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Interprofessional Management of Contrast-Induced Complications: A Narrative Review from Radiology to the Ward

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Abstract

Background: The administration of iodinated contrast media (ICM) is fundamental to diagnostic and interventional radiology but carries risks, notably contrast-induced nephropathy (CIN) and hypersensitivity reactions (HSRs). These complications span the care continuum, demanding coordinated efforts beyond radiology. **Aim:** This narrative review synthesizes evidence on interprofessional, systematic approaches to preventing and managing ICM-related complications, emphasizing roles across radiology, nursing, pharmacy, and health administration. **Methods:** A comprehensive literature search (2010-2024) was conducted across PubMed, CINAHL, and Scopus. Included studies and guidelines were analyzed thematically to map evidence-based strategies across pre-procedural, intra-procedural, and post-procedural phases. **Results:** Effective management is inherently collaborative. Key strategies include: risk stratification protocols; nurse-led pre-procedure hydration and screening; pharmacist-driven medication reconciliation; radiologist selection of low-osmolality/isosmolar agents; and standardized post-procedure monitoring coordinated by nursing with pharmacy and administrative support. System-level coordination, driven by health administration via clinical pathways and audit, is critical for adherence and outcomes. **Conclusion:** A siloed approach increases complication risks. An integrated interprofessional model, supported by standardized protocols and clear role delineation, significantly enhances patient safety and clinical outcomes across the care pathway.
Keywords: contrast-induced nephropathy, hypersensitivity reactions, interprofessional collaboration, patient safety, care coordination.

Introduction

The diagnostic and therapeutic utility of iodinated contrast media (ICM) in modern medicine is unparalleled, facilitating critical imaging procedures for millions of patients annually (Barrett et al., 2021). However, this widespread use is accompanied by the risk of significant adverse events, primarily contrast-induced nephropathy (CIN) and acute hypersensitivity reactions (HSRs). CIN, defined as an acute impairment of renal function following ICM administration in the absence of other causes, remains a leading cause of iatrogenic acute kidney injury (AKI), associated with increased morbidity, mortality, and healthcare costs (Yao et al., 2021).

Simultaneously, HSRs, ranging from mild urticaria to life-threatening anaphylaxis, pose immediate threats to patient safety (Cashion & Weisbord, 2022). Traditionally, the management of these risks has been perceived predominantly as the domain of radiology. Yet, the patient journey—from the decision to use contrast, through the procedure, to recovery and follow-up—traverses multiple clinical domains. This underscores the necessity of an interprofessional approach, integrating the expertise of radiology, nursing, pharmacy, and health

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administration to create a seamless, systematic safety net from the radiology suite to the hospital ward and beyond (Zygmont et al., 2017).

Methodology

This narrative review employed a systematic search strategy to identify relevant English-language literature published between 2010 and 2024. Electronic databases, including PubMed, CINAHL, Scopus, and Web of Science, were interrogated using a combination of Medical Subject Headings (MeSH) and keywords: "contrast-induced nephropathy," "contrast media hypersensitivity," "interprofessional relations," "patient care team," "clinical protocols," "radiology nursing," "pharmacy," and "health services administration." Reference lists of key articles were hand-searched for additional sources. The review included clinical trials, meta-analyses, systematic reviews, practice guidelines from professional societies (e.g., ACR, ESUR, KDIGO), and quality improvement studies. Excluded were non-English publications and studies predating 2010, except for seminal works. The identified literature was analyzed thematically, focusing on evidence-based interventions and role delineations across professions within the patient care pathway: pre-procedural risk assessment and preparation, intra-procedural mitigation, and post-procedural monitoring and management.

The Interprofessional Imperative

The historical compartmentalization of contrast safety within radiology departments represents a clinically inadequate and organizationally inefficient model. Complications such as contrast-induced nephropathy (CIN) and hypersensitivity reactions (HSRs) are not confined to the radiology suite; their prevention and management span the entire patient journey (Lau & Ng, 2013). Effective prevention is initiated long before contrast administration, beginning with accurate risk assessment and patient preparation in outpatient clinics or upon hospital admission (Nijssen et al., 2017). Following the procedure, the critical tasks of monitoring renal function and identifying delayed reactions become the responsibility of ward nurses and the primary medical team, highlighting the longitudinal nature of contrast safety (van der Molen et al., 2018).

