



POTENTIAL ROLE OF THE MEDICAL INSTITUTIONS IN CONDUCTING THE INVESTIGATION OF CONTRAST-ENHANCED COMPUTED TOMOGRAPHY (CECT)

Nived V Nair

Department of Research, People's Homoeopathy Medicare and Research Center, Old Court Road, Pattambi, Palakkad District, Kerala State, India-679 303

Siju J Seena

Department of Epidemiology, People's Homoeopathy Medicare and Research Center, Old Court Road, Pattambi, Palakkad District, Kerala State, India-679 303

J. Janifer Jasmine*

Department of Research, AWG, Chennai, India. *Corresponding Author

ABSTRACT

Aim: To evaluate the medical institutes' possible involvement in the study of Contrast-Enhanced Computed Tomography (CECT). **Methods:** This study is a retrospective analysis of CECT investigations carried out in 236 medical colleges throughout Indian states. Between May and December 2023, the information was gathered using the Right to Information (RTI) Act 2005 (Government Medical Colleges). **Results:** Of the 236 medical institutions that were chosen, 24 (10.2%) CECTs were carried out at the partner institution under the PPP Mode, while 212 (89.8%) CECTs were carried out at their individual facilities. The medical institutions with 1.5 years ($n = 63$, 84.1%) and those with less than 10 years ($n = 48$, 14.6%) had the greatest number of CECTs. Specialists performed the most CECTs ($n = 184$, 78.0%), followed by technicians ($n = 36$, 15.3%). There were 177 specialists with CECT, PG-MDRD, MDR, DNB, and diploma credentials, and 28 technicians with a bachelor's degree or less. In comparison to the PPP method, the own facilities had higher levels of variables such as institutional years, CECT performers' qualifications, and their designation. There were 455 contraindication replies from 236 medical facilities. Impaired RFT accounted for the largest percentage of reported contraindications ($n = 150$, 63.5%), followed by allergies to IV contrast medium ($n = 97$, 41.1%), and pregnant women ($n = 48$, 20.3%), a third but extremely susceptible group of people, each of whom held two or more lives. Compared to the PPP mode, more contraindications were discovered in the own facilities. Of the 236 medical facilities, ($n = 156$, 66.1%) gave patients an explanation of the CECT procedure's steps, ($n = 148$, 62.1%) administered the RFT test, ($n = 61$, 25.8%) obtained informed consent from the patient, and required patients to fast for four to six hours. Only 47 of the 236 universities responded with information about the test dose; of these, 24 institutions explained the test dose, and 13 institutions discussed the contrast sensitivity test. **Conclusions:** While schools with longer histories have demonstrated greater autonomy and well-established infrastructure, most have amassed sufficient resources for CECT amenities. The greater proportion of specialists with post-graduate degrees (PG-MDRD/MDR/DNB/Diploma) indicates that the CECT procedures require a higher level of skill. When doing CECT, a significant portion of establishments solely used the proper request forms. Internal facilities deal with a greater range of therapeutic issues, including pregnancy, renal impairment, and allergy to IV contrast as contraindications, and comorbidities such as diabetes and heart failure are common. Giving contrast to patients with cardiac problems may be dangerous. In general, fewer than $\frac{1}{4}$ of institutions followed protocols, SOP, or textbooks. This shows a lack of consistency and standardization of practice and emphasizes the need for stricter pre-screening procedures, careful patient evaluation before CECT, professional training, protocol reinforcement, uniform test dosage, periodic RFT evaluations, and uniform information leaflets on process explanations, advantages and hazards, and assurance will improve patient safety during CECT investigation and lower the risk of side effects and contrast reactions.

KEYWORDS : Contrast Enhanced Computer Tomography (CECT), Right to Information (RTI), Public-Private Partnership (PPP), MD (Doctor of Medicine) in Radiodiagnosis (PG-MDRD), Impaired Renal Function Test (IRFT), Standard Operating Procedures (SOP), National Medical Commission (NMC).

INTRODUCTION

When using Contrast Enhanced Computer Tomography (CECT) in a diagnostic test, the radiation oncologist and the physician who referred the patient should first: consider imaging options that would provide the same or better diagnostic information; weigh the risks to the patient against the potential benefits of the contrast-assisted examination; and reassure the patient that each application of CM has a valid medical indication [1].

Computed tomography (CT) scans have significantly improved medical diagnostics by providing extraordinarily accurate and detailed pictures when combined with IV Contrast Medium (IVCM), revolutionizing patient care. These technological advancements make it possible to obtain precise imaging, which facilitates successful diagnosis and therapy [2].

Despite their extensive use and benefits, IVCMs include an inherent risk of adverse effects. Vomiting, bloating, urticaria, and localized pain are examples of mild reactions; bronchospasm, elevated blood pressure, and spreading erythema are examples of moderate reactions; and

pulmonary edema, cardiac arrhythmia, anaphylactic shock, circulatory collapse, and unconsciousness are examples of severe reactions [3].

