

Awareness of Iodinated Contrast Media Reactions and its Management among Healthcare Personnel: A Cross-sectional Descriptive Study

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ABSTRACT

Introduction: Iodinated Contrast Media (ICM) are important drugs that play a significant role in radiologic investigations such as Computed Tomography (CT) and X-rays. Although important in practice, the administration of ICM is associated with the risk of adverse effects ranging from mild reactions like nausea and urticaria to severe anaphylaxis that can be fatal.

Aim: To evaluate the level of knowledge among healthcare professionals on the adverse reactions of ICM and their management at Radiology Department of a Tertiary Care Hospital.

Materials and Methods: The present cross-sectional descriptive study that involved 60 healthcare professionals who were recruited at the Department of Radiodiagnosis, Dr. D.Y. Patil Medical College, Hospital and Research Centre (DYPMC), Pimpri, Pune, Maharashtra, India. The study was conducted over a period of five months, from 1st November 2025 to 31st March 2026. Purposive sampling method was employed. The participants responded to a validated questionnaire that was

analysed using descriptive statistics in WinPepi Software Version 11.65.

Results: The majority (60.0%) of respondents belonged to the age group of 25-30 years; 91.7% had received contrast reaction training earlier. The strengths of the present study include high recognition of mild reactions (98.3%) and knowledge about pre-procedural renal function tests (91.7%). Important gaps have been found: only 40.0% gave the correct name of the first-line drug for anaphylaxis (epinephrine against 55.0% of those who picked antihistamines), only 26.7% knew the right route of drug application (intramuscular injection), and only 3.3% knew that there is no need for breastfeeding interruption following ICM administration according to current American College of Radiology (ACR) guidelines.

Conclusion: Though overall awareness was found satisfactory, dangerous pharmacological and guideline knowledge gaps remain. Simulation-based training of radiology staff in accordance with current ACR and European Society of Urogenital Radiology (ESUR) guidelines is highly recommended.

Keywords: Anaphylaxis, Epinephrine, Healthcare awareness, Knowledge gaps, Patient safety

INTRODUCTION

The ICM are among the most common drugs used in diagnostic imaging and account for millions of contrast-enhanced CT scans and X-ray examinations conducted every year. They are essential to the field of radiology owing to their ability to help better define anatomy and pathology [1].

Use of ICM poses the risk of the occurrence of Adverse Drug Reactions (ADR). ADRs are broadly classified as immediate or delayed. The former occur within an hour after administration and include various manifestations ranging from mild to moderate, including nausea, warmth, urticaria, and fatal anaphylaxis with bronchospasm, hypotension, and cardiovascular collapse [2,3].

Although low-osmolarity non ionic contrast media have greatly reduced the risk of adverse reactions compared with high-osmolarity ionic contrast media, anaphylaxis still occurs in roughly 0.04% of cases with non ionic ICM [4]. Because these incidents are rare but can progress rapidly, all members of the radiological team, including radiographers, nurses, and residents, should be prepared to detect early signs and act immediately [5].

Knowledge deficits like this are not exclusive to any particular centre. Khan F et al., has observed that only 28% of the radiology staff were able to identify epinephrine as the first-line medication for anaphylaxis [6], whereas Osiemo SK et al., observed a still worse result of 30% being able to identify the correct treatment for anaphylaxis with epinephrine, none getting a perfect score [7]. In a systematic review, Wang CL and Soloff EV drew a similar

conclusion regarding radiologists' knowledge of anaphylaxis pharmacotherapy [8].

The Indian environment brings with it additional pressure in the form of high patient throughput, poor specialist staffing outside working hours, and a relatively limited local body of evidence. The Pharmacovigilance Program of India has recorded quite a few cases of ADRs caused by the use of contrast agents, which shows the necessity of a stronger systemic response [9]. Against this background, the authors evaluated healthcare professionals' knowledge of ICM reactions and management in a tertiary radiology department in Pune, Maharashtra, India.