Within this continuum, pharmacists play an indispensable role in reviewing nephrotoxic medications and managing complex premedication regimens, while health administrators are pivotal in designing standardized care pathways, allocating necessary resources, and implementing system-wide audits for protocol adherence and outcomes (Amin et al., 2023; Cheng et al., 2023). Failures in communication or handover at any point in this chain can directly lead to protocol violations and adverse patient events. Consequently, an interprofessional model is not merely beneficial but essential, transforming contrast safety from a narrowly defined procedural task into a longitudinal care priority, thereby reducing institutional liability and substantially improving overall healthcare quality (Walker et al., 2022).

Pre-Procedural Phase: Risk Stratification and Preventive Strategies

The cornerstone of preventing contrast-induced complications is a robust and collaborative pre-procedural phase, demanding seamless integration between referring physicians, nursing, pharmacy, and radiology. The initial, critical step involves the identification of high-risk patients through systematic risk stratification. For CIN, validated tools such as the Mehran score are employed, incorporating variables like pre-existing chronic kidney disease (CKD), diabetes mellitus, congestive heart failure, advanced age, and anemia (Mehran et al., 2021). For HSR risk, a meticulous patient history focusing on previous ICM reactions, asthma, and other atopic conditions is paramount (Starekova et al., 2024). Radiologists, in consultation with referring clinicians, must then engage in shared decision-making, weighing the diagnostic imperative of contrast-enhanced imaging against the patient's individual risks and considering alternative modalities when appropriate (Davenport et al., 2020). Health administration underpins this process by integrating mandatory risk assessment fields into electronic order-entry systems, creating a systematic failsafe to ensure no patient proceeds without an evaluated risk profile (Alausayni et al., 2024).

Once the decision to proceed with iodinated contrast media (ICM) is made, nursing and pharmacy assume frontline preventive roles. Volume expansion with intravenous isotonic saline remains the single most efficacious prophylactic measure against CIN (Weisbord et al., 2018). Ward and pre-procedure nurses are directly responsible for initiating and meticulously monitoring these hydration protocols, which typically involve administration at 1.0-1.5 mL/kg/hr for 6-12 hours before and after the procedure, with necessary adjustments for patients with cardiac compromise (Khwaja, 2012). Concurrently, pharmacists conduct essential medication reconciliation. This process involves identifying and advising on the temporary discontinuation of nephrotoxic agents such as NSAIDs, diuretics, and metformin, as well as guiding the periprocedural management of renin-angiotensin system inhibitors (Chalikias et al., 2016). For patients with a history of mild-to-moderate HSRs, pharmacists also manage standardized premedication protocols, which commonly include corticosteroids and H1/H2 antagonist antihistamines administered 13 and 1 hour before contrast exposure (de Laforcade et al., 2021; Weinreb et al., 2021). Nursing staff subsequently ensure these time-sensitive medications are administered correctly, completing this vital collaborative loop in pre-procedural safety (Table 1). Figure 1 depicts the graded interprofessional response

to contrast-induced adverse events, ranging from mild hypersensitivity reactions to severe anaphylaxis and contrast-induced nephropathy.

Table 1: Key Pre-Procedural Interprofessional Actions

Profession	Primary Actions	Collaborative Interfaces
Referring MD/Radiologist	Confirm the necessity of ICM; perform risk stratification; order pre-procedure labs (eGFR).	Consults with nursing/pharmacy on risk; liaises with administration on protocol use.
Nursing (Ward/Pre-Procedure)	Initiate IV hydration per protocol; conduct patient allergy/HSR history; administer premedication.	Reports risk factors to radiology; coordinates with pharmacy on medication timing.
Pharmacy	Review & reconcile medications; recommend holds/adjustments (NSAIDs, metformin); prepare premedication.	Alerts nursing/MD to nephrotoxic drugs; advises on premedication regimens for HSR.
Health Administration	Design/implement electronic health record (EHR) prompts for risk assessment; ensure protocol accessibility.	Audits pre-procedure compliance; allocates resources for hydration stations.

