;149(4):431-7.
20. Szewczak K, Jednoróg S, Krajewski P. Individual dose monitoring of the nuclear medicine departments staff controlled by Central Laboratory for Radiological Protection. Nuclear medicine review. 2013;16(2):62-5.
21. Zafar T, Masood K, Zafar J. Assessment of personal occupational radiation exposures received by nuclear medicine and oncology staff in Punjab (2003–2012). Australasian physical & engineering sciences in medicine. 2015;38(3):473-8.
22. Chinangwa G, Amoako JK, Fletcher JJ. Radiation dose assessment for occupationally exposed workers in Malawi. Malawi medical journal. 2017;29(3):254-8.
23. Nassef MH, Kinsara AA. Occupational radiation dose for medical workers at a university hospital. Taibah university for science. 2017;11(6):1259-66.
24. Eyvaz Zadeh N, Khoushdel AR, Azma K, Foulad VL. Evaluation of X-Ray factors and its effect on radiology department staff at Army hospitals in Tehran in the year 1385. Annals of military and health sciences research. 2008;6(1):71-3.
25. Valuckas KP, Atkočius V, Samerdokienė V. Occupational exposure of medical radiation workers in Lithuania, 1991-2003. Acta medica lituanica. 2007;14(3):155-9.
26. ALMasri HY, Kakinohana Y, Yogi T. Occupational radiation monitoring at a large medical center in Japan. Radiological physics and technology. 2014;7(2):271-6.
27. Nakfoor CA, Brooks SL. Compliance of michigan dentists with radiographic safety recommendations. Oral surgery, oral medicine, oral pathology. 1992;73(4):510-3.
28. Kaugars GE, Broga DW, Collett WK. Dental radiologic survey of Virginia and Florida. Oral surgery, oral medicine, oral pathology. 1985;60(2):225-9.
29. Jindal T. The knowledge of radiation and the attitude towards radio-protection among urology residents in India. Clinical and diagnostic research(JCDR). 2015;9(12):JC08.
30. Harris A, Loomis J, Hopkins M, Bylund J. Assessment of radiation safety knowledge among house staff exposed to fluoroscopic radiation. Urology Practice. 2019;6(2):140-5.
31. Yunus NA, Abdullah M, Said MA, Ch'ng PE. Assessment of radiation safety awareness among nuclear medicine nurses: a pilot study. Physics: conference series. 2014;546.
32. Shannoun F, Blettner M, Schmidberger H, Zeeb H. Radiation protection in diagnostic radiology. Deutsches ärzteblatt international. 2008;105(3):41-6.
33. Voress M. The increasing use of CT and its risks. Radiologic technology. 2007;79(2):186-90.
34. Linet MS, Slovis TL, Miller DL, Kleinerman R, Lee C, Rajaraman P, et al. Cancer risks associated with external radiation from diagnostic imaging procedures. CA: a cancer journal for clinicians. 2012;62(2):75-100.
35. Suliman II, Salih LH, Ali DM, Alaamer AS, Al-Rajhi M, Alkhorayef M, et al. Occupational exposure in nuclear medicine and interventional cardiology departments in Sudan: Are they following radiation protection standards? Radiation physics and chemistry. 2019; 160:100-4.

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