Migration Letters

Volume: 19, No: S8 (2022), pp. 179-192

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

Effect of Cone-beam computed tomography (CBCT) Outside the Field of View among Emergency Physicians and health care working in X-Ray department in Public Sector Tertiary Hospitals at Saudi Arabia 2022

Sultan Mathkar Nawar Althiyabi[1], Talal Mathkar Nawar Althiyabi[2], Hesham Ali Alshehri[3], Muteb Mansour Alkalawi[4], Ahmed Theyab Almutairi[5], Yasser Ghazai alotaibi[6], Mohammed Abdulrahman Ghali Alotaibi[7], Nayef Muhammad Al-Dajani[8], Omar yousef alserihy[9], Abdulaziz Mubarak Barak Al-Otaibi[10], Adnan Barkat Alsowihri[11], Metib Ziad Nafel AL-juaid[12]

Abstract

Background: Cone-beam computed tomography (CBCT) is widely used in practice among Emergency Physicians and health care working . It became an essential tool for implant and surgical planning . However, the main limitation of CBCT is presence of artifacts. Images artifacts are distortion of recorded data on CBCT image. It occurs due to the interactions between x ray beam and high-density dental materials with high atomic number causing beam hardening . Several studies reported that presence of dental implants, metallic fillings, crowns, and root canal fillings in the field of view (FOV) could inversely affect the image quality due artifacts production and subsequently impair the final diagnosis. Moreover, there is another source of artifacts which is called exomass-related artifacts. The structures present outside the FOV, but at the same axial plane between the tube and the image receptor . These artifacts have variable appearance within the CBCT images; discrete stripe-like, ring-like patterns, double contours, and overall lack of sharpness. It is reported that exomass artefacts increase the mean voxel density values and noise of CBCT images . Aim of the study: To effect of Cone-beam computed tomography (CBCT) Outside the Field of View among Emergency Physicians and health care working in X-Ray department in Public Sector Tertiary Hospitals at Saudi Arabia 2022. Methods: This cross-sectional study was conducted among 300 participants from Public Sector Tertiary Hospitals kingdom of Saudi Arabia. A validated self-administered questionnaire was used, emergency Physicians and health care working in X-Ray, Computed Tomography, and Magnetic Resonance Imaging department It includes questions on socio demographic variables, during the August to September 2022. Results: show the remaining socio-demographic characteristics of the participant regarding age most of participants

[1] X-ray technician,Al-bijaddyah Hospital, Saudi Arabia.
[2] X-ray technician,Al-bijaddyah Hospital, Saudi Arabia.
[3] Specialist Radiological Technology, Almnar primary health care center, Saudi Arabia.
[4] Technician Radiological Technology, Almnar primary health care center, Saudi Arabia
[5] Radiologic Technologist, At Almnar health center, Saudi Arabia.
[6] Technician Radiological Technology, Almnar primary health care center, Saudi Arabia.
[7] X-ray technician, General Dawadimi hospital, Saudi Arabia.
[8] XRay technician, Dawadmi General Hospital, Saudi Arabia.
[9] Radiology consultant, Saudi Arabia.
[10] Ray technician,Dawadmi General Hospital, Saudi Arabia
[11] Ray technician, Al Shariaa Al Olaya Health Center, Saudi Arabia.
[12] Radiology technology, Erada & Mental Health Complex in Taif, Saudi Arabia.

40-50 years were (33.0%) the gender majority of participants were(59.0%) were the marital status the most of participant were (52.0%) married while single were (27.0%) , regarding the department the most of participant radiology were (44.0%). Conclusion: In conclusions, the variability of voxel density value and hypo dense artifacts of CBCT images due to high density objects outside the FOV is well documented in several studies. The effect of FOV, voxel size, kVp and mill amperage on these artifacts has been evaluated.