MATERIALS AND METHODS

The present cross-sectional descriptive study was performed at the Department of Radiodiagnosis, Dr. D.Y. Patil Medical College, Hospital and Research Centre (DYPMC), Pimpri, Pune, Maharashtra, India, from November 2025 to March 2026 after obtaining clearance from the Institutional Research Ethics Committee (IEC Ref. No. DYPSAHS/125/2025).

Inclusion and Exclusion criteria: Healthcare workers who used CT and X-ray machines in the radiology department were the study subjects. A purposive sampling technique was used. Inclusion criteria included radiographers/technologists, nurses, and residents who worked with contrast-enhanced scans. Those who refused to provide written informed consent were excluded from the study.

Sample size calculation: The sample size was determined from Khan F et al., (2023), who found that 56% of subjects could identify ICM features associated with fewer adverse effects [6]. Based on this proportion (56%) and an acceptable margin of error of 15%, the authors determined the sample size to be 60 using WinPepi Software Version 11.65. In total, 60 subjects participated in the study.

Study Procedure

A pre-designed, validated, self-administered questionnaire with closed-ended, single-best-answer multiple-choice items, following ACR and ESUR guidelines [10]. The authors adapted several items from Khan F et al., (2023) [6]. This questionnaire had three parts: Part A (demographic variables: age, sex, designation, experience, work area); Part B (12 items related to ICM pharmacology, classifications, type, adverse effects); Part C (2 items on prior exposure to contrast reactions and 14 items related to management protocol, drug selection, dose, route, emergency management, and special groups like pregnancy and lactation). An expert panel of five specialists established the questionnaire's content and face validity. The panel independently reviewed each item for relevance, clarity, and alignment with ACR/ESUR guidance, and the questionnaire was revised on the basis of their consensus feedback; content and face validity were therefore established qualitatively through this expert review rather than through a quantitative index (e.g., content validity index/ratio) or a formally reported reliability statistic (e.g., Cronbach's alpha, intraclass correlation), and no separate pilot test was conducted. Each item had a single pre-specified correct answer derived from current ACR/ESUR guidance; for items requiring selection of more than one correct component, a response was scored as correct only when the complete prespecified combination was chosen, with no partial credit. No composite or total knowledge score was calculated; findings are reported at the item level only, and responses were not stratified into poor/moderate/good knowledge categories.

STATISTICAL ANALYSIS

The information gathered was encoded and statistically analysed using descriptive analysis. The present used frequencies and percentages to present categorical variables. All analyses were performed in WinPepi software, version 11.65, and results were evaluated according to existing international and national guidelines.

RESULTS

All 60 healthcare staff approached in the present study completed the questionnaire, resulting in a 100% response rate. A large majority of participants were in the 25-30 years age category 36 (60.0%), while males accounted for a slight majority of 35 (58.3%) [Table/Fig-1].

Foundational knowledge regarding the correct type of contrast agent 56 (93.3%) and identification of mild reactions 59 (98.3%) proved near-universal, and procedural knowledge of the intravenous route of administration 57 (95.0%) was also very good [Table/Fig-2].

Only 24 (40.0%) of respondents identified epinephrine as the first-line drug for anaphylaxis, while 33 (55.0%) selected antihistamines, which should not be relied upon as sole treatment. Only 16 (26.7%) identified the intramuscular (anterolateral thigh) route as preferred for epinephrine administration, with the majority 39 (65.0%) incorrectly selecting the intravenous route. Awareness of the preferred corticosteroid for preventing delayed reactions was strikingly poor: only 1 (1.7%) of respondents correctly identified prednisolone, with 80.0% instead selecting hydrocortisone - the largest single knowledge gap identified in this study [Table/Fig-3].

Only 23 (38.3%) had the evidence-based opinion that contrast-enhanced CT can be carried out only if strictly needed and clinically necessary, consistent with current ACR guidance on imaging in pregnancy [Table/Fig-4a].

