

PERSPECTIVE ARTICLE

Clinical nursing interventions for iodine-123
imaging in radiation oncology: A reviewMarina Tatin* 

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Abstract

Iodine-123 (I-123) scintigraphy is a pivotal diagnostic and treatment planning tool in the management of thyroid cancer, neuroendocrine tumors, and certain motor disorders in the context of radiation oncology practice. This perspective article aims to synthesize the existing evidence on nursing interventions related to I-123 scintigraphy, including radiopharmaceuticals, radiation safety, patient education, and psychosocial interventions. It also highlights existing gaps in nursing practice guidelines for I-123 scintigraphy and provides evidence-based recommendations to address them. Well-designed nursing interventions play a crucial role in improving diagnostic image quality, patient compliance, safety, and occupational radiation exposure. With the increasing use of I-123 scintigraphy in theranostic cancer treatment strategies, advanced nursing competencies in nuclear medicine oncology practice are essential.

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1. Introduction

The diagnostic and therapeutic landscape of oncology has undergone significant changes due to advances in nuclear medicine imaging over the last two decades. Iodine-123 (I-123) is a gamma-ray emitter with a photon energy of 159 keV and a physical half-life of 13.2 h. It has become an indispensable tool in the surveillance of thyroid cancer, the localization of neuroendocrine tumors, and the assessment of neurological disorders in oncology patients.¹⁻⁵ I-123 is the preferred choice of the two isotopes due to its dosimetric advantages over I-131, especially when the therapeutic effect of the isotope is not the primary interest; the current standards for the production of I-123 radiopharmaceuticals also underscore its importance.⁴

The confluence of the diagnostic potential of I-123 imaging and the therapeutic potential of radiation oncology creates a clinical situation that requires nursing competencies to go beyond the realm of general oncology practice. Nurses who practice in nuclear medicine oncology settings must have a working knowledge of the kinetics of radiopharmaceuticals, the principles of radiation protection under the as low as reasonably achievable (ALARA) principle, and the psychosocial needs of the oncology patient who is to be staged or restaged.⁶⁻⁸ Despite the evident clinical need to address

I-123 imaging from a nursing practice perspective, the development of comprehensive nursing practice guidelines on the subject is still in its infancy.^{9,10}

This article aims to provide a structured narrative synthesis of the available literature. The author searched the literature in PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Cochrane Library using the medical subject headings (MeSH) terms, such as “iodine-123,” “nuclear medicine nursing,” “radiation oncology nursing,” and “radiopharmaceutical,” as well as their combination. The search period was set to 2000–2025. However, preference was given to evidence published after 2015 to include the current practice. The gray literature was supplemented with publications from the Society of Nuclear Medicine and Molecular Imaging (SNMMI), the European Association of Nuclear Medicine (EANM), the International Commission on Radiological Protection (ICRP), and the World Health Organization (WHO). Only the publications directly relevant to the practice of nursing in I-123 imaging and radiation oncology were included. The publications that did not provide direct relevance to the practice but merely reiterated the content were excluded. A total of 127 publications were included after initial screening of over 200 publications.

Similar reviews in this area are limited. Moskalenko *et al.*⁶ surveyed the practice among the United States' population of radiation oncology nurses and found that the majority had no formal education in nuclear medicine concepts but routinely handled radioactive materials. Harr *et al.*⁷ published the most recent study on role delineation for radiation oncology nursing staff in 2024 and documented the evolution of the role delineation study to include current competency domains such as nuclear medicine and theranostic nursing practice. Kelvin *et al.*¹¹ documented the role and scope of advanced practice nurses in radiation oncology and the expanding roles and responsibilities along the care continuum, but did not include I-123 imaging. Similarly, Carper and Haas¹² documented the increasing role and responsibilities of oncology advanced practice nurses in radiation oncology. However, none of the reviews have attempted to synthesize the evidence available for practice in the continuum of I-123 imaging procedures in radiation oncology (Figure 1).

2. Radiopharmaceutical fundamentals and nursing implications

A basic understanding of the physicochemical properties of I-123 is considered essential for nurses practicing in nuclear medicine oncology departments.^{4,13,14} I-123 has a decay mode dominated by electron capture, emitting gamma photons at 159 keV, with a physical half-life of

13.2 h.¹⁴ These properties provide excellent imaging characteristics and keep patient doses lower than those of I-131, which is why I-123 is the preferred isotope in nuclear medicine for strictly diagnostic procedures. However, the production of I-123 radiopharmaceuticals must meet stringent requirements to allow for the desired imaging and keep patient doses as low as possible.⁴ The behavior of the isotope in the body is determined by the carrier molecule, and sodium ¹²³I-iodide is used to image the thyroid gland via the sodium-iodide symporter in the assessment and treatment of differentiated thyroid carcinoma and metastatic thyroid cancer in accordance with EANM and American Thyroid Association guidelines.^{1,15,16} Metaiodobenzylguanidine (MIBG), labeled with I-123, is used to image the norepinephrine transporter in neuroendocrine cells and is employed in the assessment of pheochromocytoma, paraganglioma, and neuroblastoma in accordance with EANM/SNMMI procedural guidelines.^{17,18} A comprehensive and relevant article on the use of I-123 MIBG in nuclear oncology and its implications for nursing practice is provided by Chang *et al.*⁵ I-123 ioflupane (DaTscan), which is used to assess the dopamine transporter in the brain to investigate movement disorders, is covered in the Society of Nuclear Medicine (SNM) practice guideline for dopamine transporter imaging.^{2,19,20}