Key words: *X-Ray, Computed Tomography, Magnetic Resonance Imaging, Emergency Physicians, health care working, Saudi Arabia.*

Introduction

Cone-beam computed tomography (CBCT) is an imaging technology using ionizing radiation that was introduced into dentistry in the late 1990s and emergency Physicians and health care working uses.[1] CBCT has revolutionized how patients are evaluated in virtually all dental specialties and other due to its lower cost and greater accessibility than conventional computed tomography (CT).[2] Although the radiation dose of CBCT is usually lower than that of conventional CT, it is generally higher than that of conventional 2-dimensional dental radiography.[3] The radiation dose of CBCT depends on both the equipment (with variation across manufacturers) and the exposure parameters used by the operator.[4] the most important adverse effects on health derived from ionizing radiation are stochastic. These effects occur without a specific threshold; that is, even minimal doses of radiation are associated with a risk of inducing cancer or hereditary effects. The probability of these effects occurring, but not their severity, is proportional to the radiation dose. [2]. While reports from studies demonstrated dramatic rise in the prevalence of adverse health effects following exposure to ionizing radiation over the past two decades [5], the documented evidence of poor knowledge of radiation safety among various cadres of health workers at risk of occupational exposure shows the enormity of the problem at hand [6].Although X-ray doses for clinical purposes are relatively low, with the growing number of the population exposed to these radiations multiple times throughout life, any unnecessary imaging could possibly lead to several health-related problems in the future [7]. The increase in the number of imaging methods in the Emergency Department (ED) is higher than the total increase in the number of imaging methods in hospital inpatient, outpatient, and emergency Physicians office settings [8]. This trend is partly associated with the increase in the number of patients admitted in the ED. However, the use of diagnostic imaging exceeded the number of ED visits [9]

The increasing use of imaging methods has led to discussions regarding excessive and unnecessary use. The discussions are mostly centered on increased healthcare cost, exposure to radiation, reactions to contrast material (allergy, contrast-induced nephropathy, nephrogenic systemic fibrosis), and crowding in hospitals related to tests [10] Knowledge among patients regarding the effects of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging Among emergency Physicians and health care working X-ray imaging, therefore, becomes important. This awareness may help to necessitate the development of a more complete doctor patient dialogue and effective patient participation in the clinical decision-making process [11]. By having the awareness of the effects of imaging procedure that is being conducted, the patient will tend to force the physician to explain the rationale behind his decision which will encourage a more justified use of imaging in patient evaluation (where benefits outweigh the risks).[12] In addition, more elaborate doctor-patient interaction due to better awareness may also diminish the tendency of physicians to avoid seeking informed consent, a tendency which has been reported frequently in the literature. Surveying patients' knowledge and experiences, and documenting their views regarding the services provided to them would,

therefore, provide valuable insight which can help to improve the quality and safety of the healthcare system [13].

Literature Review

While radiations are extremely useful diagnostically, a study conducted in the UK estimated that up to 20% of medical X-rays ordered are not beneficial and only add to the unnecessary exposure in patients, contributing to 100-250 cases of cancer each year in the region [14]

According to the study published by Papanicolas et al.2018 , in high-income countries the average number of magnetic resonance imaging (MRI) and mean computed tomography (CT) scans were 82 and 151 per 1000 persons, respectively. These numbers were 118 and 245 in the United States, respectively, and in terms of the number of radiological imaging, the United States is the second country with the highest rate of MRI and CT technology use, following Japan [15]

Study by OECD et al, 2015 in Turkey shows similar characteristics to the high-income countries in terms of overuse of radiological imaging methods. According to the Organization for Economic Co-operation and Development European Union (EU) Health Statistics report, between 2011 and 2014, Turkey ranked first in the number of MRI scans and 8th in the number of CT scans. The EU average increase in the use of CT was 49%, while the increase was 60% in Turkey. The EU average increase in the use of MRI was 38%, while Turkey had a 134% increase [16]

Study by Johary et al., 2018, reported an excess of radiation-induced cataracts for technologists who received an eye lens dose of 55.7 mGy on average with the interquartile range from 23.6 to 69.0 mGy. The excess risk for cataract associated with radiation exposure from low-dose and low dose-rate occupational exposures [17]

In Pakistan no study has yet been conducted to evaluate knowledge of X-ray imaging among the patients. also need to evaluate the necessary safety measures undertaken during X-ray imaging in these hospitals, and the perception of patients regarding the importance of these measures.[18] Currently, there is a lack of data on radiation exposure delivered to patients in Saudi Arabia, although radiobiology researchers and other researchers have addressed the association between the relatively high doses from CT and stochastic and deterministic effects. Nevertheless, still, there is a need to optimize the dose by introducing the diagnostic reference level .[19]

Staff exposure has a high amount of variability, according to Morcillo et al. 2022, probably due to the varied level of complexity [20]. According to the linear no-threshold (LNT), any radiation dose can cause biological effects (DNA damage) that may be harmful to the exposed person, and the magnitude or probability of these effects is directly proportional to the dose (delayed effects).[21] Somatic, genetic, and teratogenicity effects are the three types of effects. [22]

Rational.

