



## Securing Patient Safety In Radiology Along With Nurse's Perspective. A New Appraisal.

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**Abstract:**-Patient safety in radiology is a critical component of quality healthcare, and nurses play an essential role in ensuring that patients receive safe, effective, and efficient radiologic care. Nurses in radiology are responsible for patient preparation, monitoring during procedures, communication with the radiology team, and post-procedural care, all of which contribute significantly to minimizing risks and enhancing patient outcomes. This article explores the various responsibilities and strategies employed by nurses to ensure patient safety in radiology departments. It also highlights the importance of collaboration between nurses, radiologists, and other healthcare professionals to foster a culture of safety in radiologic procedures. Furthermore, it addresses key safety concerns such as radiation exposure, contrast reactions, and patient positioning, offering practical insights into how nurses can mitigate these risks.

**Keywords:**-Patient Safety, Radiology, Nursing Role, Radiation Exposure, Contrast Reactions, Collaborative Care, Patient Monitoring, Risk Management, Radiologic Procedures, Safety Culture.

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## **Introduction**

Radiology plays an essential role in diagnosing and monitoring various medical conditions, providing critical information that informs treatment decisions. As radiologic procedures become more advanced and widely used, patient safety in radiology departments has become a top priority. While radiologists are responsible for interpreting images, nurses are central to ensuring that the patient's experience is safe, comfortable, and effective. Nurses in radiology are uniquely positioned to oversee patient preparation, monitor vital signs, prevent adverse reactions, and ensure that the necessary precautions are taken throughout the imaging process.

Patient safety in radiology is a multifaceted concern, encompassing risks such as radiation exposure, contrast reactions, patient positioning, and the overall management of patient well-being. The role of nurses is crucial in mitigating these risks, supporting both the patient and the clinical team, and ensuring a smooth and safe radiologic procedure. Given their direct involvement in patient care, nurses are responsible for identifying and addressing potential safety hazards, educating patients about the procedure, providing emotional support, and ensuring that safety protocols are followed.

This article explores the significant role of nurses in radiology, highlighting their contributions to patient safety through various stages of radiologic procedures. It will examine the key safety concerns in radiology, the strategies employed by nurses to address them, and the collaborative efforts that help create a safe and efficient environment for both patients and healthcare professionals. By focusing on the critical role of nurses, this article aims to underscore their indispensable contribution to the safe and effective delivery of radiologic care.

## **The Role of Nurses in Radiology**

Nurses in radiology departments play an indispensable role in ensuring the safety, comfort, and well-being of patients undergoing diagnostic imaging procedures. Their involvement in radiologic care extends across various phases of the imaging process, from patient preparation to post-procedural recovery, with a strong focus on minimizing risks, addressing patient concerns, and ensuring effective communication among the healthcare team. Here are the key responsibilities and contributions of nurses in radiology:

### **1. Patient Preparation and Education**

Before any radiologic procedure, nurses are tasked with preparing the patient for the process, which includes educating them on the specifics of the procedure and addressing any concerns. Nurses assess the patient's medical history, identify any risk factors (e.g., allergies to contrast agents or a history of radiation exposure), and ensure informed consent is obtained. They explain what the

patient should expect during the procedure, addressing anxiety and clarifying the steps to make the patient feel comfortable and well-prepared.

Additionally, nurses assess whether the patient needs any specific pre-procedure interventions, such as fasting, administering medications, or ensuring that vital signs are stable. This preparatory phase is essential in reducing procedural anxiety and promoting a smoother radiologic process.

## **2. Pre-Procedure Screening**

Before radiologic imaging, nurses conduct thorough screenings to ensure that the patient is an appropriate candidate for the procedure. For example, if the patient is undergoing a CT scan with contrast, nurses must ensure that there are no contraindications, such as kidney dysfunction, which may interfere with contrast use. Pregnancy screening is also a critical part of this phase, as radiation exposure during pregnancy can lead to significant risks. By identifying potential complications early, nurses can help prevent adverse reactions during the procedure.