Characteristics	Category	n (%)
Age group	<25 years	8 (13.3)
	25-30 years	36 (60.0)
	>30 years	16 (26.7)
Gender	Male	35 (58.3)
	Female	25 (41.7)
Designation	Residents	28 (46.7)
	Radiographer/Technologist	22 (36.7)
	Nurse	10 (16.7)
Experience	<1 year	7 (11.7)
	1-5 years	32 (53.3)
	6-10 years	12 (20.0)
	>10 years	9 (15.0)
Work area	Only CT scan modality	11 (18.3)
	Only X-ray modality	16 (26.7)
	All modalities (CT, X-ray)	33 (55.0)

[Table/Fig-1]: Combined participant characteristics (n=60).

Questions	Response option	n (%)
1. What type of contrast media is used for X-ray and CT procedures?	Iodinated ✓ CORRECT	56 (93.3)
	Gadolinium-based	1 (1.7)
	Barium	1 (1.7)
	Don't know	2 (3.3)
2. Iodinated contrast agents are classified based on:	Osmolality	31 (51.7)
	Ionicity	8 (13.3)
	Both ✓ CORRECT	18 (30.0)
	Don't know	3 (5.0)
3. Which type is safer and causes fewer reactions?	Ionic high-osmolar	16 (26.7)
	Non ionic low-osmolar ✓ CORRECT	40 (66.7)
	Don't know	4 (6.7)
4. What are the common mild reactions to iodinated contrast?	Nausea, vomiting, rash, warmth ✓ CORRECT	59 (98.3)
	Hypotension, collapse	0
	Local pain	0
	Don't know	1 (1.7)
5. What are the severe reactions (anaphylaxis) to iodinated contrast?	Breathlessness, hypotension, cardiac arrest ✓ CORRECT	51 (85.0)
	Mild itching	5 (8.3)
	Local swelling	3 (5.0)
	Don't know	1 (1.7)
6. Which medication is primarily used in management of severe contrast reactions during a CT scan and X-ray?	Antihistamines	25 (41.7)
	Corticosteroids	6 (10.0)
	Epinephrine ✓ CORRECT	29 (48.3)
	Bronchodilators	0
7. Which of the following is a risk factor for contrast-induced reactions?	Previous contrast reaction	15 (25.0)
	Asthma/allergy	5 (8.3)
	Cardiac/renal disease	6 (10.0)
	All of the above ✓ CORRECT	34 (56.7)
8. The incidence of reactions is higher with:	High-osmolar contrast ✓ CORRECT	27 (45.0)
	Low-osmolar contrast	13 (21.7)
	Both equally	15 (25.0)
	Don't know	5 (8.3)
9. What is the main route of administration for iodinated contrast in CT scans and X-rays?	Intravenous ✓ CORRECT	57 (95.0)
	Oral	2 (3.3)
	Rectal	0
	Don't know	1 (1.7)

10. Is a test dose recommended before administering Iodinated Contrast Media (ICM)?	Yes	58 (96.7)
	No ✓ CORRECT	1 (1.7)
	Don't know	1 (1.7)
11. Have you attended any training/ workshop on contrast reactions?	Yes ✓ CORRECT	55 (91.7)
	No	5 (8.3)
12. Which preliminary tests are commonly performed before a CT scan with Contrast?	Renal function tests (serum creatinine/ eGFR) ✓ CORRECT	55 (91.7)
	Liver function tests	3 (5.0)
	Complete blood count	2 (3.3)
	Electrocardiogram (ECG)	0

[Table/Fig-2]: Knowledge and awareness of Iodinated Contrast Media (ICM) - Full response distribution (N=60).