Exposure to radiation deposits energy that can ionise the media and cause tissue reactions at specific thresholds, and the intensity of the tissue reaction rises as the doses rise. The radiation damage at higher doses can lead to observable early effects and clinical symptoms. Cell death or dysfunction is a biological process for tissue responses. The overall knowledge of the patients visiting tertiary care government hospitals of Saudi Arabia regarding radiation and its hazards is unsatisfactory. Safety protocols are less implemented in these hospitals, probably due to limited of the Knowledge, to ensure the protection of patients from unnecessary repeated radiation exposure, educating patients as well as emergency Physicians and health care working may prove to be beneficial. Public

awareness programs should be conducted on a regular basis, where electronic media could play a central role. Healthcare providers should be taught to make a justified decision of exposing their patient to radiation only when the benefit outweighs the risk.

Aim of the study

To effect of Cone-beam computed tomography (CBCT) Outside the Field of View among Emergency Physicians and health care working in X-Ray department in Public Sector Tertiary Hospitals at Saudi Arabia 2022.

Methodology

Study Design

A Cross-sectional descriptive study

Study area

The study was carried out in Public Sector Tertiary Hospitals at Saudi Arabia, Saudi Arabia It has a holy value for all Muslims worldwide who travel to it annually to perform Hajj and to visit the Holy Masjid and Kaaba towards which Muslims turn in prayers .

Study Population

The study was conducted among emergency Physicians and health care working in X-Ray department in Public Sector Tertiary Hospitals at Saudi Arabia during the period of study in 2022 .

Selection criteria:

A- Inclusion criteria:

- The study included emergency Physicians and health care working who in the radiology department to X-Ray, Computed Tomography, and Magnetic Resonance Imaging and were willing to participate in the study.
- Both males and females.
- All nationalities.

Exclusion criteria:

- We excluded emergency Physicians and health care working who refused to participate, had neurological disease (which made them unable to understand and answer our questions), did not have the capacity to give informed consent, and/or if they were unable to understand the communication language.

Sampling technique:

The researcher used Multi-stage random sampling technique, by using random number generator. Then simple random sampling technique was applied to select the Public Sector Tertiary Hospitals. Also, convenience sampling technique was utilized to select the participants in the study.

Data collection tool:

The questions which were used in the survey were based on similar studies in the literature and on past experience. The questionnaire was designed to find the answers to the following three questions:

1. Do emergency doctors and health care working consider their level of knowledge sufficient on imaging methods

2. Do emergency doctors and health care working evaluate the risks associated with the radiological test, before ordering an imaging method

3. Do emergency doctors and health care working explain the risks associated with the imaging method to the patients, and discuss the risks and benefits of the imaging with the patients?.

Data collection technique:

The questionnaire consists of parts .

The first part of the survey contained data socio-demographic characteristics on the specialties of physicians and health care working the total duration of their work in the relevant specialties .

In the second part of the questionnaire, physicians were asked to evaluate their knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging “little”, “moderate”, “good” and “very good.”

In the third part of the survey, the physicians were asked to indicate one or more sources from which they obtained information on imaging methods.

The comprehensibility and clarity of the items in the questionnaire were tested by emergency Physicians and health care working , physicians from any specialty of internal sciences, physicians from any specialty of surgical sciences, radiologists by face-to-face interview. In order not to affect the results, the answers of these physicians were excluded from the study. Those who did not complete the questionnaire.

Data entry and analysis:

The Statistical Package for Social Sciences (SPSS) software version 24.0 was used for data entry and analysis. Descriptive statistics (e.g., number, percentage) and analytic statistics using Chi-Square tests (χ^2) to test for the association and the difference between two categorical variables were applied. A p-value ≤ 0.05 was considered statistically significant.

Pilot study:

Was piloted among 20 participants, after permission was taken through from the researcher, with some modification and preamble letter was issued to explain the aim of the study, request to participate, and appreciation for a response. Then, the questionnaire was validated by three consultants. A pilot study was conducted in one PHC in the same sector due to the similarity to the target group using the same questionnaire to test the methodology of the study. As a feedback, the questionnaire was clear and no defect was detected in the methodology.