While mild and moderate reactions are often caused by contrast-mediated allergic reactions, severe reactions can involve vascular injury, rapid cardiovascular depression, or severe allergic reactions that necessitate emergency medical intervention [4]. Although only 0.1–0.2% of patients have experienced severe adverse reactions, their existence highlights how crucial it is to respond promptly and skillfully in these circumstances to ensure patient safety [5]. The institutional procedures, educational background, and professional training of CT radiographers and other medical professionals can help prevent these negative reactions.

By putting the recommendations into practice, medical facilities can prevent adverse reactions in CECT investigations. CECT investigations can enhance imaging services, support emergency preparedness, and promote standardized, high-quality radiological care. They also highlight the importance of organized training and ongoing educational opportunities in improving CT radiographers' comprehension,

in accordance with international standards [6]. Other factors that may prevent negative reactions in CECT investigations include financial gain and disregard for procedure compliance. Because CT scans immediately improve their business line, private-for-profit healthcare facilities may overuse them. The financial effects of excessive use in public institutions are typically absorbed at higher administrative and management levels rather than directly harming the imaging department [7].

Public, well-established, long-standing hospitals may have more oversight, skilled personnel, and clearly defined workflows, but they may also manage larger patient loads, which may result in overutilization due to resource constraints and demand stress. Private For-Profit (PFP) and Private Not-For-Profit (PNFP) are distinct hospitals; however, those with less expertise may find it challenging to apply proper use rules, sometimes due to insufficient clinical governance frameworks and insufficient information [8].

Behavioral adjustment is feasible, according to the research findings mentioned above, but it usually requires comprehensive, multi-level initiatives that target individual practitioners, healthcare teams, institutional procedures, and the medical care environment. Effective interventions must be tailored to the specific context and population, addressing the unique aspects of the recommendations as well as the barriers and facilitators relevant to their implementation. Success primarily depends on tailoring techniques; there isn't a single implementation strategy that works for every circumstance [9].

Institutions should require simulation-based courses for radiographers in order to guarantee that they are adequately prepared to handle extreme contrast responses. National healthcare accreditation agencies should establish competency requirements and assess and standardize rescue training for all imaging facilities. Last but not least, laws permitting licensed radiologists to provide emergency medications should be looked into, particularly in high-risk circumstances where quick action is crucial.

Hence, this present research study is conducted in 219 medical colleges across India to find out the gaps found in the medical institutions in conducting CECT investigations and their salient features.

Ethical Clearance

This study was conducted using retrospectively collected data from RTI. A research ethics certificate was not necessary because the data were gathered retrospectively from the Right to Information (RTI).

Conflicts- None

Funding- None

Inclusion Criteria

The Indian medical colleges that conduct the CECT test.

Exclusion Criteria

The Indian medical colleges that do not conduct the CECT test.

MATERIALS AND METHODS

Methodology

Study Design and Participants

The sole basis for this retrospective study, which gathered data from the RTI Act 2005 (Government Medical Colleges), was the Nodal officials of every Indian government college approved by the National Medical Commission that offers MBBS, MD, DM, MS, and diploma programs, as well as the national and state-based assistants to the general public.

The National Medical Commission-approved Indian

government colleges that perform CECT investigations at their own facilities or in a partner institution under the PPP (Public-Private Partnership) Mode participated in this study.

Study Procedure

This study was carried out between May and December of 2023. Only 236 institutions provided adequate replies to the questionnaire after exclusion criteria were applied, and these institutions were selected for further data collection and analysis.

Study Variables and Data Collection

The institution's responses to this research study included information about healthcare professionals who conduct CECT, their qualifications, the steps involved in conducting CECT investigations, an explanation of the test dose, CECTs without a proper requisition form, and requests from patients without a proper requisition form. Data cleaning and labeling were carried out in addition to entering the responses into an Excel sheet.

Analysis

The collected and labelled data were analyzed and tabulated in the results section based on the objectives and study variables.

Statistical Analysis of Data

Numbers and percentages were used to represent the analysis, and the frequency values and percentages are presented.

RESULTS

The survey was completed by 236 institutions, of which 212 were CECT performed at their own facilities, and 24 were CECT performed at the partner institution under the PPP Mode.

The distribution of institutions according to the length of CECT use and the mode of performance at their own facility or under the PPP mode is shown in Table 1. Just 10.21% of the universities rely on partner institutions under the PPP paradigm, whereas the majority (89.83%) conduct CECT at their own facilities. 63 institutions have been utilizing CECT for 1.5 years or less, while 48 institutions have been using it for 6 to 10 years.

