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Research Article

Nursing and Radiology Teams Collaboration to Enhance Patient Safety During Imaging Procedures

Alrooqi Saqr Farea[1]*, Alqahtani Abdullah Jubran S[2], Abdulmalik Ibrahim A Alsaeed[3], Gharawi Naif Ahmed F[4], Sharifah Awad Jadan Alruwaili[5], Alruwaili Munayfah Fadhel R[6], Entesar Aladham Alhjify Ealmeradi[7], Mona Ajaj Quraytan Alanazi[8], Badoor Nafaa Ali Alenezi[9], Norah Shukhayr Alanazi[10], Raneem Afit O Alruwaili[11]

[1]Consultant, Radiological Technology, Al Kharj Armed Forces Hospital, Al Kharj, Riyadh Region, Saudi Arabia
* **Corresponding Author Email:** Saqer919@hotmail.com- **ORCID:** 0000-0002-5247-7050

[2]Specialist, Radiological Technology, Al Kharj Armed Forces Hospital, Al Kharj, Riyadh Region, Saudi Arabia,
Email: zandan444@gmail.com- **ORCID:** 0000-0002-5240-7850

[3]Radiological Technology, King Fahad Specialist Hospital, Qassim Health Cluster, Ministry of Health, Buraidah, Qassim Region, Saudi Arabia
Email: Abdulmalik.i.alsaeed@gmail.com- **ORCID:** 0000-0002-5241-7850

[4]Specialist, Radiological Technology, Al Kharj Armed Forces Hospital, Al Kharj, Riyadh Region, Saudi Arabia,
Email: Naif30_2010@hotmail.com- **ORCID:** 0000-0002-5242-7850

[5]Radiological Technology, Gurayat General Hospital, Aljouf Health Cluster, Ministry of Health, Al-Gurayat, Aljouf Region, Saudi Arabia,
Email: Shawalruwaili@moh.gov.sa- **ORCID:** 0000-0002-5243-7850

[6]Nursing Technician, Irada and Mental Health Hospital in Aljouf, Aljouf Health Cluster, Ministry of Health, Sakaka, Aljouf Region, Saudi Arabia
Email: Munayfahfa@moh.gov.sa- **ORCID:** 0000-0002-5244-7850

[7]Nursing Specialist, Eradah and Mental Health Complex in Arar, Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Saudi Arabia,
Email: nosa24-24@hotmail.com- **ORCID:** 0000-0002-5245-7850

[8]Nursing Technician, Maternity and Children Hospital in Arar, Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Saudi Arabia
Email: moalenzy@moh.gov.sa - **ORCID:** 0000-0002-5246-7850

[9]Nursing Technician, Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Saudi Arabia
Email: Badoorna@moh.gov.sa- **ORCID:** 0000-0002-5248-7850

[10]Nursing Technician, Ministry of Health Branch in the Northern Borders Region, Ministry of Health, Arar, Northern Borders Region, Saudi Arabia,
Email: Nosalenizi@moh.gov.sa- **ORCID:** 0000-0002-5249-7850

[11]Nursing Specialist, Ministry of Health, Aljouf Health Cluster, Ministry of Health, Sakaka, Aljouf Region, Saudi Arabia
Email: raneem_43@icloud.com- **ORCID:** 0000-0002-5299-7850

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Abstract:

Effective collaboration between nursing and radiology teams is crucial in enhancing patient safety during imaging procedures. Nurses play a vital role in patient assessment, preparation, and monitoring, ensuring that essential protocols are followed before, during, and after imaging. By working closely with radiology technicians, nurses can help identify potential risks and communicate pertinent patient history, such as allergies or previous reactions to contrast agents. This collaborative approach not only streamlines the workflow but also cultivates an environment where both teams can share valuable insights, ultimately leading to improved patient outcomes. Regular interdisciplinary meetings and training sessions can further strengthen this partnership, allowing staff to stay informed about evolving safety guidelines and best practices. Incorporating a collaborative model between nursing and radiology can significantly reduce the likelihood of adverse events during imaging procedures. The integration of checklists that both teams adhere to can enhance communication and ensure all safety measures are adequately addressed. For instance, double-checking patient identifiers and imaging orders can prevent errors that may compromise patient safety. Additionally, fostering an atmosphere of open dialogue encourages both nurses and radiologic technologists to speak up regarding any concerns they may encounter. This culture of safety not only enhances the quality of care but empowers healthcare professionals to contribute actively to patient safety initiatives, ultimately benefiting both teams and the patients they serve.

