International Journal of Research Radicals in Multidisciplinary Fields (IJRRMF), ISSN: 2960-043X
Volume 3, Issue 2, July-December, 2024, Available online at: www.researchradicals.com

Reviewing the Necessary Components of Patient Placement for the Radiology Nurse

Mohammed Mushabbab Alamri[1], Omar Aqeel Alharbi[2], Asma Hamad Alqudayri[3]

[1,2]Radiology, Al Nakheel Medical Complex, Riyadh KSA
[3]Nursing Specialist, AL Nakheel Medical Complex, Riyadh KSA

ABSTRACT

Radiology nurses, who play a crucial role in the symptomatic cycle, especially, must prioritize patient safety and effective communication in order to provide exceptional consideration. Communication of potential risks to patients is crucial in the field of Western medicine and regulation, where the emphasis has shifted from a paternalistic approach to one that values patient independence and focus. This is in line with previous discussions in another survey, and it aims to empower patients to make informed decisions about their care. In this step, we'll take a look at the potential dangers of standard demonstrative medical imaging tests, analyze patient safety guidelines put out by groups charged with protecting the public, plan ways to lessen the dangers of analytical medical imaging to patients, and figure out how to let people know about the risks of radiology tests so that everyone can make an informed decision based on their own circumstances. In addition, it discusses the healthcare professionals' approach-based duties to detect potential dangers associated with medical imaging, including ethical, legal, and other considerations. Medical imaging communication and patient safety can be enhanced by provider collaboration.

Keywords: Ensuring Patient Safety, Effective Communication, Radiology, Best Practices, Radiology Nurses

INTRODUCTION

Since radiological techniques are distinct and specialized, it is imperative that patient safety and effective communication are ensured. In order to foster a safe environment and facilitate effective communication between patients, radiologists, and other medical services specialists, radiology nurses play a crucial role [1]. Because indicative imaging is so complex and involves X-rays, CT scans, MRIs, and interventional methods, safety rules must be strictly followed in order to reduce risks such as radiation exposure, contrast responses, and procedural entanglements. Furthermore, good communication enhances the overall consideration experience, addresses patient concerns, and promotes consistency.

A comprehensive approach to managing patient safety in radiology encompasses several elements. Radiology nurses are responsible for ensuring that patients are appropriately identified, providing the necessary pre-technique training, and assessing patients for contraindications. This arrangement includes monitoring systems during and after implementation, determining patient chronicles, and guaranteeing accurate documentation [2]. To prevent harm, safety protocols such as infection control procedures, disaster preparedness, and radiation safety precautions should also be strictly followed. Radiology nurses frequently take on the role of patient advocates, helping to explain the benefits and risks of various procedures while making sure that the rights and preferences of patients are honored.

In radiology, efficient communication is also essential to maintaining patient safety and improving outcomes. In order to ensure that patients are informed and comfortable, nurses should communicate difficult medical information to them in an approachable manner [3]. This is crucial in radiology in particular, since patients may feel anxious about trying new procedures or fearful of being examined. As a mediator between patients and radiologists, radiology nurses ease patients' concerns and translate technical medical terminology into understandable terms. They also work in tandem with other providers of medical services to exchange fundamental information regarding the patient's state and the outcomes of procedures, guaranteeing the continuity of treatment [4].

Adherence to evolving norms in radiological consideration and the ongoing evolution of expertise are also highlighted in best practices for radiology nurses. As medical imaging innovation advances and radiological systems become more sophisticated, it is essential to advance education on new protocols, safety guidelines, and communication skills. In a radiology context, radiology nurses should be competent to operate imaging equipment, supervise patient care during crucial mediations, and handle emergencies [5]. A variety of approaches are needed in radiology to ensure patient safety and efficient communication. As key players in this profession, radiology nurses should uphold strict safety protocols and maintain compassionate, straightforward communication with patients and the medical services group

[6]. The best practices in radiology nursing emphasize the need for teamwork and patient-focused care in order to achieve optimal outcomes. They also revolve around specialist capability.