Furthermore, organizations that have been using CECT for more than 20 years only use their own facilities. The allocation of CECT workers among institutions that carried out the process at their own facilities and those that used the PPP option. According to the data, specialists made up the majority in both setups (79.7% in own-facility institutions and 62.5% in PPP mode), suggesting that highly qualified professionals perform the bulk of CECT treatments. Technicians made contributions of 25% in PPP contexts and 14.2% in their own institutions (Table 1).

In terms of qualifications, specialists with postgraduate degrees (PG-MDRD/MDR/DNB/Diploma) made up 96.2% of all employees who performed CECT. The procedures were also performed by a lesser fraction of technicians (28 total) and doctors (6 total), and a very small percentage of people with merely diploma-level training or less (Table 1).

Table 1: Distribution of CECT Performed Based on Years, Persons, and their Qualification at the Own Facility Institutions and Under the PPP Mode

Variables	CECT Performed at the own facility Institution	CECT Performed at the partner Institution under PPP Mode	Total

	No (%)	No (%)	No (%)
CECT Use in years			
1. 5 or below	53 (84.1)	10 (15.9)	63 (84.1)
2. 6 to 10	41 (85.4)	7 (14.6)	48 (14.6)
3. 11 to 15	30 (88.2)	4 (11.8)	34 (11.8)
4. 16 to 20	22 (95.7)	1 (4.3)	23 (4.3)
5. 21 to 25	25 (100.0)	0 (00.0)	25 (100.0)
6. 26 to 30	20 (100.0)	0 (00.0)	20 (100.0)
7. Above 30	7 (100.0)	0 (00.0)	7 (100.0)
Not available	14 (87.5)	2 (12.5)	16 (100.0)
Total	212(89.8)	24 (10.2)	236 (100.0)
Person responsible for conducting CECT			
Specialist	169 (91.8)	15 (8.2)	184 (78.0)
Doctor	8 (88.8)	1 (4.2)	9 (3.8)
Technician	30 (83.3)	6 (16.7)	36 (15.3)
Nurse	1 (100.0)	0 (00.0)	1 (0.4)
Not available	4 (66.7)	2 (33.3)	6 (2.5)
Total	212 (89.8)	24 (10.2)	236 (100.0)
Qualification: Person responsible for conducting CECT			
Specialists, PG-MDRD /MDR/ DNB/Diploma	162 (91.5)	15 (8.5)	177 (96.2)
Doctor, MBBS/ Resident/ RMP/MO	5 (83.3)	1 (16.7)	6 (66.7)
Technician, Bachelor's degree or below	25 (89.3)	3 (10.7)	28 (77.8)
Diploma or below	4 (66.7)	2 (33.3)	6 (16.7)
Master's or below	1 (100.0)	0 (00.0)	1 (2.8)
Nurse, BSc/Diploma/ GNM/ANM	1 (100.0)	0 (00.0)	1 (100.0)
Total	198 (90.4)	21 (9.6)	219 (100.0)

Table 2: Distribution of Contraindications Mentioned in 236 Institutions, CECT Performed at the Own Facility Institution and Under PPP Mode

Contraindications mentioned in 236 Institutions	CECT Performed at the own facility Institution	CECT Performed at the partner Institution under PPP Mode	Total
	No (%)	No (%)	No (%)
Contraindications mentioned			
Pregnancy (n=48)	44 (20.7)	4 (16.6)	48 (20.3)
Impaired RFT (n=150)	139 (65.5)	11 (45.8)	150 (63.5)
Allergy to IV contrast (n=97)	90 (42.4)	7 (29.1)	97 (41.1)
H/o allergy to food, drugs, asthma, atopy (n=56)	53 (25.0)	3 (12.5)	56 (23.7)
Cardiac failure/Acute MI (n=16)	16 (7.5)	0 (0.00)	16 (6.7)
Non-cooperative/ Irritation (n=11)	10 (4.7)	1 (4.1)	11 (4.6)
DM/Metformin use (n=12)	11 (5.1)	1 (4.1)	12 (5.0)
Thyroid disease/radioactive iodine treatment (n=11)	11 (5.1)	0 (0.00)	11 (4.6)
Liver disease (n=5)	5 (2.3)	0 (0.00)	5 (2.1)
Multiple Myeloma (n=7)	7 (3.3)	0 (0.00)	7 (2.9)
Elderly/children (n=5)	5 (2.3)	0 (0.00)	5 (2.1)
Trauma/ Stroke/ Head injury (n=4)	4 (1.8)	0 (0.00)	4 (1.6)
HTN (n=3)	3 (1.4)	0 (0.00)	3 (1.2)

