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ALIGNMENT OF RADIATION SAFETY ATTENTION AMID NON-RADIOLOGY PERSONNEL

Mayawati Guleria

ABSTRACT

Wilhelm C. Roentgen's discovery of X-rays in 1895 led to high hopes for their application in various fields, including medicine, industry, agriculture, and trade. The societal attitude towards safety, known as "security ethos," encompasses beliefs, standards, and rules governing the protection of individuals from danger. The Health Protection Agency (HPA) Center for Radiation reported that diagnostic X-ray exposure accounted for 15% of the total radiation dose from all sources, with 90% directed at the UK population. Radiation harm is categorized into acute, consequential, and late effects based on symptom manifestation time. The International Commission on Radiological Protection (ICRP) aims to safeguard human health and has expanded to include environmental protection. Radiographers set annual exposure limits, and various committees establish effective dose limits. Dosimeters measure radiation exposure. The RPC has significantly reduced photo-emission dosage, heightened awareness of particle emission hazards, and improved radiation protection programs. The RPC's objective is to foster a secure working environment, raise awareness of radiation hazards, decrease unsafe behaviour, manage radiation exposure, assign responsibilities among workers, and enhance an effective radiation protection program. Education on radiation safety is crucial for all employees, not just those in radiology. However, there is a lack of understanding among professionals about radiation risks and protective measures. Proper education for healthcare professionals, including nurses, doctors, and technologists, is essential to protect against the harmful effects of radiation. It is crucial to integrate radiation safety education into the training of healthcare workers to fortify against the harmful effects of radiation exposure.

KEYWORDS- *Non-Radiology Staff, Radiation Protection, Radiation Center Safety Status, TLD, ALAPR, AERB, Radiation Monitor*

INTRODUCTION

On November 8, 1895, Wilhelm C. Roentgen discovered X-rays, which raised significant hopes for their application in medicine and other sectors of daily life such as industry, agriculture, and trade. *(Thayalan et al. (2010))* Ionizing radiation has a variety of applications, including food and medical equipment sterilization, medical image generation, and even cancer treatment. *(Nassef et al. (2017))* X-rays are a form of radiation made by using a lot of power. X-rays are utilized in medical imaging in the same way that a camera creates an image using visible light. X-rays pass through the body, creating an image on a film based on how many are absorbed and how many pass through. X-ray films are frequently referred to as such, but the term refers to the sort of radiation utilized to create the image. *(Schauer DA, Linton OW, et al. (2009))* The electromagnetic spectrum encompasses all types of light, including those that are invisible to human vision. The lights that makeup rainbows make up a very small part of the electromagnetic spectrum. Radio waves, microwaves, gamma rays, UV rays, and X-rays are all examples of rays that fall inside the electromagnetic spectrum. Human eyes cannot see any of these lights. X-rays are a type of electromagnetic radiation with a highly specific wavelength. X-rays have a wavelength of 0.01nm to 10nm. X-rays have a frequency range of 30 PHz to 30 EHz. X-rays have energies ranging from 100eV to 100keV. X-rays are commonly used because of their ability to penetrate thick materials such as human skin, bones, and flesh. *(Committee 3 ICRP, et al. (2001))*

The hazards associated with the rising diagnostic usage of X-rays in medicine might significantly increase patients' radiation dose. It backs up studies provided by the Health Protection Agency (HPA) Centre for Radiation, which indicated that exposure to ionizing radiation for diagnostic reasons accounted for 15% of the total dose from all natural and manmade sources and 90% of the overall dose to the UK population. As a result, there is a worldwide interest in developing radiation protection recommendations and guidelines, some of which have already been provided by organizations such as the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). (Mohammed K. Saeed et al. (2018)) [(5)] The concept of safety culture has grown in popularity in corporations in recent years, owing mostly to the rapid development of technology and concern for employees' health and safety. The safety culture reflects the attitudes, beliefs, standards, and practices that professionals and workers have toward risk and safety. "Safety culture" is commonly used in connection with the words "nuclear safety culture," "patient safety

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culture," "health safety culture," "safety culture," "organizational safety culture," and "environmental safety culture." *(Ploussi A, Efstathopoulos EP, et al. (2016))*