Table 1: An overview of the main conclusions from recent research on the effects of radiation on medical imaging

Author(s)& Year	Title	Journal/Publisher	Key Findings
Hermena, S., & Young, M. (2023) [7]	Procedures for Producing CT-scan Images	StatPearls Publishing	gives a thorough rundown of CT-scan operations, covering image reconstruction, component responsibilities, and X-ray imaging concepts. focuses on optimizing scan parameters for both safety and quality.
Morgan, W.F., & Sowa, M.B. (2015) [8]	Ionizing radiation's non-targeted effects: mechanics and possible implications for radiation-induced health impacts.	Cancer Letters	examines ionizing radiation's non-targeted impacts, such as the abscopal and bystander effects. draws attention to the consequences for radiation risk assessment and radiation safety measures.
Ma, J., Kumar, A., Muroya, Y., Yamashita, S., Sakurai, T., Denisov, S.A., Sevilla, M.D., Adhikary, A., Seki, S., &Mostafavi, M. (2019) [9]	An excited anion radical in solution causes a dissociative quasi-free electron attachment to a nucleotide.	Nature Communications	looks at the creation of anion radicals and electron attachment to nucleosides, offering information on the effects of molecular radiation damage and its effects on DNA and other biomolecules.
Kumar, A., Becker, D., Adhikary, A., & Sevilla, M.D. (2019) [10]	Electron-DNA Reaction: Radiation Harm to Radiosensitization	International Journal of Molecular Sciences	investigates the relationship between electrons and DNA, with a particular emphasis on radiosensitivity and radiation damage. explains several forms of DNA damage and methods for increasing the radiosensitivity of tumor cells.
Tokue, H., Tokue, A., & Tsushima, Y. (2019) [11]	Unexpected burns from jogging pants revealed via magnetic resonance imaging	Radiology Case Reports	reports that during an MRI, conductive running leggings resulted in burn burns. explains mechanisms and emphasizes the significance of proper patient attire and safety precautions.
Tkach, J.A., Li, Y., Pratt, R.G., Baroch, K.A., Loew, W., Daniels, B.R., Giaquinto, R.O., Merhar, S.L., Kline-Fath, B.M., &Dumoulin, C.L. (2014) [12]	Acoustic noise characteristics of a neonatal intensive care unit's MRI equipment	Pediatric Radiology	examines the effects of MRI noise levels on newborns in NICUs. offers suggestions for lowering noise levels and enhancing patient safety and comfort.

Physics Terms And Concepts Important To Knowing The Safety Of Medical Imaging

All "medical cameras" follow the same basic principle as a "standard camera" used to capture an individual photo: (1) harness the human body's energy-retention capacity for a period of time; (2) detect and measure energy; and (3) direct the body's energy-bending processes. The bulk of medical imaging technology, including standard cameras, measures photon energy, which is also called electromagnetic radiation or energy. One exception is ultrasound, which employs tension waves, also known as vibrations per second, to measure the transmitted energy. While keeping in mind that not all sound waves are audible to humans, the words "pressure wave" and "sound wave" can be used interchangeably [13]. Several more prevalent, incomplete ideas are brought to light here. The energy in motion can be shown by particles, waves, or rays. An example of this would be x-rays, which are electromagnetic energy waves with frequencies much higher than those of visible light waves; instead of "wave," the word "beam" is usually used. Contrary to popular belief, radio waves are neither a form of sound nor a kind of electromagnetic energy that closely resembles light waves in frequency [14].

Standardized representations of energy from ionizing radiation have always been one kilogram (kg) of mass of matter, even though the SI uses the Joule (J) as its unit of energy. Dark energy is defined as the amount of radiation energy held in one kilogram of matter, and it is measured in Gy. A "natural effect of one J of radiation energy" accumulated in one kilogram of tissue is referred to as a Sievert (Sv) [15].

Here are some additional important scientific principles that will help you understand imaging exam difficulties; readers who aren't up-to-date on certain subjects will understand why these descriptions need to be expanded. Subsections in the article are generally structured according to the energy and material types used to perform the different imaging tests [16].

Exams Of Photon Transmission Medical Imaging

The majority of medical imaging still relies on photon transmission. Computerized tomography (CT) scanners, fluoroscopy video imaging, and static single picture radiography all rely on photon shaft generators and photon detectors. Through the anatomical region of interest, the generator projects high-energy photons. Both the quantity of photons that pass-through tissues and their restriction (actual retention) are affected by differences in the thickness of the underlying anatomical structures. By considering the regional differences in the detected photons, grayscale images can be generated using the photon thickness guide. When photons with X-ray beams collide with particles, they impart energy to those particles. Ionizing radiation is the result of a cascade of subatomic processes that culminate in an excess of negatively charged particles (electrons) that transform neutral molecules into such particles. In other contexts, pertaining to CT, more details regarding this cycle and its contributions to the modern age of medical imaging are explored. A patient can also be exposed to ionizing radiation during an atomic medication exam (discussed further below), but this time the radiation comes from an intravenous or oral source [17].