Pheochromocytoma (n=3)	3 (1.4)	0 (0.00)	3 (1.2)
Myasthenia gravis (n=3)	2 (0.9)	1 (4.1)	3 (1.2)
Claustrophobia (n=1)	1 (0.4)	0 (0.00)	1 (0.4)
High fever (n=1)	0 (0.00)	1 (4.1)	1 (0.4)
Adrenal hyperfunction (n=1)	1 (0.4)	0 (0.00)	1 (0.4)
Any blood/ Bone marrow diseases (n=1)	1 (0.4)	0 (0.00)	1 (0.4)
Systemic fibrosis (n=1)	1 (0.4)	0 (0.00)	1 (0.4)
Blood and Bone marrow (n=8)	8 (3.7)	0 (0.00)	8 (3.3)
Adrenal, PCC (n=4)	4 (1.8)	0 (0.00)	4 (1.6)
Cardiac disease (n=7)	7 (8.0)	0 (0.00)	7 (2.9)
Total contraindications mentioned in 236 institutions (n=455)	425 (93.4)	30 (6.6)	455 (100.0)

Data on CECT utilization at both own-facility institutions and partner institutions using the Public-Private Partnership (PPP) approach is included in Table 2. It demonstrates good adherence to procedural guidelines, with the vast majority of institutions (86.02%) performing CECT solely with appropriate request forms. Just 8.05% of CECT procedures were carried out at the patient's request without a valid request, and very few were carried out in an emergency or on the radiologist's recommendation.

Renal safety in CECT treatments is crucial, as evidenced by the fact that impaired Renal Function Test (RFT) was the most often indicated contraindication, reported by 63.56% of institutions. 20.34% of institutions listed pregnancy as a contraindication, demonstrating the proper caution regarding radiation exposure in such circumstances. Additionally, 41.10% of institutions reported having an intravenous (IV) contrast allergy (Table 2).

The distribution of contraindications listed for CECT operations carried out at partner institutions and own facility institutions under the PPP approach is shown in Table 2. A history of food, medication, asthma, or atopy allergies was the most commonly reported contraindication in both types of institutions (23.73%), indicating a common pre-existing risk factor that necessitates rigorous screening before CECT. Notable contraindications included heart-related conditions such as heart disease (7.22%) and heart failure or acute MI (6.78%).

In comparison to partner institutions, the own facility institutions reported more contraindications overall. In addition to allergy-related concerns, DM/metformin use (5.19%), thyroid disease or radioactive iodine treatment (5.19%), and patients who were uncooperative or irritable (4.72%) were other significant contraindications in our own institutions.

Table 3: Distribution of Steps of CECT Performed and Test Dose at the Own Facility Institution and Under the PPP Mode

Variables	CECT Performed at the own facility Institution	CECT Performed at the partner Institution under PPP Mode	Total
	No (%)	No (%)	No (%)
Steps: Conducting CECT			
As per SOP/protocol/ guidelines/textbook	42 (19.8)	3 (12.5)	45 (19.1)
As per the opinion of a Radiologist	0 (00.0)	1 (4.2)	1 (0.4)

Explained steps	142 (67.0)	14 (58.3)	156 (66.1)
Pregnancy excluded	12 (5.7)	1 (4.2)	13 (5.5)
RFT	135 (63.6)	13 (54.1)	148 (62.1)
4-6 hours fasting	56 (26.4)	5 (20.8)	61 (25.8)
History/ reports	41 (19.3)	2 (8.3)	43 (18.2)
H/o drug or food allergy	46 (21.7)	4 (16.6)	50 (21.1)
H/o contrast reaction/allergy	29 (13.6)	1 (4.1)	30 (12.7)
Informed consent	60 (28.3)	1 (4.1.3)	61 (25.8)
Well hydrated	11 (5.1)	2 (8.3)	13 (5.5)
Test dose	40 (18.8)	7 (29.1)	47 (19.9)
contraindications checked	1 (0.5)	0 (00.0)	1 (0.4)
Required procedures & precautions taken	6 (2.8)	0 (00.0)	6 (2.5)
Depends on the condition of the patient	0 (00.0)	2 (8.3)	2 (0.8)
Refused to answer	7 (3.3)	1 (4.2)	8 (3.4)
No SOP	1 (0.5)	0 (00.0)	1 (0.4)
Not available	13(6.1)	3(12.5)	16 (6.8)
Total	212 (100.0)	24 (100.0)	236 (100.0)
Variables	CECT Performed at the own facility Institution	CECT Performed at the partner Institution under PPP Mode	Total
	No (%)	No (%)	No (%)
Test dose explained:	Conducting CECT		
Test dose	22 (55.0)	2 (28.5)	24 (51.6)
Contrast sensitivity test	8 (20.0)	5 (71.4)	13 (27.6)
Intra-dermal Injection	6 (15.0)	0 (00.0)	6 (12.7)
Intra-venous Injection	2 (5.0)	0 (00.0)	2 (4.2)
Subcutaneous Injection	1 (2.5)	0 (00.0)	1 (2.1)
Intra-dermal test plus (IM) IV test	1 (2.5)	0 (00.0)	1 (2.1)
Total	40 (100.0)	7 (100.0)	47 (100.0)

The steps taken during CECT are compared between institutions conducting it at their own facilities and those using the PPP option in Table 3. According to the statistics, most institutions (66.1%) gave patients an explanation of the steps involved in the CECT technique, demonstrating a high degree of patient awareness and communication. Furthermore, 62.71% of institutions performed Renal Function Tests (RFTs), indicating compliance with safety protocols prior to contrast media administration. But just 19.1% of establishments adhered to protocols, textbooks, and standard operating procedures (SOPs).