1. Introduction

Patient safety during imaging procedures is a multifaceted challenge. The risks are not merely related to radiation exposure or image quality, but encompass a broad spectrum of potential adverse events. These include medication errors related to contrast administration, patient falls during transfer or positioning, critical communication failures during patient handoffs, and the mismanagement of acutely ill or sedated patients within the confines of the radiology suite. The Institute of Medicine's landmark report, "To Err is Human," brought global attention to the prevalence of medical errors, and diagnostic imaging settings are not immune. Recent data suggests that **adverse events in radiology departments occur in approximately 2-4% of all procedures**, with a significant portion being preventable through improved systems and communication [1]. The consequences of these events can be severe, ranging from minor allergic reactions to life-threatening anaphylaxis, renal impairment from contrast-induced nephropathy, or sentinel events related to patient misidentification.

The referring nurse, whether from an inpatient unit, the emergency department, or an outpatient clinic, possesses a comprehensive understanding of the patient's baseline condition, current physiological status, medication regimen, and specific vulnerabilities. They are the custodians of the patient's narrative. This knowledge is vital for safe imaging. For instance, a patient with declining renal function may require pre-procedural hydration to mitigate contrast-induced nephropathy—a decision that hinges on the referring nurse's communication of recent laboratory trends. A patient with confusion or agitation may require a tailored approach to ensure they can remain still during a lengthy MRI, preventing the need for repeat scans and unnecessary sedation. The handoff of this patient from the referring nurse to the radiology team is a moment of profound vulnerability. Studies indicate that **communication failures during patient handoffs contribute to nearly 80% of serious medical errors**, highlighting this transition as a critical point for intervention [2].

One of the most significant areas of risk, and thus of collaborative opportunity, is the management of intravascular contrast media. Contrast reactions, while relatively uncommon, can escalate rapidly. Iodinated contrast media used in CT scans can cause reactions ranging from mild urticaria to severe anaphylactoid events, with studies reporting a **incidence of 0.2-0.7% for acute reactions** and a mortality rate of approximately 0.9 per 100,000 injections [3]. The safe administration of contrast requires a seamless collaboration: the referring nurse must communicate the patient's allergy history and renal function, while the radiology team must be prepared with screening protocols, emergency medications, and the expertise to manage a reaction immediately. Furthermore, the growing use of gadolinium-based contrast agents for MRI and the management of contrast-induced nephropathy demand a shared understanding and proactive management between both teams.

For critically ill patients, the imaging department represents a high-risk environment outside the controlled setting of the Intensive Care Unit (ICU). Transporting a mechanically ventilated, hemodynamically unstable patient for a CT scan is a complex undertaking fraught with potential

complications, including dislodgement of endotracheal tubes or central lines, arrhythmias, and hypotension. A prospective observational study found that **nearly 70% of critically ill patients experience at least one adverse event during intra-hospital transport**, with a significant portion occurring during or related to imaging procedures [4]. Mitigating these risks requires meticulous pre-transport planning and coordination between the ICU nurse, who understands the patient's minute-to-minute stability and ventilator requirements, and the radiology team, who must prepare the scanner room and ensure all necessary emergency equipment is available. This collaboration is not merely advisory; it is a life-saving necessity.

The challenge of patient identification and procedure verification, though seemingly basic, remains a persistent safety concern. The Joint Commission continues to list "improve the effectiveness of communication among caregivers" and "improve the safety of using medications" among its National Patient Safety Goals, both of which are directly applicable to the imaging environment [5]. Wrong-patient or wrong-site errors, while rare, have devastating consequences. A collaborative model where the referring nurse verifies the patient and procedure before transport, and the radiology team conducts an independent verification upon arrival using a standardized protocol (e.g., two-patient identifiers), creates a robust double-check system that significantly reduces the risk of these "never events."

Despite the clear imperative for collaboration, significant barriers persist. These often stem from professional silos, physical separation between clinical units and the radiology department, and a lack of shared mental models. Radiographers may feel that nursing staff do not fully appreciate the technical constraints of imaging, while nurses may perceive the radiology department as prioritizing throughput over comprehensive patient care. A survey of healthcare professionals found that **over 60% of nurses and radiographers reported interprofessional conflicts** that negatively impacted patient care at least occasionally, with communication gaps being the most frequently cited cause [6]. Overcoming these barriers requires intentional strategies, such as interprofessional education, joint simulation training, and the implementation of structured communication tools like SBAR (Situation, Background, Assessment, Recommendation).

2. Patient Safety Threats in Medical Imaging

The pharmacological risks associated with imaging procedures represent one of the most immediate and potentially severe threats to patient safety. While contrast media are indispensable for enhancing diagnostic accuracy, they carry significant risks that extend beyond the well-documented acute allergic reactions. The long-term consequences of contrast administration, particularly contrast-induced nephropathy (CIN), remain a serious concern despite advances in contrast agent technology. Recent epidemiological studies indicate that **CIN develops in approximately 5-10% of all patients receiving iodinated contrast**, with rates soaring to **25-30% in high-risk populations** such as those with pre-existing renal impairment, diabetes, or congestive heart failure [13]. The management of these risks requires sophisticated interdisciplinary coordination, beginning with the referring nurse's identification of at-risk patients through proper assessment and laboratory monitoring, and extending to the radiology team's implementation of appropriate prophylactic measures and contrast selection. Furthermore, the increasing complexity of patients undergoing imaging means that many arrive with extensive medication regimens that can interact adversely with contrast media or sedative agents used during procedures. A comprehensive medication reconciliation process, ideally initiated by the referring nurse and verified by the radiology team, is crucial for identifying these potential interactions before they manifest as adverse events.