Questions	Response option	n (%)
1. Prior to your DPU- Radio-Diagnosis posting, had you ever witnessed or managed a contrast reaction at another institution?	Yes	54 (90.0)
	No	6 (10.0)
2. If yes, what was the severity of the most notable such reaction? (% of the 54 respondents who answered 'Yes' to item 1)	Mild	37 (68.5)
	Moderate	10 (18.5)
	Severe	7 (13.0)
3. What should be your first response to a severe contrast reaction?	Stop contrast injection and call for help ✓ CORRECT	54 (90.0)
	Give oxygen	4 (6.7)
	Continue scanning	0
	Don't know	2 (3.3)
4. The first-line drug in anaphylaxis due to contrast is:	Antihistamine	33 (55.0)
	Epinephrine ✓ CORRECT	24 (40.0)
	Steroid	2 (3.3)
	Oxygen	1 (1.7)
5. The preferred route for epinephrine administration is:	Intramuscular (thigh) ✓ CORRECT	16 (26.7)
	Intravenous	39 (65.0)
	Subcutaneous	2 (3.3)
	Don't know	3 (5.0)
6. Correct adult epinephrine dose (1:1000) for anaphylaxis:	0.1 mg	7 (11.7)
	0.3-0.5 mg IM ✓ CORRECT	45 (75.0)
	1 mg i.v.	5 (8.3)
	Don't know	3 (5.0)
7. Which of the following supportive measures are required during a severe reaction?	Oxygen (only)	3 (5.0)
	i.v. fluids (only)	4 (6.7)
	Airway maintenance (only)	3 (5.0)
	All of the above ✓ CORRECT	50 (83.3)
8. What drug is used for mild allergic reactions (itching, rash)?	Antihistamine ✓ CORRECT	27 (45.0)
	Epinephrine	22 (36.7)
	Steroid	1 (1.7)
	Don't know	10 (16.7)
9. Which corticosteroid is preferred for preventing delayed reactions?	Hydrocortisone	48 (80.0)
	Dexamethasone	3 (5.0)
	Prednisolone ✓ CORRECT	1 (1.7)
	Don't know	8 (13.3)
10. Are you aware of premedication protocols for high-risk patients (e.g., prior allergy)?	Yes	56 (93.3)
	No	4 (6.7)
11. In case of contrast extravasation (leak into tissue), what should be done?	Apply warm compress	17 (28.3)
	Elevate limb and apply cold compress ✓ CORRECT	37 (61.7)
	Ignore	1 (1.7)
	Don't know	5 (8.3)

12. Is an emergency crash cart with drugs available in your imaging unit?	Yes ✓ CORRECT	59 (98.3)
	No	1 (1.7)
13. Do you know where emergency drugs (e.g., epinephrine, antihistamines) are kept in your department?	Yes ✓ CORRECT	56 (93.3)
	No	4 (6.7)
14. Should periodic training and mock drills on contrast reaction management be conducted?	Yes ✓ CORRECT	54 (90.0)
	No	6 (10.0)

[Table/Fig-3]: Prior exposure to contrast reactions (Items 1–2) and awareness of contrast reaction management (Items 3–14) — Full response distribution (N=60).
Note: For item 2 (severity of witnessed reactions), percentages are calculated out of the 54 respondents who answered 'Yes' to item 1, not out of the full sample of 60.

Response	n (%)
Should never be done in pregnancy	32 (53.3%)
Only if necessary and benefits outweigh risks ✓ CORRECT	23 (38.3%)
Always safe during pregnancy	3 (5.0%)
Can be done without any care	2 (3.3%)

[Table/Fig-4a]: Response distribution-CT with contrast in pregnancy (N=60).

A mere 2 (3.3%) of respondents were able to correctly answer according to ACR 2025 that no breastfeeding disruption should take place following the administration of ICM [Table/Fig-4b].

Response	n (%)
No interruption needed ✓ CORRECT per ACR 2025	2 (3.3%)
6 hours interruption	5 (8.3%)
12 hours interruption	27 (45.0%)
24 hours interruption	26 (43.3%)

[Table/Fig-4b]: Response distribution-breastfeeding after ICM (N=60).

Correct identification of epinephrine as the first-line drug for anaphylaxis ranged from 9 (32.1%) among residents to 6 (60%) among nurses [Table/Fig-5]. Given the small nurse sub-group (n=10), these figures should be read as descriptive rather than as formally powered comparisons between designations; no inferential statistical test was applied.