Additional investigation reveals that in almost one-fourth of the instances, preliminary actions such as getting informed consent (25.85%) and guaranteeing 4–6 hours of fasting (25.85%) were carried out, indicating partial compliance with procedural criteria. In just 5.5% of institutions, the exclusion of pregnancy was verified (Table 3).

Institutions varied in their adherence to similar procedures, such as testing for food or medicine allergies (21.19%) and prior contrast reactions (12.7%). Except for test dosing (29.17%) and patient condition-based decisions (8.3%), institutions using the PPP approach showed somewhat lower adherence in the majority of stages (Table 3).

dose protocols used during CECT are shown in Table 3. It reveals that while a minority (6.8%) stated that SOPs were either unavailable or absent, the majority of institutions (93.4%) had SOPs available. According to the statistics, more than half of the institutions (51.06%) conducted a general test dosage before completing CECT, with contrast sensitivity testing coming in second at 27.66%. Just 4.26% of people employed intravenous techniques, and a lesser fraction (12.77%) used intradermal injections. Rarely were subcutaneous and intradermal tests plus IV test techniques used (2.13% each).

DISCUSSION

10.2% of CECT services were provided through partner institutions under the PPP mode, while the majority (89.8%) were provided within the organization's own facilities, according to the results of our research study. According to a study by Pontone G. et al., which supports our findings, organizations with well-established CECT programs give internal operations top priority in order to maintain reliable imaging techniques, high-quality images, and data validity [10].

Due to their early reliance on shared infrastructure and outside expertise, the institutions that had been utilizing CECT for less than ten years were more dependent on PPP agreements. According to Williams et al., PPP agreements should focus on addressing critical infrastructural deficiencies rather than replacing organizational independence in contemporary diagnostic imaging [11].

The results of our study show that specialists make up the great majority of professionals (PG-MDRD/MDR/DNB) who do CECT examinations (91.8%), with technicians, doctors, and nurses making up a smaller number. According to data published by Brady AP et al. (Insights into Imaging. 2025 Mar 12;16(1):57, and Insights into Imaging. 2025 Mar 15;16(1):590), the majority of institutions make sure that certified radiology professionals oversee or conduct CECT in accordance with international best-practice recommendations for imaging safety and diagnostic accuracy. The majority of PG-qualified specialists have confirmed strong adherence to the credentialing requirements for providing contrast media and optimizing radiation dose. This is consistent with studies carried out in Europe and Asia, where the necessity for trained personnel to ensure patient safety and proper interpretation is a major focus of current imaging standards. According to research by Kido A et al., systematic task-shifting from radiologists to technologists only occurs in Japan within well-defined competency frameworks, ensuring safe and effective imaging outcomes [12–14]. However, according to research by Luo J et al., competent technicians can safely handle certain procedural components under radiologists' supervision if standard operating procedures are followed [15].

The most commonly mentioned contraindications for CT/contrast imaging were impaired renal function (150/455; 33%), allergy to IV contrast (97/455; 21%), and pregnancy (48/455; ~11%), according to a discussion of the 236 institutions (n = 455 contraindications mentioned) in both own and PPP mode. These findings highlight the ongoing importance of patient selection for contrast use and CT imaging and offer insight into practical risk-avoidance strategies. Just 30 (6.6%) of the 455 aggregate contraindications that were recorded had anything to do with partner institutions under the PPP approach, while 425 (93.4%) were at establishments that had their own facilities. The current research study's findings emphasize the importance of risk-benefit analysis, screening protocols, and practice harmonization with evolving data.

Since CT use is increasing worldwide and contrast-related risks are still substantial, medical facilities should routinely

review their contraindication policies, track findings, and ensure that screening does not needlessly delay diagnosis while maintaining patient safety. The incidence of poor renal function as a contraindication is consistent with persistent concerns regarding Post-Operative Acute Kidney Damage (PC-AKI) or Contrast-Associated Nephropathy (CAN), according to data reported by Davenport MS et al. [16].