Angiography, fluoroscopy, mammography, DEXA scan, interventional treatments, computed tomography (CT), and radiographic imaging are all medical procedures that employ ionizing radiation. The main objective of radiological imaging is to provide the best image possible while using as little radiation as feasible. However, international dosage restrictions may be surpassed for some interventional purposes and circumstances. As a result, it is vital to consider both the patient's and the medical professional's safety during the procedure. *(Yurt, A., Çavuşoğlu, B., & Günay, T. et al. (2014))* Organizations such as the International Commission on Radiological Protection (ICRP) and India's Atomic Energy Regulatory Board (AERB) have issued radiation safety recommendations and set radiation safety standards. ALARA (As Low as Reasonably Achievable) recommendations have been implemented for safety measures to limit the threats of radiation. Radiation safety education is essential for protecting not just the patient but also the radiology and non-radiology employees. Dosimeters are used to measure radiation exposure, while lead aprons, thyroid shields, and lead glasses are used to limit the dosage of radiation absorbed. Despite regular radiation exposure, radiology and non-radiology professionals do not understand radiation exposure threats and protective measures. *(Ranade, A., Oka, G., Daxini, A., et al. (2020))*

The International Commission on Radiological Protection's (ICRP's) target is to provide a framework and beneficial standards for radiation protection, including medical, occupational, ecologic, and exposure controls against radiological crashes while not unfairly limiting the beneficial practices that cause radiation exposure. Except for exposures excluded from the criteria and exposures from activities or sources exempted by standards, the phrase "occupational exposures" refers to the exposure of persons at work to ionizing radiation from natural and man-made sources as a result of workplace operations. It was suggested that personnel exposed to medical radiation sources follow and perform all of the standards established in the International Basic Safety Standards for Ionizing Radiation Protection and Radiation Source Safety. Dose assessment for radiation workers is a key aspect in evaluating radiation dangers and establishing safety precautions for the government and organizations. According to the International Commission on Radiological Protection (ICRP) publication number 60, the radiation dosage to workers is expressed in terms of effective dose and equivalent dose for extremities and eye lenses. *(M.H. Nassef, A.A. Kinsara. et al. (2017))* To protect personnel, patients, and the public in general from the risks associated with their usage, X-rays, for instance, are controlled and monitored. However, the effects of X-rays at low doses are far less obvious, and their effects at large levels are carcinogenic, mutagenic, and teratogenic. In most cases, the intensity of the effects seems to have a linear connection to the dose with really no threshold value. *(SD Yusuf, I Umar, AI Bukar, MM Idris. Et al. (2020))*

TYPE OF RADIATION EFFECTS

Radiation impacts can be characterized as stochastic or non-stochastic. Stochastic effects are random and unpredictable, and they can cause cancer or genetic changes, whereas non-stochastic effects are known and preventable. Non-stochastic effects include erythema, epilation, and a reduction in sperm count. Certain organs of the body, including the thyroid and reproductive organs (gonads), should be given special care since they have been discovered to be more radiosensitive than other organs of the body. *(Alotaibi, M., & Saeed, R. et al. (2006))* The effort to identify the hereditary implications of ionizing radiation exposure for humans has undoubtedly been one of the most important concerns in human genetics during the last 50 years. Given that the majority of chromosomal aberrations and many gene mutations cause hereditary disorders, studying radiation-induced alterations in germline mutation rates should reveal crucial information about the genetic risk of ionizing radiation exposure in humans. (*Dubrova, Y. E. et al. (2003))* Radiation safety refers to safeguarding workers against negative radiation-related side effects by preventing individuals from receiving excessive doses, monitoring all radioisotopes so that they could be exposed, and taking precautions when handling radioactive materials. Additionally, radiation safety enhances patient and staff safety increases diagnosis and treatment effectiveness, and lowers the danger of radiation exposure. Radiation safety regulations must be properly followed to avoid several risks, such as environmental pollution, an increase in the risk of cancer, and damage to both staff and patient's vital organs. (*Dörr, W., & Hendry, J. H. et al. (2001))* Due to the genetic basis of radiosensitivity, significant attempts were made to create predictive tests that might determine the radiation resistance of normal tissues or tumors in specific individuals by utilizing cell death or other physiological effects of radiation in a specific cell population. *(Poglio, S., Galvani, S. et al. (2009))*

RADIATION SENSITIVITY OF THE NON-RADIOLOGY PERSONNEL

The exposure of healthy tissues might cause problems according to the target organ and cell type, the harm to normal tissues varies. According to how long it takes for symptoms to manifest, radiation harm is sometimes divided into acute, consequential, and late effects. *(H Majeed, V Gupta, et al. (2022))* When acute problems are left untreated and result in long-lasting harm, the consequences are evident. Months to years after exposure, late complications appear and typically affect postmitotic cells (liver, kidney, heart, muscle, and bone) *(Donnelly, E. H., Nemhauser. et al. (2010))* When the entire body (or the majority of it) is exposed to a significant dosage of radiation