Pre-administration nursing assessment should include medication reconciliation, with special attention to medications known to affect radiopharmaceutical uptake and biodistribution (Table 1). The SNMMI/American College of Nuclear Medicine (ACNM) practice guideline for radiopharmaceutical use.³ and the SNM guideline for dopamine transporter imaging² identify medications, such as amphetamines, cocaine, methylphenidate, bupropion, and certain antidepressants, that can degrade the quality of the DaTscan study.² For thyroid scintigraphy, iodine-containing contrast media, antithyroid medications, amiodarone, and iodine-containing supplements should also be reviewed systematically prior to the administration of radioiodine.^{1,15}

Radiopharmaceutical administration is a critical nursing procedure requiring strict adherence to both radiation safety and accuracy protocols.^{3,4,21,22} Administration via the intravenous (IV) route should adhere to the standard requirements for venous access, including the verification of the IV line's patency. Extravasation of the radioactive tracer poses two hazards: degraded image quality and radiation damage to soft tissue. Standardized extravasation management and monitoring protocols should be implemented to track such adverse reactions^{23,24} The quality control aspects of radiopharmaceutical use

and administration relevant to nurses' roles have been well covered in the study by Lego⁴ and the SNMMI/ACNM practice guideline for the use of radiopharmaceuticals.³

For oral administration of sodium ¹²³I-iodide, the timing of administration relative to meals, the positioning of the patient, and the verification of ingestion of the full dose must be addressed by the nurses.^{1,15} Capsule forms of the drug have the advantages of reduced contamination risk and ease of handling, but the patient must be assessed individually before administration can continue. Patients may have difficulty ingesting the capsule if they have dysphagia, cognitive impairments, severe levels of anxiety, or physical limitations that affect their ability to swallow the capsule safely or may need modifications to the drug or assistance to ingest the capsule safely. The nurses must also verify that the patient is capable of safely ingesting the capsule without difficulty, as this could affect the dose of the drug and the pattern of iodine uptake that may be inadvertently induced if the patient chews the capsule or the drug is crushed to facilitate ingestion.

Liquid sodium ¹²³I-iodide formulations impose additional but equally crucial nursing responsibilities. When using liquid radioiodine formulations, a radioactive material preparation area is required, along with an absorbent bench covering and special personal protective equipment to minimize the risk of skin and surface contamination. Because the liquid formulation is drawn from a stock container, the nurse is also required to ensure that the amount of radioactivity drawn is within the acceptable tolerance of the prescription when it is given to the patient. The nurse is required to ensure that the patient ingests the full amount of the radioactive solution directly observed, as any remaining amount in the cup is an unquantifiable decrease in the amount of radioactivity delivered, directly affecting the diagnostic capability of the patient. Finally, the administration equipment is required to be discarded in labeled containers for radioactive waste in a timely manner, as required by the institution's radiation safety policy and regulatory requirements.^{3,25}

3. Radiation safety and protection in nursing practice

Nursing practice in I-123 imaging facilities must be carried out with strict adherence to the ALARA principle, as emphasized in ICRP Publication 103 and reinforced by WHO recommendations on the development of a radiation safety culture in health care facilities.^{26,27} The three cardinal principles of radiation protection—time, distance, and shielding—have practical implications in the day-to-day activities of nurses. The time factor requires nurses to minimize time spent in close contact with the

radioactive patient; the distance factor requires nurses to maintain the maximum feasible distance; and the shielding factor requires nurses to use shielding devices, such as syringe shields and lead shields^{6,22,28} (Figure 2).

Personal dosimetry must be worn by nurses dealing with unsealed radioactive materials.^{4,25} The thermoluminescent dosimeters, or optically stimulated luminescence dosimeters, worn by the nurses around their necks can provide cumulative dose data, which will be used to calculate the total body dose, as required by regulatory authorities.^{25,27,29} The ring dosimeters must be worn by nurses dealing with radiopharmaceuticals, as the dose to the hands of the nurses, which is the extremity dose, can be equal to the whole-body dose.^{27,29} Moskalenko *et al.*⁶ revealed a lack of education in radiation safety among radiation oncology nurses in the United States, providing a strong empirical base to change the curriculum.

Contamination control requires nurses to be more active in radiation protection, as I-123 preparations can cause skin, clothing, environmental, and excretory contamination if radioactive materials are not handled correctly.^{22,25} The radioactive material handling area, proper use of personal protective equipment, and decontamination of radioactive materials can limit the spread of contamination. The patient must be educated regarding the precautions to prevent the spread of radioactive contamination, such as the excretion of I-123 compounds, which is the major route of excretion and causes the greatest contact exposure to family members after discharge from the hospital.^{1,30}

Table 2 presents the radiation safety checklist to be used by nurses, as mentioned in the various sections of the manuscript.