According to McDermott MC et al., a significant number of reports of IV contrast allergies reflect the known risk of hypersensitivity reactions to iodinated contrast media. Significant, minor events like rash and infection are frequently reported, but severe, potentially fatal reactions like bronchospasm and anaphylaxis are still rare (~0.04%) [17].

According to Keefe N. et al., this is consistent with the evaluation of risk and reward when imaging expecting moms. Even though the risk of iodinated contrast to the fetus is not well established, radiation exposure during CT is a known issue in pregnancies and fetal development [18].

The results of this study show significant differences between institutions operating under PPP agreements and those executing operations independently in terms of adherence to defined protocols for conducting CECT. In line with prior findings highlighting patient-centered radiology procedures, the majority of respondents (66.1%) said that the procedural steps were described to patients, highlighting an emphasis on communication and patient readiness. The Dutruel SP et al. study highlights the need for professional education in communication, the need for patient input in the planning and delivery of care, and the seamless integration of technology solutions into our workflows [19].

This current study showed that n=24 PPP institutions showed, and Montesinos-Sansaloni EX et al reported that the institutions operating in PPP mode showed somewhat lower compliance rates (58.3%) than those operating internally (67%), indicating possible deficiencies in staff education or patient care under partnership frameworks [20].

Additionally, we discovered that preliminary actions, such as ensuring that one would fast for four to six hours (25.85%) and obtaining informed consent (25.85%), were completed in nearly one-fourth of the cases. According to Ferede AA et al.'s study, informed consent procedures were used in 63.8% of all cases, which is consistent with the growing regulatory requirements that give patient autonomy and ethical compliance in diagnostic imaging top priority [21].

Precautions like testing for potential food or medicine allergies (21.19%) and previous contrast responses (12.7%) were also taken by different institutions. According to a study by Böhm et al., diagnosing "iodine allergy" could be detrimental, resulting in unclear therapeutic management and sometimes even ineffective preventative measures [22].

Describe the Standard Operating Procedures (SOPs) and test dose procedures used across CECT based on the results of our investigation. It shows that the majority of institutions (93.4%) had SOPs available; however, a minority (6.8%) said that they were either absent or unavailable. According to data released by Staniuk T et al, our research center developed fluoro-3 - deoxythymidine (a treatment for some types of cancer and viruses) using both the normal SOP and the R&D synchronization module (Raytest) [23].

The results show that a test dosage was given before to the primary surgery in 51.6% of the 47 total cases, indicating that it is still used mostly as a safety measure to assess contrast media hypersensitive reactions. Li J et al.'s study explains how to enhance healthcare judgments, and it's interesting to note that, in contrast to screening protocol adherence, the

proportion was higher within PPP institutions (28.5%) than in their own facilities (55.0%). More multicentric research might look at the relationships between pre-test procedures and the incidence of unfavorable contrast reactions [24].

Tariq A et al describe that by fine-tuning these models utilizing restricted task-specific annotated data for a variety of imaging tasks, independent models under an open-source academic license and imaging-based medical computer investigations can subsequently be advanced. Variations in rapid response protocols, institutional regulations, and training needs among countries may affect applicability. However, the impact of experience on competency and the absence of formal training are consistent with research done worldwide, and comparative studies carried out in different areas will further assess the findings' global applicability [25].

CONCLUSIONS

According to the data, the majority of institutions have built up enough internal capacity for CECT services and rely less on outside collaborations. Longer-standing institutions demonstrated more independence and well-established infrastructure. Conversely, institutions that are more recent or have less experience typically rely more on PPP agreements. CECT procedures demand a high level of expertise, as evidenced by the increased number of specialists with postgraduate qualifications (PG-MDRD/MDR/DNB/Diploma). Good adherence to procedural norms was demonstrated by the vast majority of institutions performing CECT solely with appropriate request forms.

According to research, administering contrast to patients with cardiovascular diseases may be risky, and in-house facilities deal with a wider variety of clinical challenges, either as a result of managing more patients or a wider range of clinical cases. Our findings, which indicate that renal insufficiency is a contraindication in many institutions, may be the result of physician prudence, local policy, or conservative screening techniques rather than purely evidence-driven risk. In many situations, this cautious approach may be justified, particularly when concomitant conditions like diabetes and heart failure are common.

Therefore, institutional guidelines to identify "allergy to IV contrast" as a formal contraindication or caution zone may be reflected in our findings. Even if there may be a clear diagnostic necessity, the fact that pregnancy is still one of the top three contraindications in our dataset suggests that clinicians are generally aware of radiation safety and fetal risk.

Overall, less than ¼ of institutions adhered to SOP protocols, or textbooks. This indicates a lack of uniformity and standardization of practice and highlights the need for more stringent pre-screening procedures, careful patient evaluation before CECT, stringent professional training, protocol reinforcement, and standard test doses to reduce the risk of adverse contrast reactions, particularly for individuals with known allergies, cardiac conditions, or metabolic diseases. While routine RFT checks and process explanations were common safety precautions. Better relationships between risks and benefits, assurance, and uniform information leaflets can improve patient consent and safety.