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in a short amount of time, the result is acute radiation syndrome (ARS), also known as radiation toxicity or radiation sickness (usually a matter of minutes). Most practising doctors will be unable to make the diagnosis of acute radiation sickness (ARS) in the absence of clear exposure. *(Dörr, W., & Hendry, J. H. et al. (2001))* A non-healing acute reaction has been seen to immediately proceed into a late impact, especially in those organ systems where the acutely reacting component establishes a shield against mechanical and/or chemical stress. *(Bhar, M., Mora, S. et al. (2021))*

SAFETY STANDARDS AS PER RPC, ICRP, ALARA, AND AERB

Over the past few decades, the modelling of the human body has advanced dramatically, pushing toward more realism and customization. Currently, there are three phantom format kinds and three morphometric categories (reference, patient-dependent, and patient-specific). *(Valentin J. et al. (2013))* The International Commission on Radiological Protection (ICRP) is a consultative non-governmental organization (NGO) whose recommendations serve as the foundation for the International Basic Safety Standards document and are mirrored in radiological protection laws all around the globe. The primary goal of the ICRP radiological protection system is to safeguard human health, but it now also takes environmental safeguards into account. Early ICRP guidelines (1928–1950) appear to have been mostly based on virtue ethics and nearly entirely focused on preventing deterministic tissue consequences of high radiation doses. *(Valentin J. et al. (2013))*

The basic idea behind ALARA is that radiation exposure levels should be minimized as low as feasible while still taking into account the benefits of radiation used for society and using common sense in terms of convenience and cost. Applying the architecture to actual exposure settings is a challenge. To understand this challenge, it is vital to take into account several dose-effect models for biological risk brought on by radiation exposure. No matter how little the exposures may be, ALARA is, in theory, applicable to all individual and group radiation exposures. Since the time and money required would be more than any expected benefits, it is usually impracticable to examine every exposure in a workplace using ALARA principles. *(Hendee, W. R., & Marc Edwards, F. et al. (1986))*

Professional meetings with diverse themes linked to Industrial Safety and Occupational Health are hosted annually by AERB in collaboration with a unit of the Department of Atomic Energy (DAE) to foster a safety culture and the sharing of new ideas among safety experts. The culture of radiation protection is founded on the concepts of justification, optimization, and dose limitation, as all of us in this subject are aware. When used in medicine, this translates to the defence of certain medical treatments and optimization of dosages administered to patients and medical personnel performing the operations. Of course, patients are exempt from dose limits, but it still applies to others. Unfortunately, the medical industry does not yet have as strong of a justification and optimization culture as it ought to. *(AERB AER Board - Regulation, et al. (2012))*

OCCUPATIONAL DOSAGES IN RADIOLOGY AND NON-RADIOLOGY DEPARTMENTS

Occupational dosages related to radiation are lifetime risks for cancer and it is limited for the radiographer and the radiologist and is lacking for the technologists and the physicians who are there in fluoroscopy procedures *(Linet MS, Kim KP, Miller DL., et al. (2010))*. There should be awareness for the radiation workers and they should be told about the long-term risk of radiation exposure likewise cancer.

National and International Radiation Committees have set the annual effective dose limits. Radiation Protection organizations must convert the dose of radiation to an estimated effective dose. To check the effective dose the dose which is under the apron plus 6% of the dose which is above the collar plus 2%overcollar dose can be estimated and tells the radiation dose of the thyroid shield. *(Niklason LT, Marx MV. et al. (1994))*

The radiographers who do not specialise in radioactive areas, there are some annual exposure limits as follows:

- Total effective dose equivalent 0.05Sv
- Deep dose equivalent 50rems or 0.5 Sv
- For eyes annual limit is 15 rems or 0.15Sv
- For skin and extremities, the annual limit is 50Rems or 0.5Sv *(Naseef MH, Kinsara AA., et al. (2017)), (Kamenopoulou V, Drikos G., et al. (2001))*

The doses which are there for the public are as follows:

- 1mSv a year as an effective dose
- 15mSv equivalent dose to the lenses of the eye
- 50mSv a year the equivalent dose to the skin *(Hamada N, Fujimichi Y., et al. (2014))*