Pregnant patients need an individualized nursing assessment prior to any radiopharmaceutical administration. Pregnancy screening by history and urinalysis is part of standard practice prior to all I-123 procedures.^{1,31} I-123 readily crosses the placenta and localizes in the fetal thyroid gland after 12 weeks of gestation, posing a risk of thyroid dysfunction and hypothyroidism in the developing fetus.^{15,32} Lactating patients must also be individually assessed because I-123 can be excreted into breast milk. Current SNMMI recommendations indicate that breastfeeding should be stopped after 24 hours of sodium ¹²³I-iodide administration for diagnostic procedures.^{27,33}

Pediatric patients pose different challenges in radiation protection and need specialized nursing approaches.^{5,34} Children are more radiosensitive than adults because their cells have higher growth rates and their longer lifespan makes them more susceptible to stochastic effects of ionizing radiation. Weight-based or body-surface-area

dosing of radiopharmaceuticals, according to the 2016 North American Consensus Guidelines and the EANM pediatric dosage card, minimizes dose while maintaining image quality in pediatric patients.^{35,36} Nursing practices that decrease procedure time and eliminate the need for repeat procedures through proper patient preparation and immobilization are also important in minimizing pediatric radiation dose.^{34,37}

4. Patient education and psychosocial support

Structured patient education is a fundamental component of the nursing role throughout the I-123 imaging procedure.^{38–40} The content of this education must be appropriate to the procedure, the agent used, and the patient's needs, and must include expectations for the procedure, preparation requirements, radiation precautions, and timeframes of the procedure and communication of results. There is consistent evidence that effective pre-procedure education is associated with reduced procedural anxiety, improved compliance, and increased patient satisfaction.³⁹

There is significant variability in how patient education is conducted, which affects the outcome of the procedure. Some nuclear medicine departments provide written education to patients at the time of scheduling the procedure, while others provide verbal education immediately preceding the procedure. Neither of these methods is adequate for educating the patient who is to receive the I-123 procedure, given the complex nature of the preparation requirements and the fact that changes in medications may require days to weeks of lead time to implement.^{1,41} Bolderston⁴² found a significant difference between what the staff of the radiation therapy department believed the patient understood and what the patient perceived as necessary to know, which has significant implications for the nuclear medicine nursing role. The comfort of patients during preparation time is related not only to the education provided but also to the relational style in which it is provided. Patients who report that their nurse is friendly and knowledgeable have significantly reduced procedural anxiety and improved compliance.³⁹

Pre-procedure education should be provided far in advance of the imaging procedure to permit time for any necessary adjustments in medications or diet. For thyroid imaging that involves withdrawal of thyroid hormones, nurses should prepare the patient for the effects of hypothyroidism, such as fatigue, cold intolerance, weight gain, and cognitive slowness, all of which can impact the patient's quality of life during the period of thyroid hormone withdrawal, which can be several weeks for

some patients.^{15,41} For the DaTscan, nurses should counsel the patient regarding the need for temporary cessation of medications that interfere with dopamine transporter binding sites, an important component of the imaging procedure that has the potential for impacting the patient's quality of life during the period of time before the imaging procedure, as some of these medications may need to be stopped for several days or more before the imaging procedure is scheduled.^{2,20} Table 3 presents the post-procedure discharge checklist, the operational component of the educational process.

The psychological burden of nuclear medicine imaging within an oncology context is substantial and warrants direct nursing attention.^{45–47} Patient concerns about radiation exposure, unfamiliarity with gamma camera equipment, procedural discomfort, and the prognostic weight of imaging results in the restaging setting all contribute to clinically meaningful anxiety. Cancer-related distress is prevalent across oncology populations and complicates the education encounter.^{45,46} Abel *et al.*⁴⁸ noted that psychosocial distress in patients undergoing cancer treatment is frequently underestimated by clinical staff, a finding applicable to patients proceeding through nuclear medicine imaging. Nursing communication, timely disclosure of information, and referral to psychosocial support services are evidence-based responses to this burden.^{49,50} Part of the nursing role in this context is normalizing patient concerns about radiation while providing accurate and proportionate risk information.

Cultural competency in the delivery of patient education involves adapting communication to linguistically and culturally diverse patient populations.^{51,52} This requires the use of professional interpreter services rather than ad hoc family interpretation when language barriers arise. There may be cultural beliefs regarding radiation, cancer, and procedures the patient may undergo, and the nurses need to be prepared to deal with these issues in an appropriate manner. Health literacy assessment needs to be considered in the selection of appropriate and accessible educational materials. Nuclear medicine procedures have complex concepts, including radiation dose, biodistribution, and the duration of post-procedure precautions, which may be difficult to understand for less health-literate patients. There is evidence to support the use of plain language and the need to “teach-back” to ensure understanding despite literacy levels.^{43,44,53}

5. Skin care and symptom management in radiation oncology

Regarding the patient receiving external beam radiation therapy with or after I-123 imaging, the nursing

management of radiation-induced dermatitis has been identified as a critical evidence-based practice domain.^{38,54,55} Radiation dermatitis is a common occurrence in the majority of patients receiving external beam radiation therapy, and can vary from mild erythema to moist desquamation requiring extensive wound care.⁵⁶⁻⁵⁸ Bauer *et al.*³⁸ and Morley *et al.*⁵⁹ identified evidence-based nursing interventions to facilitate patient adherence to skin care practices, emphasizing the need to develop a protocol to reinforce their importance throughout the treatment period.