Ethical considerations:

The ethical approval for this study was obtained from the ethical committee for health research (2022). The objectives of the study were explained to the participants and confidentiality was assured. Participation was voluntary. A written consent was obtained from the participants. Permission from the X-Ray, Computed Tomography, and Magnetic Resonance Imaging was obtained; permission from the Directorate Public Sector Tertiary Hospitals.

Budget: Self-funded

Result

Table 1: Distribution of socio-demographic characteristics of participant .(n-300)

	N	%
Age		
<30	57	19
30-40.	81	27
40-50.	99	33
>50	63	21
Gender		
Male	177	59
Female	123	41
Marital status		
Single	81	27
Married	156	52
Divorced	33	11
Widow	30	10
Department		
Radiology	132	44
Emergency department	117	39
Radiotherapy	51	17
Medical specialty (cadre)		
Doctor	57	19
Nurse	63	21
Imaging scientist	81	27
Radiographer	33	11
Physicist	39	13
Biomedical engineer	27	9
Length of practice (in years)		
<10 Years	117	39
>10 Years	183	61

The study included 300 patients, table 1 show the remaining socio-demographic characteristics of the participant regarding age most of participants 40-50 years were (33.0%) followed by 30-40 years were (27.0%) while , regarding the gender majority of participants were(59.0%) were male while female were (41.0%), regarding the marital status the most of participant were (52.0%) married while single were (27.0%) , regarding the department the most of participant radiology were (44.0%) while emergency department were (39.0%) while radiotherapy were (17.0%), regarding medical specialty

most of participant imaging scientist were (27.0%) while nurse were (21.0%) while doctor were (19.0%) but the radiographer were (11.0%), regarding the length of practice (in years) most of participant > 10 Years were (61.0%) while <10 years were (39.0%) .

Table 2: Distribution of knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging

Knowledge of Risks Associated	N	%
How can you assess your own level of knowledge on imaging methods?		
Very little	36	12
Moderate	99	33
Good	144	48
Very good	21	7
What is the source of your information on imaging methods? You can select multiple choices.		
Medicine school training	36	12
Specialty training	96	32
Individual interest- based research	54	18
Radiological courses or seminars	87	29
Other	27	9
Do you routinely consider the risks associated with direct radiography for the patient before ordering		
Yes	213	71
No	87	29
Do you routinely consider the risks associated with computed tomography for the patient before ordering		
Yes	201	67
No	99	33
Do you routinely consider the risks associated with magnetic resonance imaging for the patient before ordering		
Yes	195	65
No	105	35
Do you routinely pay attention to radiation exposure before you order a direct radiography		
Yes	231	77
No	69	23
Do you routinely pay attention to whether the examination was performed already for the same indication before ordering direct radiography		
Yes	207	69
No	93	31
Do you routinely pay attention to radiation exposure, before you order a computed tomography scan		

Yes	243	81
No	57	19
Do you routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan		
Yes	231	77
No	69	23
Do you routinely pay attention to contrast agent allergy, before you order a computed tomography scan		
Yes	255	85
No	45	15

The results presented in table (2) showed distribution of knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging regarding can you assess your own level of knowledge on imaging methods the majority of participant answer good were (48.0%) followed by moderate were (33.0%) while very little were (12.0%) but very good were (7.0%), regarding the source of your information on imaging methods the majority of participant answer Specialty training were (32.0%) followed by radiological courses or seminars were (29.0%) while individual interest- based research were (18.0%) while medicine school training were (12.0%), regarding routinely consider the risks associated with direct radiography for the patient before ordering the majority of participant answer Yes were (71.0%) followed by No were (29.0%), regarding routinely consider the risks associated with computed tomography for the patient before ordering the majority of participant answer Yes were (67.0%) followed by No were (33.0%), regarding routinely consider the risks associated with magnetic resonance imaging for the patient before ordering the majority of participant answer Yes were (65.0%) followed by No were (35.0%) , regarding routinely pay attention to radiation exposure before you order a direct radiography the majority of participant answer Yes were (77.0%) followed by No were (23.0%) , regarding routinely pay attention to whether the examination was performed already for the same indication before ordering direct radiography the majority of participant answer Yes were (69.0%) followed by No were (31.0%), regarding routinely pay attention to radiation exposure, before you order a computed tomography scan the majority of participant Answer Yes were (81.0%) followed by No were (19.0%) , regarding routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan the majority of participant answer Yes were (77.0%) followed by No were (23.0%) , regarding routinely pay attention to contrast agent allergy, before you order a computed tomography scan the majority of participant answer Yes were (85.0%) followed by No were (15.0%)

Table 2 continued Knowledge of Risks Associated

Table 2 continued Knowledge of Risks Associated	N	%
Do you routinely pay attention to whether the examination was performed already for the same indication before ordering computed tomography?		
Yes	177	59
No	123	41
Do you routinely pay attention to radiation exposure, before you request a magnetic resonance imaging?		