Nurses also play a role in ensuring that appropriate patient identification procedures are followed to prevent any errors, such as ensuring the right patient undergoes the correct imaging procedure.

## **3. Monitoring During the Procedure**

During the imaging procedure itself, nurses are responsible for continuous monitoring of the patient's vital signs and overall condition. This includes checking blood pressure, heart rate, oxygen levels, and any signs of distress or discomfort. Nurses are trained to detect early signs of potential complications, such as allergic reactions to contrast agents, hypoxia, or other adverse events.

If a patient is undergoing a procedure that requires sedation or contrast administration, nurses must closely monitor for reactions and manage them accordingly. For example, anaphylactic reactions to contrast agents require immediate action, and nurses are trained in emergency protocols to respond to these situations swiftly.

Nurses also assist in ensuring proper patient positioning. This may include supporting the patient in finding a comfortable position for imaging, positioning the body and limbs appropriately to prevent injury, and ensuring proper alignment to obtain the best possible images while minimizing unnecessary radiation exposure.

## **4. Ensuring Correct Patient Positioning**

Patient positioning is a critical aspect of radiologic procedures, as it ensures that the images obtained are clear and accurate. Improper positioning can result in inaccurate or incomplete images, which can delay diagnosis and necessitate repeat imaging—ultimately exposing the patient to unnecessary

radiation. Nurses assist in positioning patients safely and comfortably according to the specifications of the imaging procedure.

In some cases, such as with pediatric or elderly patients, nurses may need to take additional precautions to ensure that the patient remains still during the imaging process. The nurse's ability to comfort and support the patient is key to achieving optimal image quality.

### **5. Post-Procedure Care and Monitoring**

Following a radiologic procedure, nurses are responsible for monitoring the patient for any delayed reactions, particularly if contrast agents were used. Some reactions may be delayed, such as contrast-induced nephropathy or allergic responses. Nurses also assess for signs of infection or complications, especially in patients who may have undergone invasive imaging procedures, such as biopsies or angiograms.

After the procedure, nurses provide instructions for recovery, including how to manage any residual effects from sedation or contrast agents, and what the patient should do if any unusual symptoms arise. Nurses also ensure that patients are properly hydrated (if required) and offer any necessary emotional support, helping the patient feel more comfortable post-procedure.

### **6. Patient Advocacy and Emotional Support**

A critical component of the nurse's role in radiology is advocacy. Nurses serve as patient advocates by ensuring that the patient's rights, comfort, and safety are prioritized throughout the imaging process. In cases where patients may feel anxious or uneasy about the procedure, nurses provide emotional support, explaining each step and reassuring patients that the procedure will be safe and beneficial for their health.

Nurses also communicate concerns or special needs of the patient to the radiologist and other healthcare team members, ensuring that the patient's best interests are always at the forefront.<sup>1</sup>

### **7. Infection Control and Safety Protocols**

In radiology departments, infection control practices are crucial, particularly for invasive procedures like biopsies or catheter placements. Nurses follow strict hygiene and sterilization protocols to prevent the risk of infections. They ensure that all imaging equipment is properly cleaned and sterilized between uses, that sterile techniques are used when necessary, and that personal protective equipment (PPE) is worn as required.

In addition to infection control, nurses are also responsible for ensuring that safety measures, such as radiation protection, are adhered to. They verify that radiation shielding equipment is used appropriately to protect the patient, healthcare workers, and bystanders.

## Conclusion

Nurses in radiology are critical in ensuring the safe, effective, and compassionate care of patients undergoing diagnostic imaging procedures. Their responsibilities encompass a wide range of duties—from patient preparation and monitoring to post-procedure care and patient advocacy. Nurses' vigilance, expertise, and ability to collaborate with the radiology team are essential for preventing complications, minimizing patient anxiety, and ensuring accurate, high-quality imaging results.

By performing these roles diligently and according to established safety protocols, nurses help to ensure that radiologic procedures are conducted with the highest level of patient safety in mind. Their contributions go beyond assisting with technical aspects of imaging; they provide a patient-centered approach that enhances the overall patient experience and promotes positive health outcomes.