Ionizing particles, such as X-rays, can damage deoxyribonucleic acids (DNA) at the middle to upper limits of their energy ranges. This damage can be indirect or direct, and it can induce single-strand breaks or double-strand breaks. If these breaks are not repaired, they can cause malignant cells to grow. Although there is some evidence that medical imaging using low-energy ionizing radiation might induce cancer, the exact mechanisms by which this happens are complex and only poorly understood (as previously mentioned) [18].

Magnetic Resonance Imaging

Radio wave photons are sent through the body by X-ray machines that use magnetic resonance imaging (MRI). Here, the wave component, rather than the molecule element, is the most prominent part of the electromagnetic radiation molecule wave duality concept. Though not directly in X-rays, the wave energy can force certain particles to reverse their direction. This is especially true with hydrogen iotas, which comprise a significant amount of the molecules in tissues that include water or fat.

Slopes, which are variations in the extents and frequencies of radio waves caused by interactions with various proton concentrations in a given tissue type, can be used to detect and generate electronic images. Even while X-rays don't produce ionizing radiation, the energy "fields" they produce do pose certain risks [19].

The first step in using an X-ray machine is to create a high enough static magnetic energy field (B) at the center of the field to accelerate neighbouring ferromagnetic metals, such as iron, nickel, and cobalt. The patient could sustain internal injuries or have any ferromagnetic implants—whether medical or otherwise—such as shrapnel—dislodged if this happens. It can potentially cause injuries or death by transforming extracorporeal ferromagnetic objects in the area into projectiles that travel at high speeds. According to Schenck's analysis, which he conducted after looking at several potentially harmful effects of fields on tissues, none of these effects cause patient harm [20].

The second benefit of X-ray equipment is that the radiofrequency (RF) radiation field it produces can heat tissue, particularly ferromagnetic tissue. Shellock found that the heating effects of RF angles on tissue temperature do not have any major physiological influence, even when there are minimal changes in interior temperature. Nevertheless, reports have surfaced of heat-induced burns caused by metallic jewelry and zippers [21].

Thirdly, X-ray machines can generate electric fields that are powerful enough to shock human nerve endings and rattle machine parts, resulting in noise levels beyond 100 A-weighted decibels. There are currently no known health hazards associated with X-ray-induced nerve pain, yet it can be rather painful. Prolonged exposure to the vibrations caused by the moving parts could lead to temporary or long-term hearing loss and tinnitus [22].

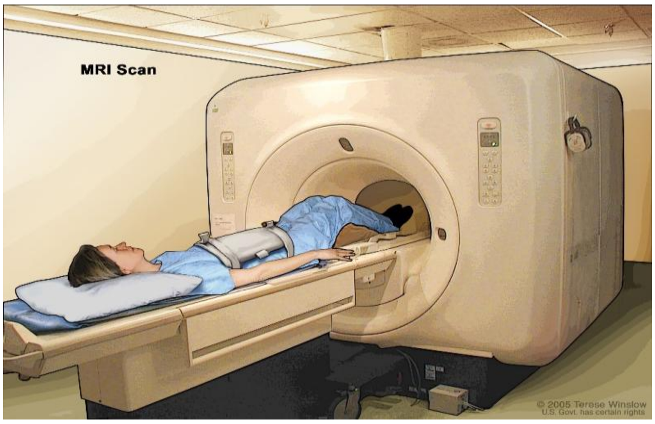

Figure 1: Magnetic Resonance Imaging.

Nuclear Medicine, Interventional Radiology, And Other Issues

Imaging and infection treatment are two applications of nuclear medicine (NM) that make use of unstable isotopes administered intravenously or orally [23]. The vast majority of NM tests employ gamma-ray emitting isotopes. Additional nuclear medicine examinations make use of isotopes that release positrons, which, when coupled with electrons from the human body, produce photons. Images can be created by absorbing energy from gamma rays and other photon energies using gems in NM scanners. When administered in certain ways, such as using beta particles, certain radiopharmaceuticals are designed to destroy tissues. On the other hand, ionizing radiation isn't the only thing that most radiopharmaceuticals used in medical imaging affect tissues with. Some CT scans expose patients to very high doses of ionizing radiation [24].

The field of interventional radiology (IR) incorporates the aforementioned imaging techniques with supplementary tools, like catheters and needles, that are inserted into the body. This is typically done to address non-dermatologic cases, open or close cylindrical structures within the body, such as vessels, or to intentionally harm tissues, like growths [25].

Concerning the unique safety issues of their respective equipment and medications, NM and IR have developed separate guidelines. Many subfields of medical imaging, including nuclear medicine (NM), infrared (IR), and cardiovascular imaging, have different sets of safety concerns, none of which are discussed in this article. Nonetheless, those subfields of medical imaging are equally subject to all of the criteria outlined in this article. We briefly touch on the potential effects on fetal development and the safety considerations associated with imaging pregnant women below [26].