Patient education regarding skin care practices, such as the use of mild soap, water, topical moisturizers, avoidance of skin irritants, and protection from the sun, has been identified as an essential component of the management of radiation-induced dermatitis.^{54,60,61} The nurses need to be updated regarding the evidence supporting the use of topical agents, as well as the institutional protocol, which includes recommendations from the Multinational Association of Supportive Care in Cancer (MASCC) Skin Toxicity Study Group.⁵⁵

Fatigue is the most frequently reported symptom among patients undergoing radiation therapy, which necessitates assessing fatigue severity with tools, educating patients on fatigue management, and referring patients to an exercise program when appropriate.⁶²⁻⁶⁴

The management of nausea and vomiting associated with the administration of radiation therapy to the abdomen, pelvis, or craniospinal axis is achieved through the administration of antiemetics that are prophylactic, nutritional education, and the establishment of rescue therapy, which may be complicated when chemotherapy is given concurrently with the radiation therapy^{65,66} (Table 4).

Radiation-induced mucositis is a significant problem that affects the quality of life of patients undergoing head and neck irradiation, compromising nutritional intake and the tolerability of the therapy.⁶⁷⁻⁶⁹ An evidence-based nursing management of mucositis has been provided by Tian *et al.*⁶⁷, which should be initiated at the onset of therapy rather than at the onset of the problem. Radiation-induced diarrhea is a problem that affects the quality of life of patients undergoing pelvic irradiation and is managed through dietary education, drug therapy, and assessment for dehydration and electrolyte imbalance.^{70,71}

6. Brachytherapy nursing and quality-of-life considerations

Brachytherapy nursing is a domain of practice that has operational overlap with nuclear medicine, especially with respect to principles of radiation safety.^{48,72,73}

Treatment outcomes and quality-of-life issues related to brachytherapy were characterized by Abel *et al.*⁴⁸, providing useful information to guide the development of nursing assessment tools for this patient population. The procedure of implanting radioactive seeds into the tumor site requires nursing staff to be familiar with the principles of radiation safety from a sealed source, which is equivalent to the principles of radiation safety used in nuclear medicine.^{72,73}

Sexual function assessment was found to be a sensitive but clinically relevant component of nursing practice following brachytherapy, as defined by Stipetich *et al.*⁷⁴ Nurses must be skilled communicators, knowledgeable about the sexual side effects of therapy across all modalities, and ready to facilitate referrals to appropriate resources.^{75,76} Radiation safety education of the patient to be discharged following permanent implant brachytherapy is very similar to that used to educate the patient following nuclear medicine therapy with a therapeutic dose of radioactivity. Patients who have undergone permanent seed implant brachytherapy remain radioactive until the seeds have lost their radioactivity and must be counseled on precautions to avoid close contact with pregnant women and young children.^{48,77}

Quality-of-life assessment using instrument-based tools to measure domain-specific quality of life helps monitor the patient's urinary, bowel, and sexual functioning following prostate brachytherapy, as well as the appropriate domains following brachytherapy to other sites.⁷⁸⁻⁸⁰ Future longitudinal assessment helps guide the nursing care plan of the patient undergoing brachytherapy. For gynecologic brachytherapy, studies have recently characterized current nursing care requirements, including pre-procedure preparation, intraprocedure pain management and positioning, bladder care, and post-procedure symptom management.⁸¹⁻⁸³

7. Integration of I-123 imaging with radiation oncology treatment planning

The relationship between I-123 imaging and the treatment planning process in radiation oncology has substantial care coordination requirements for nurses practicing in this area.⁸⁴⁻⁸⁶ This is because the results of the imaging have a direct impact on the target volume definition, dose prescription, and treatment technique selection in radiation oncology, and the quality of nursing preparation for the imaging study has practical consequences on the precision of the treatment planning process.^{87,88}

Single-photon emission computed tomography/computed tomography (SPECT/CT) imaging has an established and expanding application in the radiation treatment planning process, and its use in breast cancer