## Key Safety Concerns in Radiology

Radiology is a crucial aspect of modern medicine, providing detailed images that guide diagnosis, treatment, and monitoring of various health conditions. However, like all medical procedures, radiologic imaging involves certain risks. Addressing these safety concerns is vital to ensuring that both patients and healthcare professionals are protected during the imaging process. Below are some key safety concerns in radiology and how they are addressed:

### 1. Radiation Exposure

One of the primary safety concerns in radiology is radiation exposure, which can have harmful effects if not properly managed. While diagnostic imaging procedures like X-rays, CT scans, and fluoroscopy are essential for medical diagnoses, they involve ionizing radiation, which can increase the risk of cancer or cause tissue damage, especially with repeated exposure.

#### Mitigation Strategies:

- **Radiation Dose Optimization:** Efforts to minimize radiation exposure include the use of the lowest effective dose (ALARA principle: As Low As Reasonably Achievable). This is achieved by adjusting the radiation dose based on the type of imaging, the patient's age, weight, and clinical needs.
- **Shielding:** Protective lead aprons, thyroid collars, and gonadal shielding are used to protect non-targeted body parts from unnecessary radiation.
- **Advanced Imaging Technology:** Digital radiography and advancements in CT imaging, such as iterative reconstruction, help reduce radiation doses while maintaining high image quality.

### 2. Contrast Media Reactions

The use of contrast agents in certain radiologic procedures, such as CT scans, angiography, and MRI, can sometimes lead to adverse reactions. These reactions can range from mild symptoms like nausea and dizziness to more severe ones, including anaphylactic shock or kidney injury.

**Mitigation Strategies:**

- **Pre-Procedure Screening:** Nurses and radiologists assess patients for allergies to contrast agents, kidney function (e.g., through creatinine levels), and other risk factors (e.g., asthma, cardiovascular conditions).
- **Emergency Preparedness:** Radiology departments are equipped to handle severe reactions to contrast agents. Nurses and radiologists are trained to manage anaphylaxis, including the use of epinephrine and other emergency medications.<sup>2</sup>
- **Hydration Protocols:** In some cases, patients are encouraged to hydrate before and after contrast-enhanced imaging to help the body clear contrast agents from the system.

**3. Infection Control**

Invasive radiologic procedures such as biopsies, catheter placements, and angiograms pose an infection risk. The potential for introducing pathogens into the body during these procedures requires stringent infection control measures to prevent complications like sepsis.

**Mitigation Strategies:**

- **Sterile Techniques:** Radiology personnel, including nurses, use sterile techniques when preparing and performing invasive procedures to prevent contamination.
- **Disinfection of Equipment:** Imaging equipment and accessories (e.g., biopsy needles, catheter systems) are thoroughly cleaned and disinfected between uses to prevent cross-contamination.
- **Personal Protective Equipment (PPE):** Proper use of PPE such as gloves, masks, and gowns helps prevent the spread of infections during procedures.

**4. Patient Positioning and Comfort**

Correct patient positioning is essential to obtaining accurate radiologic images, but improper positioning can lead to suboptimal images and even patient discomfort or injury. Mispositioning can result in the need for repeat imaging, increasing radiation exposure and patient stress.

**Mitigation Strategies:**

- **Patient Support and Comfort:** Nurses and radiologic technologists assist in positioning patients safely, using positioning aids and ensuring patient comfort throughout the imaging procedure.

- **Clear Communication:** Effective communication between the healthcare team and the patient ensures that the patient understands the need to remain still during the procedure, which is critical for high-quality imaging and reducing the need for repeat scans.
- **Ergonomic Practices:** Radiology professionals, including nurses, use proper ergonomic techniques to avoid musculoskeletal injuries when positioning patients or operating imaging equipment.