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SIGNIFICANCE OF RADIATION PROTECTION IN THE RADIOLOGY DEPARTMENT

Protective accessories such as lead aprons and goggles have been practised worldwide for individual protection. There should always be audits during interventional procedures for the benefit of the patient. The implementation of a periodic safety culture for occupational workers should be followed for their safety and their benefit. *(Livingstone RS, Varghese A., et al. (2017))*

The need to establish a radiation protection culture (RPC) in every Radiology department has arisen due to the increased use of Ionizing Radiation for diagnostic purposes such as in CT. The formation of RPC has reduced the radiation dose, enhanced radiation risk awareness, it also has reduced unsafe practices and has also improved the radiation protection program. *(Ploussi A, Estathopoulos EP. et al. (2016))* Following a suggestion from the French Society for Radiation Protection, the International Radiation Protection Association (IRPA) initially defined the idea of radiation protection culture (RPC) about the safe use of ionizing radiation in the medical profession and nuclear business in 2008. The World Health Organization (WHO), the European ALARA Network, and the collaborating Associate Societies all responded favourably to the idea. Professionals established an action plan for the creation of a strong RPC and offered several definitions for RPC at the first IRPA RPC Workshop in 2009. The Association published the final draught of the Guiding Principles for Establishing an RPC two years later, following a series of meetings. Most recently, in June 2014, the draught was released in its final form. *(Le- Guen, Bernard, Kase, Ken (2014)).*

There are some Measures for radiation protection in plain film radiography likewise ALARA principle should be used to determine the ideal dose for an X-ray examination. *(Thayalan. et al. (2010))*

TO ESTABLISH A RADIATION PROTECTION CULTURE

The term "radiation protection culture" (RPC) refers to a body of information, attitudes, and behaviours relating to radiation safety. The creation of an RPC in a radiology department necessitates thorough familiarity with radiation dangers, adherence to safety guidelines, and active involvement from all parties. The development of an RPC is mostly the responsibility of experts. A robust RPC enhances patient and staff safety, offers more accurate diagnoses and treatments, and lowers radiation exposure *(Ploussi A. et al. (2015)).*

The goals of RPC are to provide a safe working environment, encourage awareness of radiation hazards, reduce risky behaviours, manage radiation risks, delegate responsibility among employees, and enhance an already effective radiation protection program. All of the aforementioned goals are accomplished through the engagement and active participation of every department employee.

- Below are some of the essential characteristics of a strong safety culture;

1. Safety is everyone's responsibility.
2. Leaders show a dedication to safety.
3. The organization is permeated by trust.
4. Making decisions that prioritize safety.
5. At all levels of an organization, a questioning attitude is fostered, including the challenging of potentially unsafe acts and decisions without regard to seniority.
6. openly disclosing issues and mistakes, even when they are made without assigning blame.
7. Learning within organizations is valued.
8. involvement of employers at all levels in enhancing performance and safety.
9. Safety is continually scrutinized.
10. As well as typically strong operational performance.

There are three main tenets of radiation protection the justification of exposure, optimization of ionizing radiation doses to minimize risks and implementation of dose limits. These guidelines were developed by the International Commission on Radiological Protection (ICRP) *(Martin A., Harbison S., et al. (2018))* RPC is aware of and apprehends the true radiation risks about their advantages. The growth of RPC would be greatly aided by a significant improvement in awareness and technical knowledge.

RESULTS

Studies have also been conducted to examine doctors' awareness and understanding of the risks that radiological exams pose to their health as well as the health of their patients. In this study by Saeed, Mohammed K., et al. (2018), doctors from 20 Saudi Arabian cities responded to 466 questionnaires that were sent using a Google spreadsheet. 167 radiologists, 106 neonatologists, 19 oncologists, 45 surgeons, 18 orthopaedists, 11 paediatricians, and 100 doctors with various specialities were in the sample. Out of all the physicians, only 133 had completed radiation protection training at work. Seventy-three per cent of the participants reported having numerous knowledge gaps. For instance, 69.3% of respondents were unaware of the recommended yearly dosage limit for a radiation worker's entire body, and 51% of respondents were unable to recognise mammography as an ionising radiation procedure. The range of scores

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for general knowledge was 0% to 16.5% (mean 5.3%), with surgeons and orthopaedists scoring the lowest. These survey findings indicate that the radiation safety training that various healthcare facilities provide to physicians is inadequate and ineffectual. Physicians' knowledge and awareness of radiation safety remain low, as indicated by their overall mean score of 5.3%.