Limitation

The cross-sectional nature of our dataset and the fact that it is based on self-reported contraindication lists rather than real patient outcomes are its drawbacks.

REFERENCES

1. Roa JA, Zanaty M, Piscopo AJ, Morris TW, Sabotin R, Ishii D, Varon A, Raghuram A, Lu Y, Samaniego EA, Hasan DM. Contrast enhancement of brain aneurysms on high-resolution vessel wall imaging [HR-VWI] correlates with the presence of microbleeds. *Cardiology and Cardiovascular Medicine*. 2021;5(1):162-171. <http://dx.doi.org/10.26502/ccm.92920190>

2. Cao CF, Ma KL, Shan H, Liu TF, Zhao SQ, Wan Y, Wang HQ. CT scans and cancer risks: a systematic review and dose-response meta-analysis. *BMC Cancer*. 2022 Nov 30;22(1):1238. <https://doi.org/10.1186/s12885-022-10310-2>
3. Andreucci M, Solomon R, Tassanarong A. Side effects of radiographic contrast media: pathogenesis, risk factors, and prevention. *BioMed Research International*. 2014;2014(1):741018. <https://doi.org/10.1155/2014/741018>
4. Trygg E, Bjällmark A, Ahlander BM, Kihlberg J. Radiographers' confidence in handling iodine-based contrast media hypersensitivity reactions. *Radiography*. 2024 Jan 1;30(1):21-7. <https://doi.org/10.1016/j.radi.2023.10.007>
5. Abu Awwad D, Hill S, Chau M, Lewis S, Jimenez YA. Radiography students' knowledge, attitude, and practice relating to infection prevention and control in the use of contrast media injectors in computed tomography. *Journal of Medical Radiation Sciences*. 2025 Mar;72(1):42-53. <https://doi.org/10.1002/jmrs.820>
6. Hadi YH, Aljuaid MH, Alotaibi NA, Altalhi FK, Ali HM, Alrefaei MG, Abu Aqil AI, Fagiry MA, Osman H, Mahmoud M. Investigating computed tomography radiographers' expertise in responding to severe contrast media reactions: a cross-sectional study. *BMC Medical Education*. 2025 Mar 27;25(1):445. <https://doi.org/10.1186/s12909-025-07040-x>
7. Gransjøen AM, Wiig S, Lysdahl KB, Hofmann BM. Barriers and facilitators for guideline adherence in diagnostic imaging: an explorative study of GPs' and radiologists' perspectives. *BMC Health Services Research*. 2018 Jul 16;18(1):556. <https://doi.org/10.1186/s12913-018-3372-7>
8. Fleming KA, Horton S, Wilson ML, Atun R, DeStigter K, Flanagan J, Sayed S, Adam P, Aguilar B, Andronikou S, Boehme C. The Lancet Commission on diagnostics: transforming access to diagnostics. *The Lancet*. 2021 Nov 27;398(10315):1997-2050. [https://doi.org/10.1016/S0140-6736\(21\)00673-5](https://doi.org/10.1016/S0140-6736(21)00673-5)
9. Karwooya MG, Kisebbo HN, Malumba R, Nsereko E. Effectiveness of clinical imaging guidelines to reduce inappropriate head computed tomography imaging: A case of Uganda. *Egyptian Journal of Radiology and Nuclear Medicine*. 2022 Jul 28;53(1):164. <https://doi.org/10.1186/s43055-022-00833-w>
10. Pontone G, Andreini D, Guaricci AI, Baggiano A, Fazzari F, Guglielmo M, Muscogiuri G, Berzovini CM, Pasquini A, Mushtaq S, Conte E. Incremental diagnostic value of stress computed tomography myocardial perfusion with whole-heart coverage CT scanner in intermediate-to high-risk symptomatic patients suspected of coronary artery disease. *JACC: Cardiovascular Imaging*. 2019 Feb;12(2):338-49. <https://doi.org/10.1016/j.jcmg.2017.10.025>
11. Williams, M. C., Nicol, E. D., Han, D., Leipsic, J., & Pontone, G. (2024). *Artificial intelligence-guided quantitative coronary CT angiography for plaque analysis: Development and validation study*. *JACC: Cardiovascular Imaging*, 17(4), 512-524. <https://doi.org/10.1016/j.jcmg.2024.01.007>
12. Brady AP, Loewe C, Brkljacic B, Paulo G, Szucsich M, Hierath M, European Society of Radiology. Guidelines and recommendations for radiologist staffing, education, and training. *Insights into imaging*. 2025 Mar 12;16(1):57. <https://doi.org/10.1186/s13244-025-01926-6>