Yes	198	66
No	102	34
Do you routinely pay attention to contrast-induced nephropathy, before you request a magnetic resonance imaging?.		
Yes	225	75
No	75	25
Do you routinely pay attention to contrast agent allergy, before you request a magnetic resonance imaging		
Yes	201	67
No	99	33
Do you routinely pay attention to whether the examination was performed already for the same indication before requesting magnetic resonance imaging		
Yes	147	49
No	153	51
Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering direct radiography?		
Yes	213	71
No	87	29
Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering computed tomography?		
Yes	186	62
No	114	38
Do you routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering magnetic resonance imaging		
Yes	222	74
No	78	26

Table 2 continued Knowledge of Risks Associated showed regarding routinely pay attention to whether the examination was performed already for the same indication before ordering computed tomography the majority of participant answer Yes were (59.0%) followed by No were (41.0%), regarding routinely consider the risks associated with computed tomography for the patient before ordering the majority of participant answer Yes were (67.0%) followed by No were (33.0%), regarding routinely pay attention to radiation exposure, before you request a magnetic resonance imaging the majority of participant answer Yes were (66.0%) followed by No were (34.0%) , regarding routinely pay attention to contrast-induced nephropathy, before you request a magnetic resonance imaging the majority of participant answer Yes were (75.0%) followed by No were (25.0%) , regarding routinely pay attention to contrast agent allergy, before you request a magnetic resonance imaging the majority of participant answer Yes were (67.0%) followed by No were (33.0%), regarding routinely pay attention to whether the examination was performed

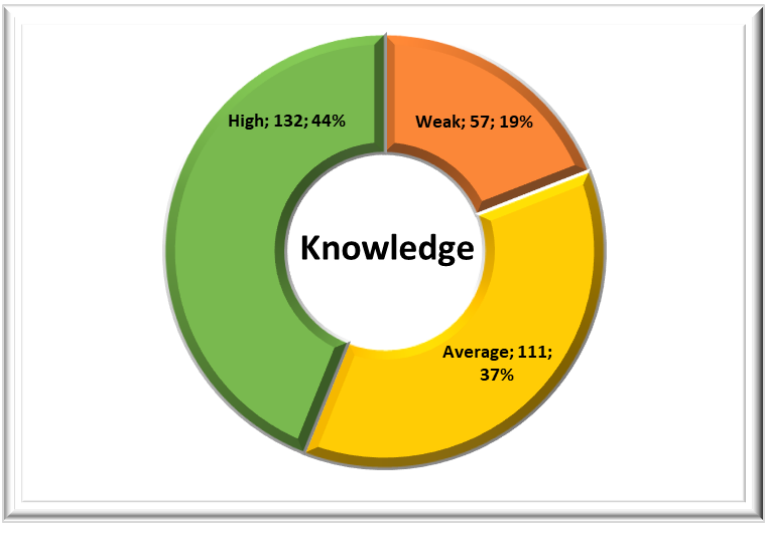
already for the same indication before requesting magnetic resonance imaging the majority of participant Answer No were (51.0%) followed by Yes were (49.0%) , regarding routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering direct radiography the majority of participant answer Yes were (71.0%) followed by No were (29.0%) , regarding routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering computed tomography the majority of participant answer Yes were (62.0%) followed by No were (38.0%) , regarding routinely inform the patient regarding the risks associated with the imaging method and discuss the risks and necessity with the patient before ordering magnetic resonance imaging the majority of participant answer Yes were (74.0%) followed by No were (26.0%) .

Table 3: Distribution of knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging

		Knowledge		Score	
		N	%	Range	Mean±SD
Weak		57	19	6-15.	10.011±2.271
Average		111	37		
High		132	44		
Total		300	100		
Chi-square	X^2	29.94			
	P-value	<0.001*			

This table shows the majority of participant (44.0%) have high of the knowledge towards risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging followed by (37.0%) of participant average but weak were (19.0%) while Range(6 -15) and Mean ±SD(10.011±2.271) X^2 29.94 and a significant relation P=0.001.