Additionally, studies have been conducted to investigate Kuwaiti radiology nurses' degree of awareness regarding radiation hazards and protective measures. Numerous organisations and academics have found several radiation dangers, including immune system failure and aberrant DNA molecule changes that lead to cancer. 35 radiology nurses who worked in radiography departments representing seven government general and speciality hospitals in Kuwait, including Mubarak and Kuwait Cancer Control Centre, were included in this study by Alotaibi M, Saeed R. et al. (2006). As was to be expected, the majority of the population (86%) was of Asian descent, while the minority (14%) was of Arab non-Kuwaiti descent. Approximately half of the sample, or 16 nurses (44%), were between the ages of 30 and 39 years. Nurses 40 years of age and older made up the second-largest group, 11 (34%). The remaining eight nurses, or 22 per cent, were under 29 years old. There were 28 nurses (80%) who were female and 7 (20%) who were male. Neither before nor after they become radiology nurses do they get instruction on radiation dangers. The fact that they lacked radiological specialisation made matters worse. Their nursing managers were the only ones who gave them the go-ahead to work in this area without enough training from the radiology and nursing departments. Sadly, the thermoluminescent dosimeters were not given to these nurses.

Studies have also been conducted to determine the degree of radiation protection knowledge among radiologists and clinicians, as well as to determine whether or not radiation protection education raises awareness. In this cross-sectional study by Algohani, Khaled Awdah, et al. (2018), the knowledge of radiation protection was measured through the use of an anonymous questionnaire. According to these poll findings, 101 participants, or 100%, answered the questions. Of these, 22 participants (21.8%) were consultants, 30 participants (29.7%) were specialists, and 49 participants (48.5%) were residents. Of the participants, 48 (47.5%) had previously attended a radiation protection course, which is somewhat less than half. 68.8% of individuals who took a course reported knowing about the POPUMET requirements ($p<0.001$). The procedures carrying a risk equivalent to 0.25 mSy of predicted radiation dosage were questioned by the participants. Attending the training was found to increase awareness about the danger of three (out of four) operations (p0.05) and the radiosensitivity of various organs. The vast majority of participants (96%) were unaware that patients' yearly radiation doses are not limited. Of the participants, around half (56.4%) knew what the word "ALARA" meant. The current study's findings indicated that healthcare staff' and patients' safety is not sufficiently guaranteed by their degree of awareness of radiation protection. As a result, healthcare personnel should routinely participate in more effective awareness programmes, and their awareness levels should be constantly monitored to identify areas for development.

Additionally, studies have been conducted to evaluate medical students' knowledge, risks, and misconceptions about radiation-using and non-radiation-using equipment. A self-administered questionnaire was used in this study by **Mubeen, S. M., Abbas, Q., et al. (2018)** among medical students at a private medical college in Karachi. The research comprised one hundred and twelve fourth and final-year MBBS students who had finished their clinical rotation in the radiology department. Software for statistical analysis was used to examine the acquired data. Almost 40% of the students acknowledged that following an X-ray, items in the X-ray room release radiation. Almost the same number concurred that safety precautions should be used when doing ultrasounds and that high-quality microwave equipment releases hazardous radiation. A little over one-third of students believed that intravenous contrast material used in angiography is radioactive, whereas the same amount thought that gamma rays were more dangerous than X-rays. While 18% of students believed that MRIs released ionising radiation, 67% of students agreed that nuclear material utilised in medicine has the potential to explode. Out of all medical specialists, 28% of students think radiologists live shorter lives than other medical professionals. According to these findings, the majority of medical students in both years knew very little about the different facets of radiation sources, the dangers associated with them, and how to protect themselves. In the field of radiography, medical students need better instruction and curricula.

Studies have also been conducted to examine medical students and junior physicians in Ireland's understanding of ionising radiation and see if this knowledge increased with clinical practice. In their 2009 study, McCusker, M. W., et al. examined 269 participants who answered questions on patient dosages and the principles of diagnostic imaging. According to the study's overall knowledge results, 99% of participants misjudged the radiation dose associated with a barium enema, abdominal plain film, lumbar spine X-ray, and PET scan. Nearly 90% of respondents misjudged the CT abdomen/pelvis dosage. While 27% of individuals believed that MRI required ionising radiation, 42% of subjects were aware that PET did. After moving into a clinical setting, there was a noticeable increase in comprehension, but no more advancement. One per cent had taken official radiation safety courses. In summary, little was known about patient dosages and basic radiological techniques. To enhance fundamental understanding and promote safe practice, current undergraduate instruction must be extended and maintained beyond qualification.