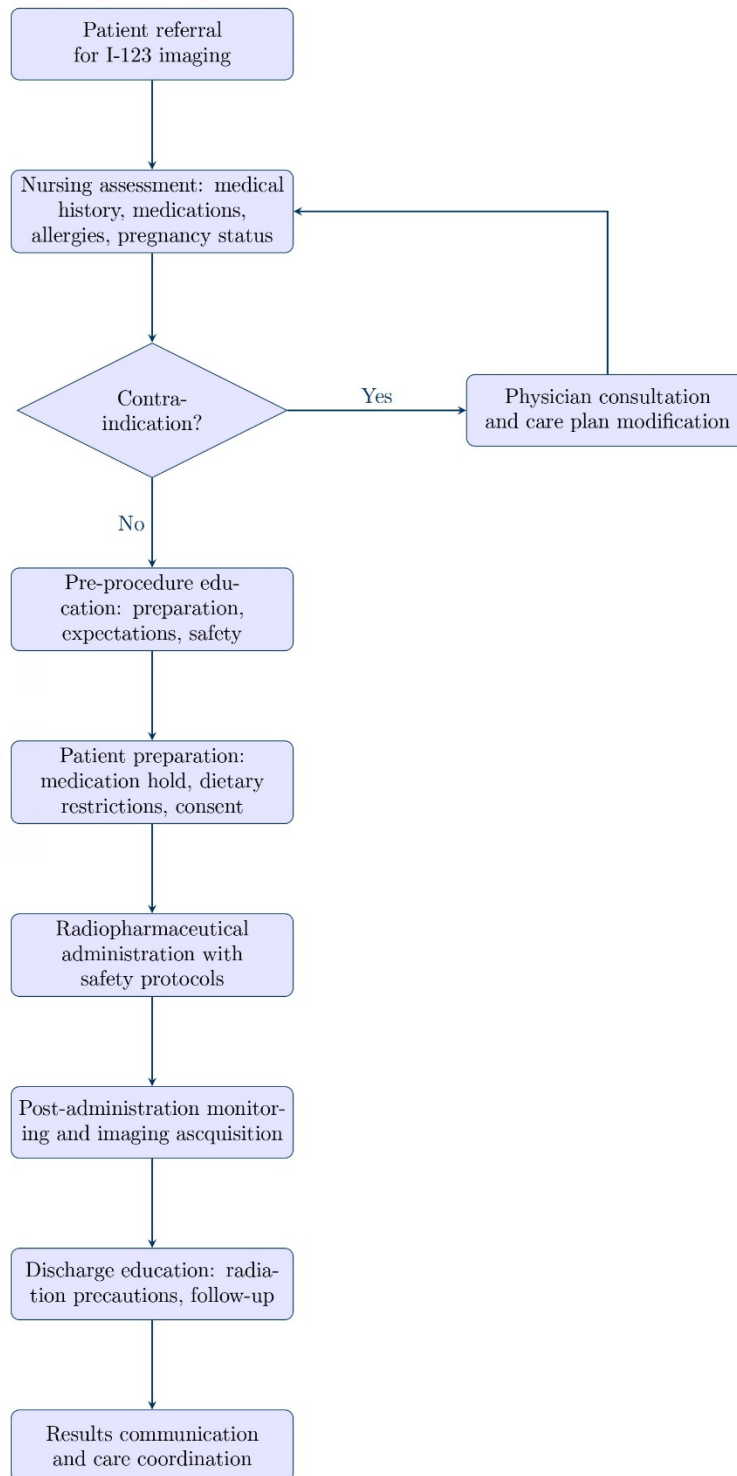


Figure 1. Clinical nursing workflow for I-123 imaging in radiation oncology settings. Image created by the authors with LabNinja and Latex.

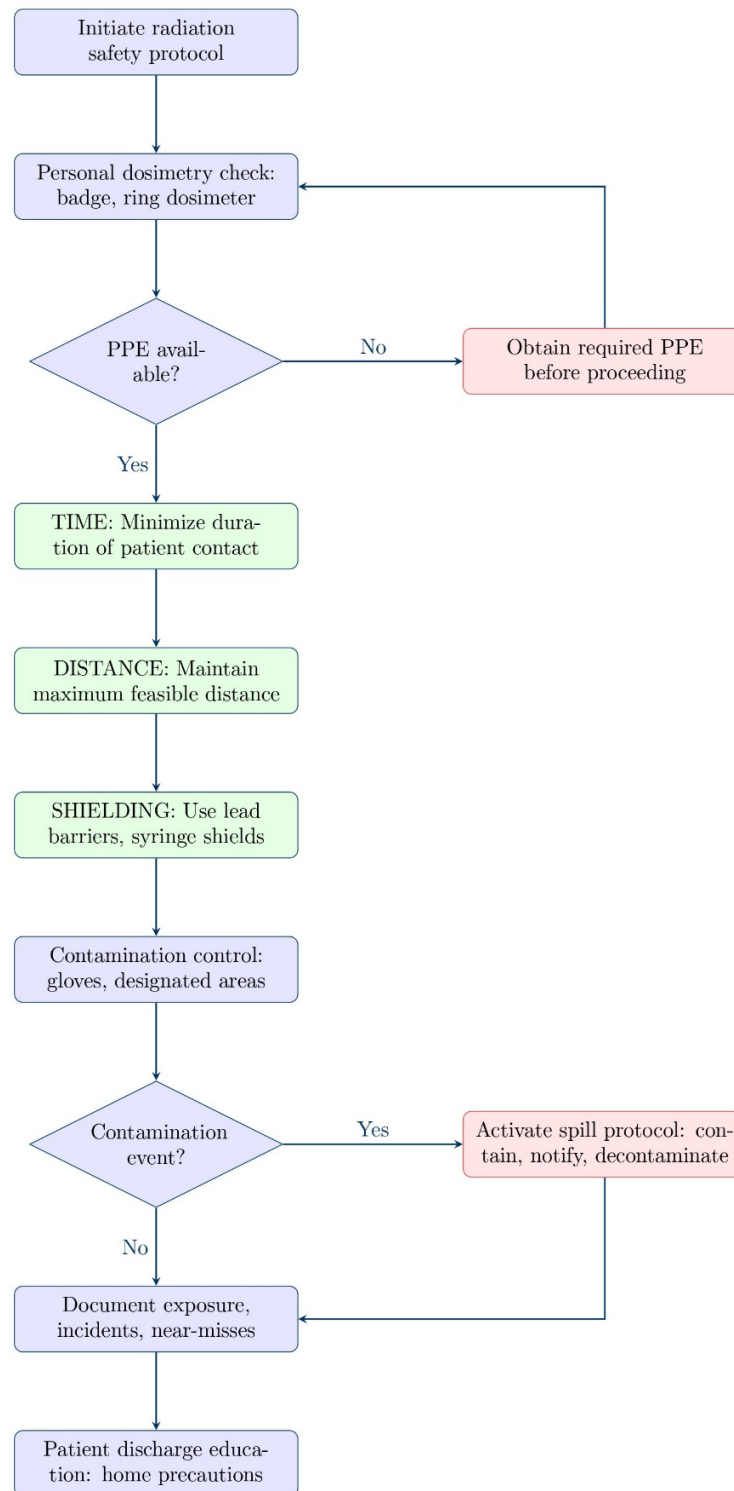


Figure 2. Radiation safety protocol framework for nursing practice in I-123 imaging. Image created by the authors with LabNinja and Latex. Abbreviation: PPE: Personal protective equipment.