13. Brady AP, Paulo G, Brkljacic B, Loewe C, Szucsich M, Hierath M, European Society of Radiology. Current status of radiologist staffing, education, and training in the 27 EU Member States. *Insights into Imaging*. 2025 Mar 15;16(1):59. <https://doi.org/10.1186/s13244-025-01925-7>
14. Kido A, Ohno K, Yamada K, Yamakado K, Hiraki T, Mizowaki T, Aida N, Oyama-Manabe N, Kodama N, Ueda K, Aoki S. Overview of task shifting guidelines in Japan: from radiologists to radiological technologists. *Japanese Journal of Radiology*. 2025 May 5:1-8. <https://doi.org/10.1007/s11604-025-01774-w>
15. Luo J, Wan X, Du J, Liu L, Zhao L, Peng X, Wu M, Huang S, Nie X. Comprehensive multi-phase 3d contrast-enhanced CT imaging for primary liver cancer. *Scientific Data*. 2025 May 10;12(1):768. https://pmc.ncbi.nlm.nih.gov/articles/PMC12065907?utm_source=chatgpt.com
16. Davenport MS, Perazella MA, Yee J, Dillman JR, Fine D, McDonald RJ, Rodby RA, Wang CL, Weinreb JC. Use of intravenous iodinated contrast media in patients with kidney disease: consensus statements from the American College of Radiology and the National Kidney Foundation. *Radiology*. 2020 Mar;294(3):660-8. <https://doi.org/10.1148/radiol.2019192094>
17. McDermott MC, Wildberger JE, Bae KT. Critical but commonly neglected factors that affect contrast medium administration in CT. *Insights into Imaging*. 2024 Aug 28;15(1):219. <https://doi.org/10.1186/s13244-024-01750-4>
18. Keeffe N, Patel N, Mody P, Smith K, Quist-Nelson J, Kaufman C, Kohi M, Salazar G. Obstetric interventional radiology: periprocedural considerations when caring for the pregnant and postpartum patient. In *Seminars in Interventional Radiology* 2024 Aug (Vol. 41, No. 04, pp. 413-423). Thieme Medical Publishers, Inc. <https://doi.org/10.1055/s-0044-1790559>. ISSN 0739-9529
19. Dutruel SP, Hentel KD, Hecht EM, Kadam N. Patient-centered radiology communications: engaging patients as partners. *Journal of the American College of Radiology*. 2024 Jan 1;21(1):7-18. <https://doi.org/10.1016/j.jacr.2023.10.009>
20. Montesinos-Sansaloni EX, Ribeiro-Soriano D, Botella-Carrubi D. Innovation dynamics in public funding: a comparative analysis of social economy and capitalist organisations in public-private partnerships. *European Journal of Innovation Management*. 2025 Sep 25:1-22. <https://doi.org/10.1108/EJIM-02-2025-0166>
21. Ferede AA, Fetene MG, Mehretie EB, Getahun WT, Abneh AA. Knowledge and associated factors of patients toward informed consent in obstetric and gynecologic surgical procedures at Debre Markos Comprehensive Specialized Hospital, Ethiopia. *Frontiers in Surgery*. 2025 Jun 5;12:1472033. <https://doi.org/10.3389/fsurg.2025.1472033>
22. Böhm I, Nairz K, Morelli JN, Keller PS, Heverhagen JT. Iodinated contrast media and the alleged "iodine allergy": an inexact diagnosis leading to inferior radiologic management and adverse drug reactions. In *RöFo-Fortschritte auf dem Gebiet der Röntgenstrahlen und der bildgebenden Verfahren* 2017 Apr (Vol. 189, No. 04, pp. 326-332). © Georg Thieme Verlag KG. <http://dx.doi.org/10.1055/s-0042-122148>
23. Staniuk T, Małkowski B, Srutek E, Szlezak P, Zegarski W. Comparison of FLT-PET/CT and CECT in gastric cancer diagnosis. *Abdominal Radiology*. 2016 Jul;41(7):1349-56. <https://link.springer.com/article/10.1007/s00261-016-0647-5>
24. Li J, Wei WF, Song LN, Mei XY, Yuan XS, He JB, Jiang LZ, Li HY, Wu HL, Chen JP. Double low-dose computed tomography (CT) angiography of craniocervical arteries using a test bolus of diluted contrast medium and a personalized contrast protocol. *Clinical Radiology*. 2024 Nov 1;79(11):e1330-8. <https://doi.org/10.1016/j.crad.2024.07.021>
25. Tariq A, Ramasamy G, Patel B, Banerjee I. Self-supervised learning for chest computed tomography: training strategies and effect on downstream applications. *Journal of Medical Imaging*. 2024 Nov 1;11(6):064003. <https://doi.org/10.1117/1.JMI.11.6.064003>