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Additionally, studies looking at researching Medical ionising radiation are commonly utilised to aid in patient diagnosis and treatment in hospitals, especially dentistry clinics, and medical research. Investigated were dental undergraduate students' and interns' attitudes, perceptions, and levels of understanding regarding ionising radiation exposure in radiological investigations and dental care clinics. **Abuelhia, Elfatih, et al. (2022)** carried out A cross-sectional study was carried out, and the University of Imam Abdulrahman Bin Faisal was granted a licence to use the "QuestionPro" program, which was used to create 17 online questions. In addition to interns from King Fahad University Hospital and private dentistry clinics, participants included senior medical dental students in their third and fifth years at Imam Abdulrahman Bin Faisal University. Out of the 855 participants, 360 began the online questionnaire, and 258 (72%) finished it. Overall, there was a dearth of information; 32% of respondents were doubtful and 32% mistakenly assumed that ionising radiation was utilised in ultrasound and magnetic resonance imaging. Forty per cent (n = 104) of the respondents thought dental X-rays were hazardous. A third of participants (n = 85) said that there is no radiation dispersion during an X-ray or CT scan, whereas another third (n = 76) expressed uncertainty. Respondents overestimated the radiation dosage (45%; n = 116) and (44%; n = 104) were ignorant about the radiation dose from a chest radiograph. Over half of the participants (54%) are aware of the effects of ionising radiation on healthy tissue. 39% of respondents said they are exposed to less radiation while using digital radiography as opposed to conventional radiography. Regarding radiation safety and risks, 46% of respondents stated that personal monitoring badges need to be worn always, while 58% (n = 150) recommended frequent usage of lead aprons. While 37% of the respondents (n = 95) had not received radiation safety education, 63% of the subjects had acquired it through official lectures, tutorials, or workshops. The International Commission on Radiological Protection's international guidelines were unknown to 53% of the respondents. Fifty per cent (n = 129) of those questioned claimed they would adhere to radiation safety procedures if they ever launched a private dentistry clinical practice.

STATISTICS REFLECTING THE AWARENESS LEVEL

- Awareness Level During Working in Radiology

ALARA	Yes No	0% 100%
10 Days	Yes No	67% 33%
Most affect members	Fetus Pregnant women	67% 33%

Table 1, only 3 of the 35 radiological nurses who work in the radiology department have taken radiation safety lessons. The ALARA principles were unknown to the majority of these nurses, but just two of them were aware of the ten-day rule. In it, two nurses chose the fetuses, while one nurse chose the expectant mothers. *(Alotaibi, M., & Saeed, R. et al. (2006))*

- Awareness Regarding Radiation Protection

Lead rubber apron	5	15
Lead thyroid protector	0	0
Lead screen	0	0
Distance	0	0
Film badge	30	86

Table 2 shows that out of 35 nurses, 30 of them believed that a film badge was the best form of protection, while the other five chose a lead apron. These nurses had no idea that radiation may be reduced by moving farther away from the source of the radiation and then moving behind a lead shield.

The familiarities of the three pillars (time, distance, and shielding) throughout the entire sample were as follows: 38% of the nurses were familiar with time, 25% were not at all familiar with time, and 37% were; 31% of the nurses were very familiar with shielding, 38% of the nurses were very comfortable with shielding, and 31% of the nurses were unfamiliar with shielding. Of the nurses, 19% were very familiar with distance, 47% were familiar with distance, and 34% were unfamiliar with distance. The majority of nurses—30 (83%)—were terrified of radiation because it risked the human body, including cancer and infertility. Only five nurses (or 17%) of the remaining workforce had no radiation phobia. These nurses said that they were not worried because they were aware of radiation safety measures and their consequences. All of the nurses stated that they were interested in finding out more about radiation and its risks. Finally, nurses were asked to provide one open-ended response: What recommendations do you have to raise radiology nurses' understanding of radiation risks? Most of the 35 nurses—29, or 82%—suggested taking radiation safety training before working in the radiology department. Six (18%) of the remaining respondents advised holding regular radiation safety workshops and seminars. *(Alotaibi, M., & Saeed, R. et al. (2006))*

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DISCUSSION

The review study underlines how important it is to raise non-radiology staff members' understanding of radiation safety. This is in line with other research that highlights the importance of thorough training courses for medical personnel who could come into contact with radiation-emitting equipment. For example, Algohani, Khaled Awdah, et al. (2018) showed that enhanced instruction and training resulted in a significant decrease in occurrences of radiation exposure among staff members who are not in radiology.