Table 1. Pre-procedure nursing assessment checklist for I-123 imaging

Assessment item	Yes	No/NA
Patient identification and consent		
Patient identity confirmed with two identifiers	<input type="checkbox"/>	<input type="checkbox"/>
Informed consent obtained and documented	<input type="checkbox"/>	<input type="checkbox"/>
Patient understands the procedure's purpose and expected duration	<input type="checkbox"/>	<input type="checkbox"/>
Medical history		
Allergy history reviewed (e.g., iodine, contrast agents, medications)	<input type="checkbox"/>	<input type="checkbox"/>
Previous nuclear medicine studies documented	<input type="checkbox"/>	<input type="checkbox"/>
Thyroid disease history documented (thyroid imaging only)	<input type="checkbox"/>	<input type="checkbox"/>
Neurological history documented (DaTscan only)	<input type="checkbox"/>	<input type="checkbox"/>
Pregnancy and lactation screening		
Last menstrual period documented	<input type="checkbox"/>	<input type="checkbox"/>
Urine pregnancy test performed and a negative result confirmed (where applicable)	<input type="checkbox"/>	<input type="checkbox"/>
Lactation status assessed; breastfeeding interruption counseling provided if applicable	<input type="checkbox"/>	<input type="checkbox"/>
Medication reconciliation		
Medication list reviewed against procedure-specific interference guide (Table 5)	<input type="checkbox"/>	<input type="checkbox"/>
Medication hold instructions confirmed with patient; physician consulted if uncertain	<input type="checkbox"/>	<input type="checkbox"/>
Iodine-containing supplements or contrast agents discontinued per protocol	<input type="checkbox"/>	<input type="checkbox"/>
Patient preparation		
Fasting requirements met (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>
Low-iodine dietary requirements confirmed (thyroid imaging only)	<input type="checkbox"/>	<input type="checkbox"/>
Hydration status assessed; IV access confirmed or established as required	<input type="checkbox"/>	<input type="checkbox"/>
Ability to swallow capsule intact confirmed (oral sodium ¹²³ I-iodide only)	<input type="checkbox"/>	<input type="checkbox"/>
Positioning tolerance and claustrophobia concerns addressed	<input type="checkbox"/>	<input type="checkbox"/>

Abbreviation: IV: Intravenous; NA: Not available.

patients has been demonstrated to have advantages over conventional treatment planning in target volume definition.⁸⁴ This modality has also been demonstrated to have advantages in reducing normal tissue irradiation to high doses in radiation oncology.^{86,89} Nurses providing care to patients during the pre-imaging process need to be aware of the requirements of the procedures in nuclear medicine and radiation oncology.

The theranostic model of care, in which the results of I-123 MIBG imaging are used to select appropriate patients for subsequent I-131 MIBG therapy and to guide treatment planning, is the most significant model integrating nuclear medicine and radiation oncology in the treatment of cancer.^{5,85} Studies have specifically investigated the use of I-123 MIBG imaging to calculate dosimetry for treatment planning, compared with post-therapy I-131 MIBG imaging, in patients undergoing high-dose MIBG therapy for cancer, with substantial implications for nursing care

during treatment and follow-up.^{85,90,91} This nursing care has to consider the results of the imaging study and the requirements of the radiation oncology treatment and follow-up processes in the subsequent treatment phase.^{92,93}

The residual radioactivity from the recent I-123 diagnostic procedure can also pose radiation safety issues during the radiation therapy simulation if the two procedures occur in close temporal proximity.^{94,95} Nursing communication with the simulation staff regarding the timing and the agent of the recent nuclear medicine studies is an important but often neglected dimension of care coordination. Nursing participation in tumor conferences during which imaging results often dictate treatment decisions is an evolving role for the advanced practice nurse and requires education regarding the implications and results of imaging studies.^{7,96-98} Care coordination and participation in treatment planning discussions were identified in the 2023 role delineation study by Harr *et*