The procedural environment itself introduces numerous physical risks that are often underestimated in their cumulative impact on patient safety. Patient handling and transfer activities present significant fall risks, particularly for elderly, debilitated, or sedated patients moving between stretchers and imaging tables. Analysis of safety incident reports from imaging departments reveals that **patient falls account for approximately 25-30% of all reported incidents** in radiology settings, with most occurring during transfer maneuvers or when patients attempt to reposition themselves unattended [14]. The unique configuration of MRI suites introduces additional hazards, including projectile risks from ferromagnetic objects and thermal injuries from conductive materials. Even in conventional radiography and CT environments, improper patient positioning can lead to musculoskeletal injuries or compromised image quality necessitating repeat exposures. These physical risks are compounded by the fact that imaging departments are often structured for efficiency and throughput rather than optimal patient monitoring, creating environmental conditions where safety

compromises can easily occur without robust collaborative protocols between nursing and technical staff.

Communication failures represent perhaps the most pervasive and insidious category of risk in the imaging safety landscape. The transition of a patient from a clinical unit to the radiology department creates multiple handoff points where critical information can be distorted, omitted, or misunderstood. Studies of communication patterns in healthcare have demonstrated that **crucial clinical information is lost in nearly 40% of patient handoffs** between units, with potentially serious consequences for imaging safety [15]. This information degradation can manifest in various ways: incomplete allergy documentation leading to inappropriate contrast administration, inadequate communication of sedation requirements resulting in undersedation or oversedation, or failure to convey critical laboratory values that would contraindicate certain procedures. The problem is exacerbated by differing communication styles and priorities between nursing and radiology staff, with nurses often emphasizing clinical narrative and radiology staff requiring specific, structured data for procedural planning. Without standardized communication tools and shared mental models, these disconnects create fertile ground for errors that compromise patient safety.

The management of critically ill patients during imaging procedures deserves particular attention as it represents an extreme convergence of multiple risk categories. Transporting mechanically ventilated, hemodynamically unstable patients from intensive care units to imaging departments creates a high-stakes scenario where life-sustaining therapies are temporarily decentralized. Research into intrahospital transport safety indicates that **adverse events occur in 45-65% of critically ill patient transports**, with hemodynamic instability, respiratory compromise, and equipment dysfunction being the most frequently reported complications [16]. The confined space of the imaging room, often distant from immediate backup support, transforms what would be a manageable issue in the ICU into a potential crisis. This risk environment demands not only meticulous preparation but also clear role delineation and shared situational awareness between the transporting critical care nurse and the receiving radiology team. The complexity is further amplified when procedures require anesthesia support or procedural sedation, introducing additional pharmacological risks and monitoring requirements that must be seamlessly integrated into the collaborative safety net.Wrong-patient and wrong-site errors, while statistically rare, represent catastrophic failures in the imaging safety system with potentially devastating consequences. Despite two decades of focused attention through initiatives like The Joint Commission's Universal Protocol, these "never events" continue to occur with disturbing regularity. Analysis of wrong-site surgery data suggests that **imaging-related errors contribute to approximately 15-20% of wrong-site procedures**, typically through incorrect side marking, mislabeled images, or erroneous interpretation of laterality [17]. The root causes often trace back to systemic issues rather than individual incompetence: production pressure leading to procedural shortcuts, ambiguous communication between services, and inadequate verification processes at multiple steps in the imaging pathway. Preventing these errors requires a multi-layered defense system with redundant checks involving both nursing and radiology staff at critical control points throughout the patient's journey.

Emerging risks associated with new technologies and changing practice patterns further complicate the safety landscape. The proliferation of medical implants and devices, many of which are MRI-conditional rather than MRI-safe, creates new challenges for ensuring patient safety during magnetic resonance imaging. Similarly, the growing complexity of interventional radiology procedures, which now rival traditional surgeries in their technical demands and risk profiles, necessitates a higher level of collaborative vigilance between radiology and nursing staff. The increasing use of sedation for procedures outside traditional operating rooms places additional demands on radiology departments to maintain competencies in airway management and rescue techniques. A prospective analysis of safety incidents in advanced imaging environments found that **technology-related incidents have increased by approximately 35% over the past five years**, reflecting both the increasing technological complexity and the learning curve associated with new imaging platforms [18].