This paper promotes standardised training courses to guarantee uniform procedures and expertise throughout various medical divisions. This is in line with the recommendations made by agencies such as the National Council on Radiation Protection and Measurements (NCRP) and the International Atomic Energy Agency (IAEA), which emphasise the need for standardised training standards to reduce radiation risks in various clinical settings (IAEA, edition 2014).

The review paper's main focus is on the value of multidisciplinary cooperation in advancing radiation safety. This idea is consistent with research by Mohammed K. et al. (2018), which shows how maintaining a culture of safety and reducing radiation exposure events may be achieved through efficient communication and collaboration across various healthcare departments.

Another important topic of discussion is how to improve radiation safety procedures by integrating technology improvements. This is consistent with research by Paolicchi, F., et al. (2016), which highlights the benefits of automated monitoring systems and rapid feedback mechanisms for radiation safety procedure improvement.

CONCLUSIONS

The study found that non-health professionals who work with ionizing radiation have insufficient general knowledge about radiation, radiation protection, health concerns, and doses employed in radiological applications. Technologists had a statistically significant knowledge deficit compared to residents, fellows, and staff radiologists. This is concerning because technologists are the patients' first point of contact, and should be sufficiently prepared to respond to common patient queries and concerns. Residents and fellows are the next levels of contact, and they are frequently relied upon to advise colleagues in other specialities and patients regarding dose and safety concerns. The most important duty of staff radiologists is to regularly acquire and teach knowledge about radiation and any developments in the field to technicians, residents, and fellows, as well as to provide professional advice on risk and dose issues. We discovered a lack of understanding of the health dangers connected with ionizing radiation, which is consistent with the findings of similar surveys. A better understanding of radiation protection issues has become an important element of professional expertise for not only radiologists and radiation therapists, but also other specialists and medium-level or auxiliary staff, in an era of increasing pro-health awareness within society and of increasingly common claims filed against medical personnel. Radiation and biological impacts of radiation courses should be incorporated in the training of healthcare workers, during and after their education, to raise awareness of the safety precautions needed to defend against the harmful effects of ionizing radiation.

REFERENCES

1. *Thayalan K, Ravichandran R. The physics of radiology and imaging. JP Medical Ltd; 2014 May 30. (chapter 1)*
2. *Nassef MH, Kinsara AA. Occupational radiation dose for medical workers at a university hospital. Journal of Taibah University for Science. 2017 Nov 1;11(6):1259-66.*
3. *Schauer DA, Linton OW. NCRP report No. 160, ionizing radiation exposure of the population of the United States, medical exposure—are we doing less with more, and is there a role for health physicists? Health physics. 2009 Jul 1;97(1):1-5.*
4. *Valentin J. Radiation and your patient: A guide for medical practitioners: ICRP Supporting Guidance 2: Approved by ICRP Committee 3 in September 2001. Annals of the ICRP. 2001 Oct;31(4):1-52.*
5. *Saeed MK, Al-Shari H, Almarzooq MM, Alsareii SA, Aljerdah SA, Al-ayed MS. Radiation awareness among physicians about the hazards of radiological examinations on the health of workers and their patients in Saudi Arabia. Journal of radiation research and applied sciences. 2018 Oct 1;11(4):299-304.*
6. *Ploussi A, Efstathopoulos EP. Importance of establishing radiation protection culture in radiology department. World journal of radiology. 2016 Feb 2;8(2):142.*
7. *Yurt A, Çavuşoğlu B, Günay T. Evaluation of awareness on radiation protection and knowledge about radiological examinations in healthcare professionals who use ionized radiation at work. Mol Imaging Radionucl Ther. 2014 Jun 1;23(2):48-53.*
8. *Ranade AS, Oka GA, Daxini A, Ardawatia G, Majumder D, Bhaskaran S. Radiation safety knowledge and practices: is the Indian orthopaedic community well-informed?. Indian Journal of Orthopaedics. 2020 Sep;54:158-64.*
9. *Yusuf SD, Umar I, Bukar AI, Idris MM. Assessment of the knowledge and attitude to radiation safety standards of the radiological staff in Damaturu, Yobe State, Nigeria. Asian J Med Principles and Clin Practice. 2020;3:1-7.*
10. *Alotaibi M, Saeed R. Radiology nurses' awareness of radiation. Journal of Radiology Nursing. 2006 Mar 1;25(1):7-12.*