Table 2. Radiation safety compliance checklist for nursing staff

Safety item	Compliant	No/NA
Personal dosimetry		
Whole-body dosimeter worn at collar level	<input type="checkbox"/>	<input type="checkbox"/>
Ring dosimeter worn during radiopharmaceutical administration	<input type="checkbox"/>	<input type="checkbox"/>
Dosimetry readings reviewed; within regulatory limits	<input type="checkbox"/>	<input type="checkbox"/>
Personal protective equipment		
Disposable gloves worn and changed between patients	<input type="checkbox"/>	<input type="checkbox"/>
Lead syringe shield and L-block used for all injections	<input type="checkbox"/>	<input type="checkbox"/>
Thyroid shield available where institutional protocol requires	<input type="checkbox"/>	<input type="checkbox"/>
ALARA practice		
Procedure planned to minimize contact time with radioactive patient	<input type="checkbox"/>	<input type="checkbox"/>
Maximum feasible working distance maintained throughout care	<input type="checkbox"/>	<input type="checkbox"/>
Shielding positioned appropriately for the procedure type	<input type="checkbox"/>	<input type="checkbox"/>
Contamination control		
Designated area prepared with absorbent bench covering	<input type="checkbox"/>	<input type="checkbox"/>
Pre-procedure contamination survey completed and documented	<input type="checkbox"/>	<input type="checkbox"/>
Radioactive waste containers available, labeled, and accessible	<input type="checkbox"/>	<input type="checkbox"/>
Spill kit stocked; staff aware of decontamination procedure	<input type="checkbox"/>	<input type="checkbox"/>
Emergency preparedness		
Radiation safety officer contact number posted in work area	<input type="checkbox"/>	<input type="checkbox"/>
Extravasation management protocol accessible and current	<input type="checkbox"/>	<input type="checkbox"/>
Decontamination procedures reviewed with staff at start of shift	<input type="checkbox"/>	<input type="checkbox"/>

Abbreviation: ALARA: As low as reasonably achievable; NA: Not available.

al.⁷ as an evolving core competency for advanced practice nurses in radiation oncology and represent a significant evolution in the practice patterns described in the earlier surveys. The role of advanced practice nurses in radiation oncology was also described by Kelvin *et al.*¹¹ as expanding to include patient triage, treatment decision support, and care continuity across modalities.

8. Quality improvement and outcomes monitoring

Systematic quality improvement is a vital process for advancing nursing practice in the provision of I-123 imaging services.^{4,6,99} Process metrics such as repeat-procedure rates, radiopharmaceutical adverse-event rates, and patient complaints are quality indicators that can be monitored and reported by nursing staff.^{100,101} The standardization of the receipt, storage, preparation, and administration of radiopharmaceuticals can be carried out more consistently.^{3,102}

Using patient-reported experience measures to evaluate

the care a patient receives can provide information on the intangible aspects of care that process metrics cannot provide.^{103,104} Patient communication, anxiety, and the perceived safety of the procedure are experience measures relevant to the provision of care in nuclear medicine imaging, as the patient may be anxious about the use of radiation in the process.

Using outcomes from I-123 imaging to evaluate the care a patient receives can help understand the long-term relationship between the quality of the imaging and outcomes in oncology.^{84,85} Nursing documentation is a key source of information for analyzing the long-term relationship between imaging quality and oncology outcomes.

Adverse event reporting and analysis are key processes in the provision of quality care that require active participation by nursing staff.^{6,105} Adverse reactions to radiopharmaceuticals, extravasation, contamination, and falls that occur during the process can be documented and used to improve the quality of care delivered to

Table 3. Post-procedure patient discharge checklist

Discharge item	Done	No/NA
Immediate post-procedure assessment		
Vital signs within normal limits; injection site assessed	<input type="checkbox"/>	<input type="checkbox"/>
No immediate adverse reactions observed	<input type="checkbox"/>	<input type="checkbox"/>
Patient tolerating oral intake	<input type="checkbox"/>	<input type="checkbox"/>
Radiation precaution education (confirmed by teach-back)		
Duration of radiation precautions explained (typically 24 h for diagnostic I-123)	<input type="checkbox"/>	<input type="checkbox"/>
Distance precautions for pregnant women, infants, and young children explained	<input type="checkbox"/>	<input type="checkbox"/>
Hydration and frequent voiding instructions provided to accelerate renal elimination	<input type="checkbox"/>	<input type="checkbox"/>
Hand hygiene after toilet use emphasized	<input type="checkbox"/>	<input type="checkbox"/>
Lactation instructions (if applicable)		
Breastfeeding interruption period explained (24 h for sodium ¹²³ I-iodide)	<input type="checkbox"/>	<input type="checkbox"/>
Breast milk expression and discarding instructions provided	<input type="checkbox"/>	<input type="checkbox"/>
Formula or pumped-milk alternatives discussed with patient	<input type="checkbox"/>	<input type="checkbox"/>
Follow-up and documentation		
Results communication timeline explained to patient	<input type="checkbox"/>	<input type="checkbox"/>
Follow-up appointment scheduled or self-scheduling instructions provided	<input type="checkbox"/>	<input type="checkbox"/>
Written discharge instructions given in patient's preferred language	<input type="checkbox"/>	<input type="checkbox"/>
Emergency contact numbers provided	<input type="checkbox"/>	<input type="checkbox"/>
Procedure and education documented in medical record	<input type="checkbox"/>	<input type="checkbox"/>

Abbreviation: NA: Not available.

patients.^{23,105–107} Near-miss reporting, as used in other disciplines, can provide a system that learns without waiting for an adverse event to occur.^{106,107} Table 5 lists the medication washout periods by procedure type. The nurse provides the final check for drug interactions and should be aware of the growing list of interfering medications.^{3,21}

Technology is changing the face of the nuclear medicine practice environment and has created new nursing practice implications.^{5,108,109} Quantitative SPECT/CT systems provide enhanced anatomical localization and diagnostic information, with direct implications for nursing care related to the imaging procedure.^{108,109} The theranostic landscape is expanding to include new agents, such as lutetium-177 DOTATATE for neuroendocrine tumors, lutetium-177 PSMA for metastatic prostate cancer, and the iodine theranostic pair, creating substantive new nursing practice demands in both the diagnostic and therapeutic settings.^{110–113} The theranostic nursing role demands competence in I-123 diagnostic imaging, therapeutic radiopharmaceuticals, radiation isolation, and toxicity management.