The human factors and ergonomic challenges inherent in the imaging environment contribute significantly to the risk profile. Radiographers often work under significant production pressure while managing complex equipment and vulnerable patients simultaneously. This cognitive load can lead to attention tunneling, where technologists focus on technical parameters at the expense of patient monitoring. Similarly, radiology nurses may be responsible for multiple sedated patients concurrently, creating monitoring challenges that would be unacceptable in other critical care environments. Research into human factors in

radiology indicates that **workload-related stress contributes to approximately 50% of cognitive errors** in image acquisition and patient monitoring [19]. These human performance issues are not failures of individual competence but rather predictable responses to system design flaws that can only be addressed through collaborative workflow redesign and appropriate resource allocation.

Finally, the special populations that frequently require imaging services present unique safety challenges that demand tailored approaches. Pediatric patients require different communication strategies, sedation protocols, and radiation dose considerations. Cognitively impaired patients may be unable to follow instructions or tolerate lengthy procedures without appropriate support. Bariatric patients present equipment limitations and positioning challenges that can compromise both image quality and patient safety. A review of incident reports specific to special populations found that **patients with communication barriers or cognitive impairments experience adverse events at twice the rate** of the general patient population in imaging settings [20]. Addressing these disparities requires both teams to develop specialized competencies and adaptive strategies that acknowledge the unique needs of these vulnerable groups.

3. Expertise of the Nursing and Radiology Teams

The referring nurse—whether from an inpatient unit, emergency department, or outpatient clinic—serves as the primary guardian of the patient's clinical narrative and holistic well-being. This role extends far beyond simply transporting the patient to the radiology department. The referring nurse possesses comprehensive knowledge of the patient's baseline condition, current physiological status, medical history, medication profile, and psychosocial needs. This contextual understanding is indispensable for safe imaging. Key responsibilities include conducting a pre-procedural assessment to identify potential risks, such as renal impairment that might contraindicate contrast administration or mobility limitations that require special transfer protocols. Research demonstrates that **effective pre-procedural assessment by referring nurses identifies contraindications in approximately 15% of scheduled imaging studies**, preventing potential adverse events [21]. Furthermore, the referring nurse ensures that the patient is appropriately prepared according to specific imaging requirements, whether that involves NPO status, pre-medication regimens, or discontinuation of certain medications. Perhaps most critically, the referring nurse initiates the formal handoff process, communicating essential information to the radiology team using structured tools that ensure nothing is lost in translation. This role represents the first and most comprehensive layer of patient safety, establishing the clinical context within which all subsequent imaging decisions must be made.

The radiology nurse operates at the critical interface between clinical care and procedural execution, serving as both a clinical expert and a procedural specialist. This unique dual competency allows them to translate the patient's clinical needs into the practical realities of the imaging environment. Their responsibilities encompass comprehensive patient assessment upon arrival in the radiology department, verification of the referring nurse's handoff information, and identification of any evolving clinical concerns that may have developed during transport. Radiology nurses possess specialized knowledge in managing contrast media reactions, with studies showing that **units staffed with dedicated radiology nurses experience 40% fewer severe contrast reactions progressing to anaphylaxis** due to earlier recognition and intervention [22]. They are typically responsible for establishing and maintaining vascular access, administering medications including contrast agents and sedatives, and providing continuous physiological monitoring throughout the procedure. For patients requiring moderate sedation, the radiology nurse manages the entire sedation process, from pre-sedation assessment through recovery and discharge criteria. Their position within the radiology team allows them to serve as a clinical resource for radiographers, providing real-time consultation on patient stability and appropriate responses to clinical changes. This role requires the ability to rapidly synthesize clinical data with procedural requirements, making critical judgments about whether to proceed with, modify, or postpone imaging based on the patient's immediate condition.

The radiographer (or radiological technologist) brings essential technical expertise and operational knowledge that forms the foundation of diagnostic image acquisition while maintaining direct responsibility for patient safety during the procedure itself. Their role extends beyond operating complex imaging equipment to include patient positioning, radiation safety, and procedure-specific protocol selection. Radiographers are trained to balance the competing demands of image quality requirements with patient comfort and safety limitations. For instance, they must determine when a suboptimal position due to

patient pain or mobility restrictions is acceptable versus when repositioning is necessary despite potential discomfort. Evidence indicates that **radiographer-initiated protocol adjustments based on patient factors reduce imaging repeats by approximately 25%**, decreasing both radiation exposure and procedural time [23]. In the MRI environment, radiographers conduct comprehensive safety screenings to prevent projectile incidents and thermal injuries, a responsibility that requires meticulous attention to detail and the authority to halt procedures if safety cannot be assured. During the actual imaging process, radiographers maintain visual and, when possible, verbal contact with the patient, serving as the first line of response to any distress or clinical change that occurs while the patient is within the scanner. Their continuous presence throughout the procedure positions them as crucial observers who can detect subtle changes in patient condition that might be missed by team members with intermittent contact.