Figure (1): Distribution of knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging



Discussion

Through this study, we aimed to highlight to effect of Cone-beam computed tomography (CBCT) Outside the Field of View among Emergency Physicians and health care working in X-Ray department in Public Sector Tertiary Hospitals at Saudi Arabia 2022 , almost half of all ED visits in the Saudi Arabia resulted in at least one imaging examination, and about 1 in 6 patients were ordered to undergo CT [23]. MRI, which is one of the advanced imaging modalities, has been recently used by the emergency services especially in neuroimaging [24], similar In the study by Rosenkrantz et al., it was found that the use of CT as an advanced imaging method increased without any significant reduction in ultrasonography and plain radiography in the diagnosis of some diseases such as pneumonia and appendicitis. Furthermore, it was determined that use of diagnostic modalities including multiple imaging methods such as CT and ultrasonography or CT, radiography, and ultrasonography in the diagnosis of urinary calculi increased at the same visit [25] . EMPs should have a good knowledge of the imaging methods often used.[26] The study included 300 participant show the remaining socio-demographic characteristics of the participant age most of participants 40-50 years were (33.0%), regarding the gender majority of participants were(59.0%) were male, marital status the most of participant were (52.0%) married, department the most of participant radiology were (44.0%) while emergency department were (39.0%), medical specialty most of participant imaging scientist were (27.0%), length of practice (in years) most of participant > 10 Years were (61.0%) (See table 1)

Our results show that a high percentage of the study participants was aware of the term knowledge of Risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging, the study population demonstrated a high level of knowledge regarding the procedure and the harmful effects of X-ray imaging. (See table 2) regarding can you assess your own level of knowledge on imaging methods the majority of participant answer good were (48.0%), the source of your information on imaging methods the majority of participant answer Specialty training were (32.0%) , regarding routinely consider the risks associated with direct radiography for the patient before ordering the majority of participant answer Yes were (71.0%), regarding routinely consider the risks associated with computed tomography for the patient before ordering the majority of participant answer Yes were (67.0%), routinely consider the risks associated with magnetic resonance imaging for the patient before ordering the majority of participant answer Yes were (65.0%, routinely pay attention to radiation exposure before you order a direct radiography the majority of participant answer Yes were (77.0%), regarding routinely pay attention to contrast-induced nephropathy, before you order a computed tomography scan the majority of participant answer Yes were (77.0%) followed by No were (23.0%) , regarding routinely pay attention to contrast agent allergy, before you order a computed tomography scan the majority of participant answer Yes were (85.0%) followed by No were (15.0%)

These results are differing from those that we found in the literature. A study conducted in Hong Kong reported that 87.9% of the local patients were unaware of the fact that plain X-rays contain radiations [27]. Another study reported similar results, where 34% of participants did not know that imaging may expose them to radiations [28]. As opposed to these, a study reported 70.8% of participants showing an overall understanding of the imaging technique that they were undergoing [29]. Our study also demonstrated that the high were (44.0%) emergency Physicians and health care working in Saudi Arabia were Knowledge to the hazards of X-rays, showing of Knowledgeable to the risks of having cancer, anemia, burns, cataract, and fertility problems (Table 3). Similar findings have been reported in the literature. A study conducted in Nigeria reported a relatively higher percentage of participants (86.7%) who did not know about the dangers of X-ray imaging [30]. Other studies have reported underestimation of cancer risk by the patients associated with imaging [31, 32]. in our study shows the majority of participant (44.0%) have high of

the knowledge towards risks Associated with the Use of Plain X-Ray, Computed Tomography, and Magnetic Resonance Imaging followed by (37.0%) of participant average but weak were (19.0%) while Range(6 -15) and Mean ±SD(10.011±2.271) X2 29.94 and a significant relation P=0.001. (See label 3)

Conclusion

This study demonstrated average radiation protection practices despite good knowledge of radiation hazards among the participants, but radiation exposure and there is therefore need for periodic in-service training and regular monitoring of occupationally exposed health workers to ensure compliance with radiation safety regulations. The overall knowledge of the participants in the Public Sector Tertiary Hospitals at Saudi Arabia regarding radiation and its hazards is satisfactory. Safety protocols are less implemented in these hospitals, probably due to limited resources. To ensure the protection of participants from unnecessary repeated radiation exposure, educating patients as well as the health care providers may prove to be beneficial. Public awareness programs should be conducted on a regular basis, where electronic media could play a central role. Healthcare providers should be taught to make a justified decision of exposing their patient to radiation only when the benefit outweighs the risk. It has been suggested that participants exposure history must be maintained and updated after each exposure. Informed consent should be sought and a clear explanation of the imaging and its associated risks should be provided to each patient prior to the procedure.