Artificial intelligence in the interpretation of nuclear medicine imaging provides opportunities to improve

diagnostic accuracy and efficiency. However, the roles of the nurse and the patient also become issues to be clarified in the use of artificial intelligence in the imaging process and the implications for the nursing role, patient education, and communication.^{114,115} Telehealth enables the nursing role to extend beyond the imaging procedure to include education and monitoring before and after the procedure.^{7,116,117} Personalization of dosimetry in the radiopharmaceutical process creates individual parameters for care and education to be incorporated into the nursing role and process.^{118,119}

9. Recommendations for practice advancement

Based on the synthesis, several priority recommendations emerge to advance the practice of nursing in I-123 imaging and radiation oncology:

- (i) Development of a competency framework: Professional nursing associations in partnership with SNMMI and EANM should develop a specialty competency framework in nuclear medicine oncology nursing. Harr *et al.*⁷ identified care coordination, theranostic patient management, and radiation safety as areas that

Table 4. Radiation oncology treatment symptom assessment tool

Symptom	None (0)	Mild (1)	Moderate (2)	Severe (3)/Action required
General				
Fatigue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nausea/Vomiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Appetite change/Weight loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sleep disturbance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skin				
Erythema	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dry desquamation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Moist desquamation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pruritus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pain at treatment site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oral and gastrointestinal				
Oral mucositis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dysphagia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Xerostomia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diarrhea/Constipation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Psychosocial				
Anxiety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Depression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Distress related to imaging results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

should be included in the competency framework of the radiation oncology nurse. However, they found that the areas were not adequately addressed in the curriculum. Moskalenko *et al.*⁶ found that fewer than half of the surveyed radiation oncology nurses were taught radiation physics or radiopharmaceutical pharmacology in their foundational education.

- (ii) Interprofessional education: Collaborative learning among students in nursing, nuclear medicine technology, medical physics, and radiation oncology has been recognized to enhance interprofessional functioning and professional role clarification.^{6,120,121}
- (iii) Nursing research investment: The scarcity of nursing-specific research in I-123 imaging, consistently evident

Table 5. Medication interference reference guide for I-123 imaging procedures

Procedure	Interfering agents (representative examples) and recommended hold period
Thyroid scintigraphy	Levothyroxine (T4; 4–6 weeks), liothyronine (T3; 2 weeks), antithyroid drugs (PTU, methimazole; 3–5 days), amiodarone (3–6 months), iodinated contrast media (6–8 weeks), iodine supplements or kelp (2–4 weeks)
DaTscan (ioflupane)	Amphetamines (2 weeks), methylphenidate (2 weeks), cocaine (2 weeks), bupropion (1–2 weeks), modafinil (1–2 weeks), phentermine (1–2 weeks), benzatropine (5 days), mazindol (2 weeks)
MIBG scintigraphy	Tricyclic antidepressants (2 weeks), sympathomimetics (2 weeks), reserpine (2 weeks), labetalol (3 days), calcium channel blockers (consult physician)

Notes: This guide reflects current SNMMI and EANM procedure guidelines. Specific discontinuation decisions should be made in consultation with the referring physician and nuclear medicine specialist, balancing imaging quality requirements against individual patient safety considerations. This table is a clinical reference aid and does not replace institutional protocols or specialist judgment.

Abbreviations: EANM: European Association of Nuclear Medicine; MIBG: Metaiodobenzylguanidine; PTU: Propylthiouracil; SNMMI: Society of Nuclear Medicine and Molecular Imaging.

across the literature reviewed here, represents a gap that calls for targeted investment. Priority research questions include the effectiveness of structured nursing intervention programs on image quality and patient outcomes, optimal educational modalities for patients undergoing radiopharmaceutical procedures, and the impact of nursing-led care coordination in theranostic programs.^{7,124}

(iv) Policy and scope of practice advocacy: Nursing participation in professional society committees, regulatory processes, and institutional policy development processes is essential to ensure that the unique contributions of the registered nurse are reflected in the practice standards and resource allocation in nuclear medicine oncology.^{6,7,125–127}

10. Conclusion

Nursing care for patients undergoing I-123 imaging in radiation oncology requires a challenging combination of technical skills, radiation safety expertise, patient education, and psychosocial support. What is needed to be effective in this field goes far beyond the general educational requirements of the oncology nurse, and this difference underscores the need for specialized educational programs designed to validate the competency of the oncology nurse. There is evidence of the positive effects of nursing intervention programs on the quality of diagnostic images, patient adherence to treatment, patient safety, and patient satisfaction.

Professional society practice guidelines, such as the SNM practice guideline for dopamine transporter imaging, the EANM/SNMMI thyroid imaging guideline, and the SNMMI/ACNM practice guideline for radiopharmaceutical use, offer a procedural approach to nuclear medicine imaging, although there is a scarcity of evidence to support the effectiveness of these interventions from a nursing perspective. The theranostic era is moving rapidly, and the I-123/I-131 pairing, as well as the radioligand therapies, has the potential to create a new competency model of the nuclear medicine oncology nurse. This requires a new investment of effort in education, interprofessionalism, and a genuine desire to conduct nursing research.

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