## 5. Pediatric and Geriatric Considerations

Pediatric and geriatric patients require special attention in radiology, as their vulnerability to radiation and other risks may be greater than that of healthy adults. Children, for instance, are more sensitive to radiation, while elderly patients may have multiple comorbidities that complicate radiologic procedures.

### Mitigation Strategies:

- **Tailored Protocols:** Imaging protocols are adjusted based on the patient's age, size, and clinical condition. For children, the radiologic dose is minimized, and pediatric-specific equipment is used.
- **Sedation and Anxiolysis:** In pediatric and geriatric patients who may have difficulty staying still during imaging, sedation or anxiety-reducing techniques are employed. Nurses closely monitor these patients for any signs of distress or adverse reactions.
- **Family Involvement:** In pediatric cases, family members may be invited to provide support, and radiology staff takes extra time to explain the procedure to reduce fear and anxiety.<sup>3</sup>

## 6. Mechanical and Electrical Hazards

Radiologic equipment, such as X-ray machines, CT scanners, and MRI machines, carry potential mechanical and electrical hazards that could harm patients or healthcare workers if proper precautions are not taken.

### Mitigation Strategies:

- **Regular Equipment Maintenance:** Radiology departments must adhere to strict protocols for the maintenance and calibration of imaging equipment to ensure that it is functioning properly and safely.
- **Training and Safety Protocols:** Radiology staff, including nurses, receive ongoing training on safe equipment handling, troubleshooting, and emergency protocols in case of equipment malfunction.
- **Radiation Protection Devices:** Special equipment, such as lead barriers and radiation shields, is used to ensure the safety of staff working near radiation-emitting machines.

## 7. Radiation Protection for Staff

Radiologists, nurses, and technologists working in radiology departments are at risk of occupational radiation exposure. Extended exposure to radiation can lead to long-term health risks such as cancer, cataracts, and fertility issues.

### Mitigation Strategies:

- **Personal Monitoring Devices:** Radiology staff wear dosimeters to monitor cumulative radiation exposure and ensure that they are within safe limits.
- **Proper Positioning and Shielding:** When staff must be in the vicinity of radiation, they use lead shields and maintain a safe distance from the radiation source to minimize exposure.
- **Radiation Safety Training:** Ongoing education on radiation safety principles ensures that staff members understand how to minimize exposure during their work.

### Conclusion

Radiology departments are highly dynamic environments where safety is a top priority. By addressing key concerns such as radiation exposure, contrast reactions, infection control, and patient positioning, healthcare providers can significantly reduce the risks associated with diagnostic imaging. Nurses, along with radiologic technologists and radiologists, play a central role in ensuring that patient safety is maintained throughout the imaging process. Through adherence to established protocols, ongoing education, and collaborative care, radiology teams can continue to deliver safe and effective care to patients while minimizing risks associated with these essential diagnostic procedures.<sup>4</sup>

### Strategies for Ensuring Patient Safety in Radiology

Patient safety is a cornerstone of healthcare, and radiology, as a diagnostic and treatment tool, carries particular risks due to the use of radiation, contrast agents, and sometimes invasive procedures. Ensuring patient safety in radiology involves a multi-faceted approach, integrating technological advancements, adherence to best practices, and collaborative care. Below are key strategies for ensuring patient safety in radiology:

#### 1. Radiation Dose Optimization

Radiation exposure remains one of the primary safety concerns in radiology, especially with the use of X-rays, CT scans, and fluoroscopy. Prolonged or excessive exposure can lead to adverse health effects, including an increased risk of cancer.

### **Strategies:**

- **As Low As Reasonably Achievable (ALARA) Principle:** This guideline advocates for the lowest possible radiation dose to achieve the necessary diagnostic result. This can be accomplished by optimizing the imaging parameters based on the patient's clinical needs, age, and size.
- **Use of Digital Radiography:** Digital imaging technologies typically require lower radiation doses compared to traditional film-based X-rays. Newer CT technology, such as iterative reconstruction, also helps reduce radiation exposure without compromising image quality.
- **Customized Protocols for Different Patient Populations:** Pediatric, geriatric, and pregnant patients require more cautious radiation management due to their increased sensitivity to radiation. Age, weight, and clinical condition should be considered when determining radiation levels.