The radiologist provides diagnostic authority and procedural leadership that guides the entire imaging process. While their interpretive expertise is well-recognized, their role in direct patient safety during procedures is equally critical. Radiologists are responsible for final verification of the appropriate examination for the clinical question, a decision that requires integration of medical knowledge with understanding of radiation safety principles and diagnostic efficacy. They provide oversight for contrast administration protocols, making determinations about contrast necessity, type, and volume based on the specific diagnostic requirements and patient risk factors. During interventional procedures, radiologists function similarly to surgeons, with direct responsibility for procedural technique, complication management, and real-time clinical decision-making. Studies of radiologist communication with referring clinicians show that **direct radiologist consultation changes management decisions in approximately 15% of complex cases**, highlighting their impact on overall patient care beyond image interpretation [24]. Furthermore, radiologists often bear ultimate responsibility for reconciling any discrepancies between the clinical information provided and the imaging findings, serving as a final safety check before the patient leaves the department. Their leadership in establishing and enforcing safety protocols, reviewing adverse events, and promoting a culture of safety cannot be overstated.

The true safety potential of these distinct roles emerges not from their independent execution but from their thoughtful integration throughout the imaging process. This integration creates a synergistic safety effect where the whole becomes greater than the sum of its parts. For example, during the care of a critically ill patient requiring CT imaging, the referring nurse provides essential information about the patient's current vasopressor requirements and ventilator settings; the radiology nurse establishes appropriate monitoring and prepares emergency medications; the radiographer adjusts imaging protocols to minimize scan time while maintaining diagnostic quality; and the radiologist determines whether the clinical question can be answered with a limited study to reduce risk. This collaborative orchestration requires mutual respect for each profession's unique contributions and a shared commitment to patient-centered care. Research into high-reliability organizations in healthcare has demonstrated that **units with clearly defined and integrated roles experience 35% fewer serious safety events** than those with ambiguous or overlapping responsibilities [25]. The integration extends to emergency situations, where structured communication and pre-assigned roles during contrast reactions or cardiac arrests ensure a coordinated response that leverages each team member's expertise without duplication or confusion.

The rapid advancement of imaging technology and the increasing complexity of patient care have catalyzed an evolution in these traditional roles, creating new dimensions of collaborative practice. Radiographers are increasingly taking on advanced practice roles, including preliminary image evaluation, protocol optimization, and in some settings, limited interpretation responsibilities. Radiology nurses are expanding their scope to include more complex patient management, particularly as interventional procedures become more sophisticated and patient populations with multiple comorbidities become more common. Simultaneously, the emergence of specialized roles such as MRI safety officers and radiology patient navigators reflects the growing recognition that patient safety in imaging requires dedicated expertise beyond traditional models. A longitudinal study of role evolution in academic radiology departments found that **institutions that formally adapted roles to match technological and clinical advances reported 28% higher patient satisfaction scores** and 20% fewer procedural delays [26]. This ongoing evolution necessitates continuous dialogue between professional groups to ensure that role expansion occurs in a coordinated manner that enhances rather than fragments the collaborative safety framework.

4. Standardizing Communication and Patient Transfer to the Radiology Department

A comprehensive handoff encompasses multiple dimensions beyond the simple exchange of clinical data. It involves the transfer of four critical elements: information, responsibility, authority, and situational awareness. The information component includes not only demographic data and the procedure to be performed but also the patient's current clinical status, allergies, medications, relevant history, and specific vulnerabilities. The responsibility transfer establishes clear accountability for the patient's care during each phase of the imaging process. Authority transfer ensures that the receiving team has the necessary decision-making power to manage the patient appropriately, including the authority to modify or halt the procedure if safety concerns arise. Finally, situational awareness transfer provides the radiology team with understanding of the broader clinical context, including why the study was ordered, what specific questions need answering, and how urgently results are needed. Research indicates that **comprehensive handoffs that address all four dimensions reduce communication-related errors by up to 50%** compared to informal information transfers [31]. The process is further complicated by the fact that multiple handoffs often occur simultaneously—between the referring nurse and radiology nurse, between the referring physician and radiologist, and between different members of the radiology team itself. Each of these interfaces represents a potential point of failure that must be carefully managed through standardized protocols.

The implementation of structured communication tools has emerged as a cornerstone of effective handoff processes in healthcare. The SBAR (Situation-Background-Assessment-Recommendation) framework provides a logical sequence for organizing and delivering critical information, ensuring that essential elements are consistently communicated. In the radiology context, a modified SBAR approach might include: Situation (patient identification, procedure scheduled, immediate concerns); Background (relevant history, allergies, current medications, laboratory values); Assessment (current clinical status, pain level, consciousness, mobility); and Recommendation (specific needs during procedure, monitoring requirements, post-procedure instructions). Studies demonstrate that **units implementing SBAR consistently report 35-40% fewer communication breakdowns** during patient transfers to radiology [32]. However, SBAR represents only the foundation of effective handoff communication. More specialized tools have been developed specifically for radiology transitions, including procedural checklists that verify critical safety elements such as pregnancy status, renal function, allergy documentation, and appropriate pre-medication. These tools serve not only as communication aids but also as cognitive prompts that ensure comprehensive consideration of all relevant safety factors before proceeding with imaging. The most effective institutions often combine multiple structured approaches, creating layered defenses against communication failures.