Figure 2: Interventional Radiology

Public Safety Standards Established By Organizations Charged With Maintaining Safety In The United States
The United States' radiologists are required to meet certain training and expertise standards set by organizations like the American Board of Medical Specialties and the American Radiological Society [27]. The primary authority in the US for establishing norms of practice for healthcare providers (HCPs) conducting medical imaging is the American College of Radiology (ACR) and its affiliated groups, including the General Practitioners of Interventional Radiology [28]. According to the American Cancer Society (ACR) website, starting in 2022, the mission of the center will be "to serve patients and society by enabling individuals to propel the practice, science, and callings of radiological consideration." The ACR satisfies part of this logic by disseminating (and posting on its website with the goal of free public circulation) its:

- **Practice Parameters and Technical Standards (PPTS).**"Promote the safe and efficient application of demonstrative and restorative radiology by illustrating explicit training, abilities, and strategies [29]." That is the stated goal of the PPTS on its website. The goal is to provide guidelines for achieving high standards in radiography and to limit the degree of variability in radiology treatments.
- **Appropriateness Criteria (AC).**To paraphrase what the Air conditioner website says, "are evidence-based guidelines to assist physicians and other providers in selecting the best imaging or therapy option for a specific clinical condition [30],"

Figure 3: Patient Safety.

CONCLUSION

In radiology, ensuring patient safety and good communication is not only crucial and should be given careful thought, but it also reflects the larger trend in modern healthcare toward patient autonomy and informed decision-making. This audit demonstrates the value of radiology nurses in investigating and mitigating risks associated with analytical imaging tests while adhering to established safety guidelines established by administrative bodies. Specialists in radiology empower patients to make highly informed decisions that align with their own goals and well-being by thoroughly comprehending and communicating the potential risks associated with imaging technologies. Building trust between patients and medical service providers is ensured by putting ethical and legal commitments into practice. Encouraging collaborative efforts amongst medical care groups also ensures a long-term approach to patient attention, improves communication, and enhances overall safety. A safer and more patient-centered imaging environment can be significantly improved by radiology nurses and other professionals using these principles.

REFERENCES

[1]. Olejarczyk JP, Young M. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Nov 28, 2022. Patient Rights and Ethics.

[2]. Young M, Wagner A. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Nov 28, 2022. Medical Ethics.