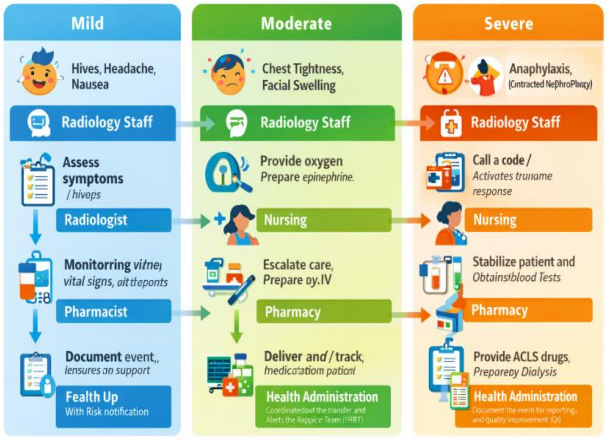

Figure 1. Interprofessional Response to Contrast-Induced Adverse Events

Intra-Procedural Phase in Minimizing Risk During Contrast Administration

Within the controlled environment of the radiology suite, the focus shifts to active risk mitigation during the administration of iodinated contrast media (ICM), relying on the coordinated expertise of the procedural team (Bahrainwala et al., 2020). The radiologist's selection of contrast agent is a critical decision point influencing patient safety. The consistent use of low-osmolality or iso-osmolar agents, as opposed to older high-osmolality formulations, represents a foundational safety advance, having significantly reduced the incidence of both CIN and HSRs (McCullough et al., 2016). Complementing agent choice, adherence to the principle of using the lowest diagnostically efficacious volume, tailored to patient body habitus and the specific clinical question, is paramount for minimizing renal insult and adverse reaction potential (Stocker et al., 2022).

Radiologic technologists serve as essential first-line sentinels during injection, trained to recognize prodromal signs of an HSR, such as patient-reported warmth, nausea, or cutaneous changes, and to immediately cease the injection while alerting the supervising radiologist. Simultaneously, the presence of periprocedural nursing staff, particularly for high-risk patients, is non-negotiable for safety. These nurses provide continuous hemodynamic monitoring, administer emergency medications according to established protocols in the event of an acute reaction, and offer patient reassurance. Their competency in advanced cardiac life support and anaphylaxis management protocols is a crucial component of departmental readiness (Kang et al., 2022).

Post-Procedural Phase in Monitoring, Management, and Care Coordination

The post-procedural phase is where significant safety gaps often manifest, underscoring the imperative for seamless interprofessional handoff and coordinated longitudinal care (Matari et al., 2019). For patients with a known history of HSR or those experiencing any acute reaction, mandatory monitored observation is required, typically for 30 to 60 minutes in a dedicated recovery area staffed by nurses specifically trained in contrast reaction management (Mossa-Basha et al., 2020). A critical component of this immediate phase is the meticulous and clear documentation of the reaction's nature, severity, and treatment administered, which must be communicated without delay to the receiving ward team and permanently integrated into the patient's electronic health record (EHR). Beyond immediate reactions, systematic follow-up is essential for patients at risk of CIN. Evidence-based guidelines mandate the monitoring of serum creatinine at 48 to 72 hours post-procedure to identify delayed renal injury (Stacul et al., 2011).

Operationalizing this falls to ward nurses to coordinate timely blood draws and to the primary medical team to interpret results. Pharmacists re-engage at this juncture to advise on the safe

reinstatement of temporarily held medications, such as metformin, which should only be resumed after confirming the absence of significant renal function decline (Chalikias et al., 2016). A key administrative function is to establish reliable systems that ensure this follow-up occurs, especially for outpatients who are at high risk of falling through the cracks. Strategies include creating automated EHR order sets for post-procedure labs, developing nurse-led telephone follow-up programs, or establishing dedicated renal safety clinics (Stewart et al., 2013). Ultimately, consistent, structured documentation of the contrast agent type, volume, lot number, and any adverse events is both a legal necessity and a cornerstone of future care (Guo et al., 2023). Figure 2 illustrates the interprofessional workflow involved in the safe use of iodinated contrast media across the pre-procedural, intra-procedural, and post-procedural phases.

Health administrators drive this standardization by implementing structured templates within the EHR, ensuring critical safety information flows reliably to all subsequent caregivers, including primary care physicians for long-term patient safety (Wu et al., 2022).