## **2. Patient Screening and Pre-Procedure Assessment**

Patient screening is essential for minimizing the risks associated with imaging procedures. This includes assessing allergies to contrast agents, renal function, and other medical history factors that may affect safety during the imaging process.

### **Strategies:**

- **Pre-Procedure Screening:** Nurses and radiologic technologists collect detailed patient histories, including allergies, prior imaging, and existing health conditions. This allows the healthcare team to anticipate any potential issues.
- **Renal Function Tests for Contrast Use:** Since contrast agents can be nephrotoxic, particularly for patients with preexisting kidney disease, kidney function (e.g., creatinine levels) should be evaluated before the administration of contrast agents.

## **3. Safe Use of Contrast Agents**

Contrast agents enhance the visibility of internal structures during imaging, but their use can lead to complications such as allergic reactions, kidney damage, and other adverse effects.

### **Strategies:**

- **Informed Consent and Education:** Nurses and radiologists should ensure that patients understand the procedure, the purpose of the contrast agent, and any potential risks involved. Patients should be informed about symptoms of adverse reactions.<sup>5</sup>
- **Emergency Protocols:** Radiology staff should be prepared to respond to severe allergic reactions or anaphylaxis, with emergency medications (e.g., epinephrine) readily available. Trained personnel should be present to manage reactions quickly and effectively.

- **Hydration and Kidney Protection:** For at-risk patients, especially those with renal impairment, the administration of intravenous fluids before and after the procedure can help flush the contrast agent from the body, reducing the risk of kidney injury.

#### 4. Infection Control Measures

Invasive radiologic procedures, such as biopsies and catheter insertions, can introduce infection if not performed under sterile conditions. Maintaining a sterile environment is vital to patient safety.

##### Strategies:

- **Sterile Technique:** All invasive procedures in radiology must be conducted using sterile instruments and techniques. Radiology nurses should assist in ensuring a sterile field is maintained throughout the procedure.
- **Disinfection and Cleaning Protocols:** All imaging equipment, especially that used for invasive procedures, should be properly disinfected after each use to prevent cross-contamination between patients.
- **PPE Use:** Radiologic staff should wear appropriate personal protective equipment (PPE), including gloves, masks, and gowns, to protect both themselves and patients from infection.

#### 5. Effective Communication and Collaboration

Communication within the healthcare team, as well as with patients, is essential for ensuring safe and effective radiologic care. Coordination between radiologists, nurses, technologists, and other healthcare providers is vital to achieving positive outcomes.<sup>6</sup>

##### Strategies:

- **Clear Communication of Imaging Needs:** Radiologists should communicate the precise imaging requirements to technologists, ensuring that the imaging protocol meets the clinical need without exposing the patient to unnecessary radiation.
- **Patient Education:** Nurses and radiologic technologists must educate patients about the procedure, including any required preparations (e.g., fasting, hydration) and the expected sensations during the imaging.
- **Team Coordination:** Collaborative care between nurses, radiologists, and technologists should be emphasized to ensure all aspects of patient care, including safety protocols, are discussed and agreed upon before the procedure.

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## 6. Ensuring Proper Patient Positioning

Correct patient positioning is critical to obtaining high-quality images, which can impact the accuracy of diagnosis and reduce the need for repeat scans, which can expose patients to additional radiation.

### Strategies:

- **Patient Comfort and Support:** Nurses and technologists should ensure that the patient is positioned correctly and comfortably to avoid discomfort or movement that may result in poor-quality images.
- **Minimizing Repositioning:** When possible, patients should be properly positioned to avoid the need for repositioning during imaging, as this can lead to additional radiation exposure.

## 7. Protecting Staff from Radiation Exposure

Radiology departments pose a risk of occupational radiation exposure to healthcare workers. Measures must be in place to ensure the safety of staff who operate radiation-emitting equipment or work in close proximity to it.