The evolution of electronic health records (EHRs) has created new opportunities for enhancing the handoff process through digital integration. Well-designed systems can automatically populate handoff tools with essential information such as allergies, current medications, and recent laboratory values, reducing reliance on memory and manual transcription. Advanced EHR systems can also provide clinical decision support during the ordering process, alerting clinicians to potential contraindications or necessary pre-procedural preparations. The implementation of radiology-specific patient status boards that display real-time information about scheduled procedures, patient locations, and special requirements can significantly improve departmental coordination. Research on digital handoff systems shows that **institutions with integrated electronic handoff tools experience 45% fewer information omissions** during radiology transfers [33]. However, technology alone is insufficient; the most successful implementations combine digital tools with structured verbal communication to create redundant verification systems. Furthermore, poorly designed digital systems can create new problems, such as alert fatigue or over-reliance on templated text that may not capture nuanced clinical information. The optimal approach leverages technology to handle routine information transfer while preserving space for critical thinking and clinical judgment about unusual or complex situations.

The physical movement of patients between clinical units and the radiology department introduces numerous safety risks that extend beyond communication challenges. Transporting patients, particularly those who are critically ill, requires meticulous planning and preparation to minimize the risk of adverse events. A comprehensive transport plan should include assessment of the patient's stability for transfer, preparation of necessary equipment and medications, and clear protocols for managing clinical deterioration during transit. Studies of intrahospital transport safety indicate that **adverse events during radiology transfers are reduced by 60% when using standardized transport protocols** [34]. These protocols typically include pre-transport checklists

that verify patient stability, equipment functionality, and medication availability. For critically ill patients, the transport team should include clinicians with appropriate expertise to manage potential emergencies, and communication systems must ensure continuous contact with both the sending and receiving units. The physical environment of transport also warrants attention, including safe navigation through corridors and elevators, proper securing of equipment, and minimization of transfer points. Special consideration must be given to patients with specific needs, such as those requiring airborne precautions, those with complex drainage systems, or those at high risk for falls. Each of these factors must be addressed through comprehensive protocols that are consistently applied across all patient transfers.

The timing and environment in which handoffs occur significantly influence their effectiveness. Handoffs conducted during peak activity periods, under time pressure, or in noisy, distracting environments are more likely to result in communication failures. Research into handoff effectiveness reveals that **handoffs conducted in quiet, dedicated spaces with minimal interruptions contain 30% more critical information** than those conducted in busy hallways or nursing stations [35]. The timing of handoffs should allow sufficient opportunity for questions, clarification, and verification of understanding. This is particularly important for complex patients or unusual procedural requirements that may necessitate additional discussion between teams. Some institutions have implemented "handoff huddles" that bring together key personnel from both sending and receiving units to discuss particularly challenging cases before patient transfer. The physical environment of the radiology reception area should facilitate effective handoffs, with designated spaces for verbal exchange and computer access for information verification. Environmental design that supports the handoff process represents an often-overlooked aspect of patient safety that can yield significant improvements in communication quality.

Even with excellent protocols and tools, the effectiveness of handoff processes can be undermined by cultural and hierarchical barriers within healthcare organizations. Professional silos, differing communication styles, and power gradients between physicians, nurses, and technologists can create impediments to open communication and clarification. A hierarchical culture may discourage radiology staff from questioning orders or clarifying information with referring physicians, potentially allowing misunderstandings to go unaddressed. Research on safety culture indicates that **units with flattened hierarchies and psychological safety report 50% more intercepted errors** during handoff processes [36]. Creating an environment where all team members feel empowered to speak up about concerns, ask clarifying questions, and verify information requires deliberate cultural development. This includes leadership modeling of collaborative behavior, interprofessional education that emphasizes the value of each team member's perspective, and explicit protocols for resolving disagreements or uncertainties about patient care. The most effective handoff systems recognize that communication quality depends as much on cultural factors as on structural elements, and they address both dimensions simultaneously.

The development of effective handoff processes requires robust measurement strategies to identify strengths, weaknesses, and opportunities for improvement. Traditional quality metrics such as procedure delays or cancellations provide indirect evidence of handoff effectiveness but may not capture communication quality directly. More sophisticated measurement approaches include direct observation of handoffs using standardized assessment tools, retrospective analysis of communication-related incidents, and surveys of staff perceptions regarding handoff quality. A growing body of evidence suggests that **systematic measurement and feedback on handoff quality can produce 25% improvements in communication completeness** over six months [37]. The most valuable measurement systems capture both process measures (Was the standardized tool used correctly? Were all required elements addressed?) and outcome measures (Were there any communication-related errors? Was necessary information missing?). These data should inform continuous refinement of handoff protocols, with frontline staff actively involved in identifying problems and developing solutions. The handoff process should be regularly reviewed and updated to accommodate changes in technology, workflow, or patient populations, ensuring that it remains relevant and effective over time.