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11. *Dubrova YE. Long-term genetic effects of radiation exposure. Mutation Research/Reviews in Mutation Research. 2003 Nov 1;544(2-3):433-9.*
12. *Dörr W, Hendry JH. Consequential late effects in normal tissues. Radiotherapy and oncology. 2001 Dec 1;61(3):223-31.*
13. *Poglio S, Galvani S, Bour S, André M, Prunet-Marcassus B, Pénicaud L, Casteilla L, Cousin B. Adipose tissue sensitivity to radiation exposure. The American journal of pathology. 2009 Jan 1;174(1):44-53.*
14. *Rocha PH, Reali RM, Decnop M, Souza SA, Teixeira LA, Júnior AL, Sarpi MO, Cintra MB, Pinho MC, Garcia MR. Adverse Radiation Therapy Effects in the Treatment of Head and Neck Tumors. RadioGraphics. 2022 May;42(3):806-21.*
15. *Donnelly, E. H., Nemhauser, J. B., Smith, J. M., Kazzi, Z. N., Farfán, E. B., Chang, A. S., & Naeem, S. F. Acute Radiation Syndrome: Assessment and Management. Southern Medical Journal, 2010 103(6), 541–546*
16. *Bhar M, Mora S, Kadri O, Zein S, Manai K, Incerti S. Monte Carlo study of patient and medical staff radiation exposures during interventional cardiology. Physica Medica. 2021 Feb 1;82:200-10.*
17. *Valentin J. Radiation risks and the ICRP. InRadioactivity in the Environment 2013 Jan 1 (Vol. 19, pp. 17-32). Elsevier.*
18. *Hendee, W. R., & Marc Edwards, F. ALARA and an integrated approach to radiation protection. Seminars in Nuclear Medicine, (1986). 16(2), 142–150.*
19. *Board AE. AERB. Regulation. 2012 Jan;2(3).*
20. *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 Dec;174(6b):793-808.*
21. *Niklason LT, Marx MV, Chan HP. The estimation of occupational effective dose in diagnostic radiology with two dosimeters. Health physics. 1994 Dec 1;67(6):611-5.*
22. *Nassef MH, Kinsara AA. Occupational radiation dose for medical workers at a university hospital. Journal of Taibah University for Science. 2017 Nov 1;11(6):1259-66.*
23. *Kamenopoulou V, Drikos G, Dimitriou P. Dose constraints to the individual annual doses of exposed workers in the medical sector. European journal of radiology. 2001 Mar 1;37(3):204-8.*
24. *Hamada N, Fujimichi Y. Classification of radiation effects for dose limitation purposes: history, current situation, and future prospects. Journal of radiation research. 2014 Jul 1;55(4):629-40.*
25. *Livingstone RS, Varghese A. Radiation safety culture: the way forward in practising interventional radiology. Journal of Clinical Interventional Radiology ISVIR. 2017 Aug;1(02):100-6.*
26. *Ploussi A, Efstathopoulos EP. Importance of establishing radiation protection culture in radiology department. World journal of radiology. 2016 Feb 28;8(2):142.*
27. *International Radiation Protection Association. International Radiation Protection Association-IRPA.*
28. *Thayalan K, Ravichandran R. The physics of radiology and imaging. JP Medical Ltd; 2014 May 30. (chapter 2)*
29. *Martin A, Harbison S, Beach K, Cole P. An introduction to radiation protection. CRC Press; 2018 Oct 25.*
30. *Algohani KA, Aldahhasi AA, Algarni AH, Amrain KY, Marouf MA. Awareness of radiation protection measures among radiologists and non-radiologists. The Egyptian Journal of Hospital Medicine. 2018 Jan 1;70(3):371-5.*
31. *Mubeen SM, Abbas Q, Nisar N. Knowledge about ionising and non-ionising radiation among medical students. J Ayub Med Coll Abbottabad. 2008;20(1):118-21.*
32. *Abuelhia E, Alghamdi A, Tajaldeen A, Mabrouk O, Bakheet A, Alsaleem H, Alaraik W, MSmar A, Quwaihes F, Alshahrani K, Hlosh Y. Dental Undergraduates and Interns' Awareness, Attitudes, and Perception of Radiological Protection. International Journal of Dentistry. 2022 May 9;2022.*
33. *Paolicchi F, Miniati F, Bastiani L, Faggioni L, Ciaramella A, Creonti I, Sottocornola C, Dionisi C, Caramella D. Assessment of radiation protection awareness and knowledge about radiological examination doses among Italian radiographers. Insights into imaging. 2016 Apr;7(2):233-42.*