Item (correct answer)	Residents (n=28)	Radiographer/Technologist (n=22)	Nurses (n=10)	Overall (n=60)
First-line drug for anaphylaxis - correct: Epinephrine	9/28 (32.1%)	9/22 (40.9%)	6/10 (60.0%)	24/60 (40.0%)
Preferred route of epinephrine - correct: Intramuscular (thigh)	8/28 (28.6%)	7/22 (31.8%)	1/10 (10.0%)	16/60 (26.7%)
Drug for mild allergic reaction - correct: Antihistamine	15/28 (53.6%)	7/22 (31.8%)	5/10 (50.0%)	27/60 (45.0%)
CT with contrast in pregnancy - correct: only if necessary, benefits > risks	12/28 (42.9%)	7/22 (31.8%)	4/10 (40.0%)	23/60 (38.3%)
Breastfeeding after ICM - correct: no interruption needed	0/28 (0.0%)	2/22 (9.1%)	0/10 (0.0%)	2/60 (3.3%)

[Table/Fig-5]: Designation-wise awareness of key anaphylaxis - Management items (N=60).

DISCUSSION

In the present study, basic contrast-safety awareness was high, with 98.3% of respondents correctly recognising mild ICM reaction symptoms and 91.7% aware of the need for pre-procedural renal function testing. These figures compare favourably with the results of Hadi YH et al., regarding basic precautions awareness among CT radiographers in Saudi Arabia (93.4%) [11], and with Osiemo SK et

al., regarding symptom and risk factor awareness among Kenyan CT radiographers (82%) [7]. Good staff training participation rates (91.7%) in the present study are themselves a positive achievement, and correspond well to the findings of Kruse DE et al., who reported that high-fidelity simulation training, but not didactic-only teaching, produced a measurable improvement in residents' contrast-reaction management knowledge, an effect that was most pronounced among junior residents [12].

The most troubling finding was that 40.0% of respondents correctly identified epinephrine as the drug of choice in anaphylaxis treatment, compared to the overwhelming 55.0% who opted for antihistamines. This is not a one-off observation; according to Khan F et al., the percentage was 28% [6]; according to Osiemo SK et al., it was 30% [7], while according to Wang CL and Soloff EV, surveys showed only 29% of radiology staff were familiar with the correct dosage and mode of administration of epinephrine [8]. The problem is that while antihistamines are appropriate in cases of mild allergic reaction, they are ineffective as monotherapy in anaphylaxis and may actually delay epinephrine administration [10].

Similarly, route knowledge did not perform much better, with only 26.7% selecting the preferred anterolateral thigh intramuscular route, while the majority (65.0%) opted for the intravenous route [10]. This matters because intramuscular administration is the internationally accepted first-line treatment for anaphylaxis in departments, due to its favourable pharmacokinetics and lower risk of arrhythmias [10].

The breastfeeding issue showed the largest gap: only 3.3% of participants knew there is no need to interrupt breastfeeding after ICM injection, although ACR 2025 recommends no breast milk interruption because oral bioavailability is less than 1% [13]. A similar finding was reported by Colleran GC et al., who surveyed radiologist fellows and trainees in Ireland and found that 56% recommended interruption of breastfeeding following iodinated or gadolinium-based contrast administration, with 68% specifically advising mothers to "pump and dump" breast milk for 24-48 hours despite the absence of supporting evidence; notably, 84.5% of their respondents had received no formal training in breastfeeding medicine, a knowledge gap comparable to that observed in the present study cohort [14]. A comparable pattern was seen in Türkiye, where Karatekin S et al., similarly found that most radiology staff surveyed lacked formal training in breastfeeding-related imaging guidance [15]. The consequences in terms of new mothers' unnecessary stress without any evidence are rather practical.

Limitation(s)

First, because the research was conducted at one Tertiary Care Institute using purposive sampling, the results cannot be easily extrapolated to other settings; also, the small sample size makes subgroup comparisons by designation impractical. Additionally, self-administered questionnaires may be subject to response bias, and the authors did not use a grading system for the assessment.

CONCLUSION(S)

In conclusion, healthcare personnel in the present tertiary radiology department showed reasonably good baseline knowledge of ICM types, reaction recognition, and emergency infrastructure, but important gaps persist in the pharmacological management of anaphylaxis.

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