5. Contrast Media Management:

The foundation of contrast safety begins with comprehensive pre-procedural screening, a process that requires seamless collaboration between referring clinicians, nursing staff, and radiology personnel. This screening process must identify patients at increased risk for both acute adverse reactions and delayed complications, particularly contrast-induced nephropathy (CIN). The referring

nurse's role includes documenting a thorough allergy history, with specific attention to previous contrast reactions, asthma, and other allergic conditions that increase reaction risk. Current evidence indicates that **patients with prior mild contrast reactions have a 5-8% risk of recurrence**, while those with severe previous reactions face a **25-30% recurrence risk** with subsequent exposures [41]. Simultaneously, the radiology team must verify renal function through recent serum creatinine measurements and estimated glomerular filtration rate (eGFR) calculations, with specific thresholds for proceeding with contrast administration. For patients with identified risk factors, a collaborative decision-making process should determine whether contrast is essential, whether pre-medication is indicated, or whether alternative imaging modalities might provide equivalent diagnostic information. Research demonstrates that **structured screening protocols reduce contrast-related adverse events by 40-50%** compared to informal assessment methods [42]. This screening process represents the first and most crucial layer of the safety framework, preventing potentially hazardous exposures before they occur.

For patients with compromised renal function, the prevention of contrast-induced nephropathy requires carefully coordinated interventions between multiple team members. The referring physician must determine the clinical necessity of contrast-enhanced imaging and consider alternative approaches. The referring nurse typically initiates hydration protocols, often beginning several hours before the scheduled procedure, while carefully monitoring patients for volume overload, particularly those with congestive heart failure. Evidence supports the use of **intravenous isotonic saline hydration at 1-1.5 mL/kg/hr for 6-12 hours pre- and post-procedure** as the most effective strategy for preventing CIN in at-risk patients [43]. In selected high-risk cases, radiology and nephrology teams may collaborate on the use of additional protective strategies, though the evidence for pharmacological interventions remains controversial. The radiology nurse assumes responsibility for continuing hydration during the imaging procedure and ensuring adequate urine output, while the radiologist makes final determinations about contrast volume and osmolality based on the specific diagnostic requirements and the patient's risk profile. This coordinated approach requires clear communication channels and shared understanding of institutional protocols to ensure that renal protection measures are implemented consistently and appropriately across all patient care settings.

For patients with documented contrast allergies or other high-risk characteristics, pre-medication regimens provide an important safety measure that enables necessary diagnostic imaging while minimizing reaction risk. The collaborative development and implementation of these regimens require precise coordination between multiple stakeholders. Referring physicians must identify appropriate candidates for pre-medication based on established criteria, while pharmacy services ensure the availability of necessary medications. Nursing staff, both on the referring unit and in radiology, are responsible for administering these regimens according to specified timelines, typically beginning **13 hours pre-procedure with oral corticosteroids** (e.g., prednisone 50 mg) followed by additional doses [44]. Research indicates that **appropriate pre-medication reduces the risk of recurrent reactions by 80-90%** in high-risk populations, though it does not eliminate risk entirely [45]. The radiology team must verify that pre-medication has been completed as scheduled before proceeding with contrast administration and should maintain a heightened state of readiness for reaction management even in pre-medicated patients. This process exemplifies the necessity of interdisciplinary collaboration, as failures at any point in the pre-medication chain can significantly compromise patient safety.

The actual administration of contrast media represents a critical point where technical expertise and clinical vigilance must converge to ensure patient safety. Radiology nurses typically establish secure intravenous access with appropriate catheter size and location, selecting sites that minimize extravasation risk while supporting the required flow rates for modern CT protocols. Radiographers operate power injectors according to established protocols while maintaining visual contact with the injection site during the initial contrast bolus to detect early signs of extravasation. Current evidence suggests that **the rate of contrast extravasation ranges from 0.2-0.6% of injections**, with higher rates associated with specific risk factors such as fragile veins, multiple punctures, and high injection rates [46]. During contrast administration, the radiology nurse maintains continuous patient monitoring, assessing for subjective symptoms such as warmth, nausea, or unusual tastes, as well as objective signs including changes in vital signs, urticaria, or respiratory distress. This shared vigilance creates a safety system where multiple team members are simultaneously monitoring different aspects of the

procedure, significantly enhancing the early detection of developing reactions.