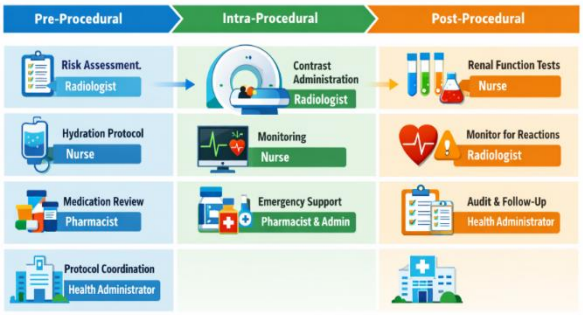

Figure 2. Interprofessional Care Pathway for the Prevention and Management of Contrast-Induced Complications

The coordinated response to acute hypersensitivity reactions, as detailed in Table 2, exemplifies the required interprofessional synchronicity from immediate intervention through to long-term safety planning.

Table 2: Management of Acute Hypersensitivity Reactions: An Interprofessional Response

Reaction Severity	Immediate Actions (Radiology/Nursing)	Follow-up & Coordination (Nursing/Pharmacy/Admin)
Mild (e.g., limited urticaria, pruritus)	Stop injection if ongoing; observe; consider oral/IV antihistamine (Diphenhydramine).	Document reaction thoroughly; flag patient chart for future premedication; educate patient.
Moderate (e.g., diffuse urticaria, bronchospasm, facial edema)	Stop injection; secure airway/O2; administer IM/IV antihistamines; inhaled beta-agonist for bronchospasm; consider corticosteroids.	Transfer to observation/ward for monitoring; pharmacy to review and supply further medications; formal allergy consultation.
Severe (Anaphylaxis: hypotension, laryngeal edema)	Stop injection; call code/rapid response; administer IM Epinephrine (1:1000) immediately; secure airway; IV fluids; advanced life support.	Transfer to ICU/ED; comprehensive documentation for risk management; administration to lead root cause analysis; permanent EHR flag for "contrast allergy."

The Role of Health Administration in System-Level Integration

The efficacy of interprofessional efforts in managing contrast-induced complications is ultimately dependent on robust system-level integration, a function orchestrated by health administration. Administrators are responsible for constructing the foundational infrastructure that transforms evidence and guidelines into reliable, safe practice (Donnelly et al., 2018). A primary function is the development, dissemination, and enforcement of standardized clinical pathways. These evidence-based protocols must codify each step of the contrast journey—from risk assessment and premedication to hydration regimens and post-procedural monitoring—ensuring they are accessible and actionable for all relevant clinical staff across departments (Clements & Koukounaras, 2023). To ensure protocol fidelity and team readiness, administrators must also mandate and resource ongoing interprofessional education and competency assurance. This includes organizing regular, multidisciplinary training sessions that cover contrast reaction management, with high-fidelity simulation for severe reactions like anaphylaxis being particularly valuable for reinforcing roles and improving crisis response (Khan et al., 2023).

Furthermore, the administration's role extends to establishing a culture of continuous quality improvement through systematic audit. This involves defining key performance metrics, such as protocol adherence rates, the incidence of CIN and HSRs, and the completion rate of follow-up renal function tests, and then leading regular audits of these data (Alderson et al., 2014). Creating effective feedback loops where audit results inform protocol refinement is essential for iterative improvement. Finally, none of these initiatives is possible without strategic resource allocation. Health administrators hold the fundamental duty of ensuring adequate staffing levels, maintaining fully stocked and accessible emergency carts, and

providing dedicated physical spaces for pre-procedure hydration and post-procedure monitoring, thereby removing practical barriers to safe care delivery (Ong et al., 2022). Through these interconnected actions, health administration provides the essential scaffolding that binds discrete professional tasks into a coherent, reliable, and safe system of care.

Conclusion

The management of contrast-induced complications is a paradigm of modern interprofessional healthcare. No single discipline can independently ensure patient safety along the entire care pathway. From the pharmacist reviewing medications and the nurse initiating hydration, to the radiologist selecting the appropriate agent and the administrator designing the safety system, each role is interdependent. This narrative review underscores that successful outcomes hinge on the systematic integration of these roles through standardized protocols, clear communication channels, and shared accountability. Future efforts should focus on leveraging health information technology for better risk prediction and automated follow-up, and on robustly studying the impact of interprofessional models on hard clinical and economic outcomes. Ultimately, fostering a culture of collaborative vigilance from radiology to the ward is the most effective contrast medium for visualizing and ensuring patient safety.

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