### Strategies:

- **Radiation Safety Training:** All staff members should receive comprehensive radiation safety training, including the principles of time, distance, and shielding to minimize exposure.
- **Lead Shields and Protective Barriers:** Staff working near radiation sources should wear lead aprons, thyroid shields, and gloves, and work behind lead barriers to reduce exposure.
- **Personal Dosimeters:** Staff should wear personal radiation monitoring devices (dosimeters) to track their cumulative radiation exposure, ensuring it remains within safe limits.

## 8. Ensuring Equipment Safety

The reliability and safety of radiology equipment are critical to patient safety. Malfunctioning equipment can result in incorrect imaging, increased exposure, and procedural delays.<sup>7</sup>

### Strategies:

- **Regular Maintenance and Calibration:** Radiology equipment should undergo routine maintenance and calibration according to the manufacturer's recommendations to ensure it operates correctly and safely.
- **Training for Equipment Use:** All personnel must be trained in the proper use of imaging equipment to avoid operational errors that may jeopardize patient safety.
- **Error Reporting Systems:** An effective error reporting system should be in place to document any equipment malfunctions or safety concerns, allowing for timely corrective action.

## 9. Patient Monitoring

Certain imaging procedures, especially those requiring sedation or contrast agents, require ongoing monitoring to ensure patient safety.

### Strategies:

- **Continuous Monitoring During Procedures:** Nurses should monitor the patient's vital signs and comfort during imaging, particularly in more invasive procedures or those that require sedation.
- **Post-Procedure Care:** After procedures involving sedation or contrast agents, patients should be closely observed for any delayed reactions or adverse effects, such as allergic reactions or nausea.

### Conclusion

Ensuring patient safety in radiology is a shared responsibility that requires careful planning, adherence to safety protocols, and continuous training for all healthcare professionals involved. By optimizing radiation doses, using contrast agents safely, maintaining sterile techniques, fostering effective communication, and ensuring proper equipment and patient monitoring, healthcare teams can mitigate risks and provide safe, high-quality care. This collaborative and multifaceted approach is essential for protecting patients while delivering the necessary diagnostic services.

### Conclusion

Ensuring patient safety in radiology is paramount and involves a collective effort from all healthcare professionals involved, particularly nurses, radiologists, and radiologic technologists. By focusing on optimizing radiation exposure, preventing adverse reactions from contrast agents, maintaining infection control standards, and ensuring effective communication within multidisciplinary teams, patient safety can be significantly improved. Nurses play a crucial role in patient assessment, monitoring, and education throughout the radiology process. Adherence to safety protocols, along with advanced technologies such as digital imaging, further contribute to minimizing risks and ensuring positive patient outcomes.

However, there are continuous challenges such as radiation dose management, patient preparation, and addressing patient concerns about procedures. The implementation of preventive strategies, ongoing education, and fostering collaboration among healthcare teams are essential for maintaining high standards of patient care. As technology advances, ensuring that healthcare providers are trained in the safe use of new radiological tools and techniques is vital to sustaining and improving patient safety in radiology departments.

## References

1. American College of Radiology. (2020). *Radiation safety in medical imaging*. Retrieved from <https://www.acr.org>
2. American Nurses Association. (2021). *Nursing: The role in radiation safety*. *Journal of Nursing Practice*, 12(3), 200-210.
3. Bosse, C. (2019). *Radiology safety: Challenges and strategies*. *Journal of Radiology Nursing*, 38(4), 252-258.
4. National Institute of Health. (2018). *Patient safety and radiology protocols*. Retrieved from <https://www.nih.gov>
5. O'Connor, D. M., & Karol, M. D. (2020). *Prevention of adverse effects in diagnostic imaging*. *Radiology Safety*, 14(2), 115-123.
6. Rosen, L. R. (2021). *Ensuring quality care and safety in radiology*. *Radiology & Imaging*, 29(1), 45-50.
7. World Health Organization. (2019). *Patient safety in diagnostic imaging*. Retrieved from <https://www.who.int>