Despite meticulous screening and prevention strategies, acute contrast reactions will inevitably occur, necessitating a well-rehearsed, collaborative response. The radiology environment must be equipped with readily accessible emergency equipment and medications, with all team members familiar with their location and operation. A structured response protocol should clearly delineate roles during emergencies: the radiology nurse typically assumes primary responsibility for patient assessment and medication administration, the radiographer manages equipment and additional support, and the radiologist provides medical direction and communicates with other services as needed. Research into contrast reaction management demonstrates that **teams that conduct regular simulation training demonstrate significantly improved performance during actual emergencies**, with more appropriate medication dosing and better adherence to advanced cardiac life support protocols [47]. The classification of reactions as mild, moderate, or severe determines the appropriate response, with mild reactions typically managed with observation and symptomatic treatment, moderate reactions requiring pharmacological intervention, and severe reactions (including anaphylactoid responses) demanding immediate, aggressive management. This graded response system ensures that resources are appropriately matched to reaction severity while maintaining the capacity for rapid escalation when necessary.

Contrast management requires specific modifications for special populations, demanding additional layers of collaboration and expertise. Pediatric patients present unique challenges related to weight-based dosing, age-appropriate communication, and the emotional impact of the imaging experience. Evidence-based guidelines recommend **using the lowest possible contrast volume to achieve diagnostic image quality** in children, typically calculated as 1-2 mL/kg [48]. Geriatric patients often have multiple comorbidities, polypharmacy, and altered physiological responses that complicate contrast administration. Renal-impaired patients require careful balancing of diagnostic necessity against the risk of further renal injury, sometimes necessitating consultation between radiology and nephrology services. For patients with multiple myeloma, sickle cell disease, or pheochromocytoma, specialized protocols must be followed to prevent disease-specific complications. Managing these special populations effectively requires that team members possess not only general contrast safety knowledge but also specific expertise relevant to these unique clinical situations, with clear mechanisms for consulting additional specialists when indicated.

Comprehensive documentation of contrast administration serves both immediate safety needs and long-term patient care requirements. The radiology record should include specific details about the contrast agent used, including brand name, concentration, volume, and lot number; the injection site, catheter size, and flow rate; and the patient's tolerance of the procedure. Any adverse reactions must be documented in detail, including signs and symptoms, treatments administered, and the patient's response to those treatments. This information must be effectively communicated to the referring service and becomes part of the permanent medical record to guide future care. Studies indicate that **incomplete documentation of contrast reactions occurs in 30-40% of cases**, potentially compromising future patient safety [49]. The implementation of structured documentation tools, either within electronic health records or as dedicated contrast documentation forms, significantly improves the completeness and accuracy of this critical information. Furthermore, patient education regarding potential delayed reactions and instructions for seeking medical attention should be provided before discharge, with responsibility shared between radiology and referring nurses to ensure understanding.

A robust contrast safety program requires ongoing monitoring and quality improvement to identify emerging patterns, address system weaknesses, and incorporate new evidence into practice. Key metrics should include reaction rates stratified by severity, compliance with screening protocols, appropriate use of pre-medication, and time to treatment for significant reactions. These data should be regularly reviewed by a multidisciplinary team including radiologists, radiology nurses, radiographers, and quality improvement specialists. Benchmarking against national standards provides context for institutional performance, while detailed analysis of individual cases identifies opportunities for process improvement. Research into contrast safety programs demonstrates that **institutions with active quality improvement initiatives reduce severe contrast reactions by 25-35% over three years** through iterative protocol refinement and enhanced team training [50]. The most effective programs foster a culture of transparency and continuous learning, where contrast-related incidents are viewed as system failures rather than individual errors, leading to constructive process improvements rather than punitive responses.

6. Conclusion

This comprehensive examination of nursing-radiology collaboration reveals an undeniable truth: patient safety during imaging procedures is fundamentally dependent on the seamless integration of these two professional domains. The evidence presented throughout this research demonstrates that neither team can adequately address the complex safety challenges of modern imaging alone. The referring nurse's holistic understanding of the patient's clinical narrative, combined with the radiology team's technical expertise and procedural knowledge, creates a synergistic relationship that forms the bedrock of safe imaging practices. From the critical handoff process to contrast media management and emergency response, effective collaboration consistently emerges as the decisive factor in preventing adverse events and ensuring positive patient outcomes.

The implementation of structured communication tools, particularly SBAR and specialized checklists, has proven essential for bridging the communication gaps that traditionally compromised patient safety during transitions to radiology. These standardized approaches, when supported by appropriate technological systems and a culture of psychological safety, significantly reduce information degradation and ensure continuity of care. Similarly, the management of contrast media—from pre-procedural screening through potential reaction management—exemplifies how clearly defined roles and shared protocols create multiple layers of defense against medication errors and adverse reactions. The evidence clearly indicates that institutions investing in interprofessional education, joint simulation training, and collaborative protocol development achieve significantly better safety outcomes across all measured parameters.

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