[3]. Young M, Smith MA. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Dec 13, 2022. Standards and Evaluation of Healthcare Quality, Safety, and Person-Centered Care.
[4]. Dydula C, Belev G, Johns PC. Development and assessment of a multi-beam continuous-phantom-motion x-ray scatter projection imaging system. Rev SciInstrum. 2019 Mar;90(3):035104.
[5]. Takata N, Begum A. Corrections to air kerma and exposure measured with free air ionisation chambers for charge of photoelectrons, Compton electrons and Auger electrons. RadiatProt Dosimetry. 2008;130(4):410-8.
[6]. Masterson EA, Themann CL, Luckhaupt SE, Li J, Calvert GM. Hearing difficulty and tinnitus among U.S. workers and non-workers in 2007. Am J Ind Med. 2016 Apr;59(4):290-300.
[7]. Hermena S, Young M. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Aug 8, 2023. CT-scan Image Production Procedures.
[8]. Morgan WF, Sowa MB. Non-targeted effects induced by ionizing radiation: mechanisms and potential impact on radiation induced health effects. Cancer Lett. 2015 Jan 01;356(1):17-21.
[9]. Ma J, Kumar A, Muroya Y, Yamashita S, Sakurai T, Denisov SA, Sevilla MD, Adhikary A, Seki S, Mostafavi M. Observation of dissociative quasi-free electron attachment to nucleoside via excited anion radical in solution. Nat Commun. 2019 Jan 09;10(1):102.
[10]. Kumar A, Becker D, Adhikary A, Sevilla MD. Reaction of Electrons with DNA: Radiation Damage to Radiosensitization. Int J Mol Sci. 2019 Aug 16;20(16) [
[11]. Tokue H, Tokue A, Tsushima Y. Unexpected magnetic resonance imaging burn injuries from jogging pants. Radiol Case Rep. 2019 Nov;14(11):1348-1351.
[12]. Tkach JA, Li Y, Pratt RG, Baroch KA, Loew W, Daniels BR, Giaquinto RO, Merhar SL, Kline-Fath BM, Dumoulin CL. Characterization of acoustic noise in a neonatal intensive care unit MRI system. PediatrRadiol. 2014 Aug;44(8):1011-9.
[13]. TerHaar G. Ultrasonic imaging: safety considerations. Interface Focus. 2011 Aug 06;1(4):686-97.
[14]. Cha MJ, Kang DY, Lee W, Yoon SH, Choi YH, Byun JS, Lee J, Kim YH, Choo KS, Cho BS, Jeon KN, Jung JW, Kang HR. Hypersensitivity Reactions to Iodinated Contrast Media: A Multicenter Study of 196 081 Patients. Radiology. 2019 Oct;293(1):117-124.
[15]. McDonald JS, Hunt CH, Kolbe AB, Schmitz JJ, Hartman RP, Maddox DE, Kallmes DF, McDonald RJ. Acute Adverse Events Following Gadolinium-based Contrast Agent Administration: A Single-Center Retrospective Study of 281 945 Injections. Radiology. 2019 Sep;292(3):620-627.
[16]. Davenport MS, Khalatbari S, Cohan RH, Dillman JR, Myles JD, Ellis JH. Contrast material-induced nephrotoxicity and intravenous low-osmolality iodinated contrast material: risk stratification by using estimated glomerular filtration rate. Radiology. 2013 Sep;268(3):719-28.
[17]. Marckmann P, Skov L, Rossen K, Dupont A, Damholt MB, Heaf JG, Thomsen HS. Nephrogenic systemic fibrosis: suspected causative role of gadodiamide used for contrast-enhanced magnetic resonance imaging. J Am SocNephrol. 2006 Sep;17(9):2359-62.
[18]. Dykes TM, Bhargavan-Chatfield M, Dyer RB. Intravenous contrast extravasation during CT: a national data registry and practice quality improvement initiative. J Am CollRadiol. 2015 Feb;12(2):183-91.
[19]. Wang CL, Cohan RH, Ellis JH, Adusumilli S, Dunnick NR. Frequency, management, and outcome of extravasation of nonionic iodinated contrast medium in 69,657 intravenous injections. Radiology. 2007 Apr;243(1):80-7.
[20]. Runge VM, Dickey KM, Williams NM, Peng X. Local tissue toxicity in response to extravascular extravasation of magnetic resonance contrast media. Invest Radiol. 2002 Jul;37(7):393-8.
[21]. Al-Benna S, O'Boyle C, Holley J. Extravasation injuries in adults. ISRN Dermatol. 2013; 2013:856541.
[22]. Wegwarth O, Wagner GG, Gigerenzer G. Can facts trump unconditional trust? Evidence-based information halves the influence of physicians' non-evidence-based cancer screening recommendations. PLoS One. 2017;12(8): e0183024.
[23]. Carey M, Herrmann A, Hall A, Mansfield E, Fakes K. Exploring health literacy and preferences for risk communication among medical oncology patients. PLoS One. 2018;13(9): e0203988.
[24]. Coyle M, Gillies K. A systematic review of risk communication in clinical trials: How does it influence decisions to participate and what are the best methods to improve understanding in a trial context? PLoS One. 2020;15(11): e0242239.
[25]. Wegwarth O, Gigerenzer G. The Barrier to Informed Choice in Cancer Screening: Statistical Illiteracy in Physicians and Patients. Recent Results Cancer Res. 2018; 210:207-221.

[26]. Rao VM, Levin DC. The overuse of diagnostic imaging and the Choosing Wisely initiative. Ann Intern Med. 2012 Oct 16;157(8):574-6.

[27]. Stouten S, VerduynLunel S, Finnon R, Badie C, Dekkers F. Modeling low-dose radiation-induced acute myeloid leukemia in male CBA/H mice. Radiat Environ Biophys. 2021 Mar;60(1):49-60.

[28]. Marsh RM, Silosky M. Patient Shielding in Diagnostic Imaging: Discontinuing a Legacy Practice. AJR Am J Roentgenol. 2019 Apr;212(4):755-757.

[29]. vanVeelen NM, Link BC, Donner G, Babst R, Beeres FJP. Compartment syndrome of the forearm caused by contrast medium extravasation: A case report and review of the literature. Clin Imaging. 2020 May; 61:58-61.

[30]. Montori VM, LeBlanc A, Buchholz A, Stilwell DL, Tsapas A. Basing information on comprehensive, critically appraised, and up-to-date syntheses of the scientific evidence: a quality dimension of the International Patient Decision Aid Standards. BMC Med Inform DecisMak. 2013;13Suppl 2(Suppl 2): S5.