References:

1. Pauwels, R. (2015). Cone beam CT for dental and maxillofacial imaging: dose matters. Radiation protection dosimetry, 165(1-4), 156-161..
2. Raith, A., Kamp, C., Stoiber, C., Jakl, A., & Wagner, M. (2022, April). Augmented reality in radiology for Education and training—a design study. In Healthcare (Vol. 10, No. 4, p. 672). MDPI.
3. Abdelkarim, A. (2019). Cone-beam computed tomography in orthodontics. Dentistry journal, 7(3), 89..
4. Haleem, A., Javaid, M., Singh, R. P., & Suman, R. (2022). Medical 4.0 technologies for healthcare: Features, capabilities, and applications. Internet of Things and Cyber-Physical Systems, 2, 12-30..
5. De Grauwe, A., Ayaz, I., Shujaat, S., Dimitrov, S., Gbadegbegnon, L., Vande Vannet, B., & Jacobs, R. (2019). CBCT in orthodontics: a systematic review on justification of CBCT in a paediatric population prior to orthodontic treatment. European journal of orthodontics, 41(4), 381-389.
6. Barragán-Montero, A., Bibal, A., Dastarac, M. H., Draguet, C., Valdes, G., Nguyen, D., ... & Lee, J. A. (2022). Towards a safe and efficient clinical implementation of machine learning in radiation oncology by exploring model interpretability, explainability and data-model dependency. Physics in Medicine & Biology, 67(11), 11TR01.
7. Li, C., Dos Reis, A. A., Ansari, A., Bertelli, L., Carr, Z., Dainiak, N., ... & Zhang, J. (2022). Public health response and medical management of internal contamination in past radiological or nuclear incidents: A narrative review. Environment international, 163, 107222.
8. Albuquerque, G., Cruz, A., Carvalho, D., Mayrink, N., Pinheiro, B., Campos, A., ... & Valentim, R. (2022). A method based on non-ionizing microwave radiation for ancillary diagnosis of osteoporosis: a pilot study. BioMedical Engineering OnLine, 21(1), 1-14.
9. Obrador, E., Salvador-Palmer, R., Villaescusa, J. I., Gallego, E., Pellicer, B., Estrela, J. M., & Montoro, A. (2022). Nuclear and radiological emergencies: biological effects, countermeasures and biodosimetry. Antioxidants, 11(6), 1098.
10. Broder, J. S., Oliveira J. e Silva, L., Bellolio, F., Freiermuth, C. E., Griffey, R. T., Hooker, E., ... & Carpenter, C. R. (2022). Guidelines for reasonable and appropriate Care in the Emergency Department 2 (GRACE-2): low-risk, recurrent abdominal pain in the emergency department. Academic Emergency Medicine, 29(5), 526-560.

11. Morar, L., Băciuț, G., Băciuț, M., Bran, S., Colosi, H., Manea, A., ... & Dinu, C. (2022). Analysis of CBCT bone density using the Hounsfield scale. Prosthesis, 4(3), 414-423..
12. Baloescu, C. (2018). Diagnostic imaging in emergency medicine: how much is too much?. Annals of emergency medicine, 72(6), 637-643.
13. Tai, H. Y., & Wu, S. H. (2022). Infrastructure of the Medical Information System. In Digital Health Care in Taiwan: Innovations of National Health Insurance (pp. 111-128). Cham: Springer International Publishing..
14. Yurt, A., Çavuşoğlu, B., & Günay, T. (2014). Evaluation of awareness on radiation protection and knowledge about radiological examinations in healthcare professionals who use ionized radiation at work. Mol Imaging Radionucl Ther, 23(2), 48-53.
15. Papanicolas, I., Woskie, L. R., & Jha, A. K. (2018). Health care spending in the United States and other high-income countries. Jama, 319(10), 1024-1039.
16. Demir, M. C., & Akkas, M. (2019). Awareness of risks associated with the use of plain X-Ray, computed tomography, and magnetic resonance imaging among emergency physicians and comparison with that of other physicians: a survey from Turkey. Medical science monitor: international medical journal of experimental and clinical research, 25, 6587.
17. Johary, Y. H., Aamry, A., Albarakati, S., AlSohaim, A., Aamri, H., Tamam, N., ... & Bradley, D. (2022). Staff radiation exposure at four radiology departments in the Aseer region of Saudi Arabia. Radiation Physics and Chemistry, 200, 110302.
18. Naqvi, S. T. S., Batool, S. W., Rizvi, S. A. H., & Farhan, K. (2019). 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, 11(5).
19. Sulieman, A., Elnour, A., Mahmoud, M. Z., Alkhorayef, M., Hamid, O., & Bradley, D. A. (2020). Diagnostic reference level for computed tomography abdominal examinations: A multicentre study. Radiation Physics and Chemistry, 174, 108963.
20. Morcillo, A. B., Huerga, C., Bayón, J., López, A., Corredoira, E., Hernández, T., ... & Alejo, L. (2022). Assessment of occupational exposure in the main paediatric interventional radiology procedures. Radiation Protection Dosimetry, 198(7), 386-392.
21. Costantini, D., & Borremans, B. (2019). The linear no-threshold model is less realistic than threshold or hormesis-based models: An evolutionary perspective. Chemico-biological interactions, 301, 26-33.
22. Balog, M., Anderson, A. C., Heffer, M., Korade, Z., & Mirnics, K. (2022). Effects of psychotropic medication on somatic sterol biosynthesis of adult mice. Biomolecules, 12(10), 1535.
23. Alalshaikh, A., Alyahya, B., Almohawes, M., Alnowiser, M., Ghandour, M., Alyousef, M., ... & Alageel, M. (2022). Emergency Medicine Physicians' Views on Providing Unnecessary Management in the Emergency Department. Open Access Emergency Medicine, 183-193..
24. Hussain, S., Mubeen, I., Ullah, N., Shah, S. S. U. D., Khan, B. A., Zahoor, M., ... & Sultan, M. A. (2022). Modern diagnostic imaging technique applications and risk factors in the medical field: A review. BioMed Research International, 2022.
25. Rosenkrantz, A. B., Hanna, T. N., Babb, J. S., & Duszak Jr, R. (2017). Changes in emergency department imaging: perspectives from national patient surveys over two decades. Journal of the American College of Radiology, 14(10), 1282-1290.
26. Dasanayaka, C. H., Gunarathne, N., Murphy, D. F., & Nagirikandalage, P. (2022). Triggers for and barriers to the adoption of environmental management practices by small and medium-sized enterprises: A critical review. Corporate Social Responsibility and Environmental Management, 29(4), 749-764.
27. Rathan, R., Hamdy, H., Kassab, S. E., Salama, M. N. F., Sreejith, A., & Gopakumar, A. (2022). Implications of introducing case based radiological images in anatomy on teaching, learning and assessment of medical students: a mixed-methods study. BMC Medical Education, 22(1), 723..
28. Kwok, C., Degen, C., Moradi, N., & Stacey, D. (2022). Nurse-led telehealth interventions for symptom management in patients with cancer receiving systemic or radiation therapy: a systematic review and meta-analysis. Supportive Care in Cancer, 30(9), 7119-7132.
29. Paech, D., Nagel, A. M., Schultheiss, M. N., Umathum, R., Regnery, S., Scherer, M., ... & Niesporek, S. C. (2020). Quantitative dynamic oxygen 17 MRI at 7.0 T for the cerebral oxygen metabolism in glioma. Radiology, 295(1), 181-189.
30. Mitchell, E., Abdur-Razzaq, H., Anyebe, V., Lawanson, A., Onyemaechi, S., Chukwueme, N., ... & Ubochioma, E. (2022). Wellness on Wheels (WoW): Iterative evaluation and refinement

of mobile computer-assisted chest x-ray screening for TB improves efficiency, yield, and outcomes in Nigeria..

31. Pooli, A., Johnson, D. C., Shirk, J., Markovic, D., Sadun, T. Y., Sisk Jr, A. E., ... & Reiter, R. E. (2021). Predicting pathological tumor size in prostate cancer based on multiparametric prostate magnetic resonance imaging and preoperative findings. Journal of Urology, 205(2), 444-451.
32. Alhashem, R., Byrne, S., & Hall, D. (2022). Fifteen-minute consultation: Diagnosing serious pathology in children with headaches presenting to the emergency department. Archives of Disease in Childhood-Education and Practice.