

Society of Nuclear Medicine Procedure Guideline for the Use of Radiopharmaceuticals

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I. Purpose

This guideline was developed by the Society of Nuclear Medicine to describe important factors common to most nuclear medicine procedures. It is intended to guide nuclear medicine practitioners in establishing policies and procedures for the use of radiopharmaceuticals in clinical practice. This guideline is intended to be concordant with the regulations of the Nuclear Regulatory Commission (NRC) and other state and federal government agencies.

II. Background Information and Definitions

- A. Radiopharmaceuticals (also known as radioactive drugs) are drugs that contain radionuclides that emit radiation(s). The distribution of the radiopharmaceutical within the body is determined by the physicochemical properties of the drug, the stability of the radiolabel, the purity of the radiopharmaceutical preparation, the pathophysiological state of the patient and the presence or absence of interfering drugs. Dynamic and static images of the distribution of the radiopharmaceutical within the body can be obtained using a gamma camera, or other suitable instrument appropriate for the radiopharmaceutical being imaged, e.g., positron emitting radiopharmaceuticals. Measurement of radioactivity in specified sites of accumulation or in biological samples following administration of the radiopharmaceutical can be performed for non-imaging procedures. High dose, nonpenetrating radiation in localized sites of accumulation of the radiopharmaceutical can be useful for therapeutic procedures.
- B. Physiologic and pharmacologic interventions are procedures, which increase the sensitivity and/or specificity of a nuclear medicine procedure

by affecting the distribution and pharmacokinetics of the administered agents through an alteration in organ physiology.

III. Common Indications

Any procedure which uses a radiopharmaceutical (see specific procedure guideline).

IV. Procedures

A. Clinical Use of Radiopharmaceuticals

1. A physician-derived order (e.g., prescription, requisition) is required for the conduct of all procedures. The order should specify the procedure desired, the drug(s) to be used, the amount(s) to be administered, the route of administration, and, if applicable, the rate of infusion. Alternately, the order may specify a standard procedure with the other required information, i.e., standing orders, specified in a routinely updated and physician-approved procedure manual located within the nuclear medicine laboratory.
2. The prescribing physician is ultimately responsible for the safety, quality, and correctness of all radiopharmaceuticals prepared and dispensed for administration under his (her) direction.
3. The nuclear pharmacist is ultimately responsible for the safety, quality and correctness of radiopharmaceuticals prepared and dispensed under his (her) supervision.
4. The preparation, quality control, dispensing and patient administration of radiopharmaceuticals and adjunctive drugs may be delegated to qualified personnel, in accordance with applicable state and local laws.
5. There must be a signed and dated written di-

rective for each patient for I-125 or I-131 sodium iodide in quantities 1.1 MBq (30 μ Ci) and for all therapeutic radiopharmaceuticals, such as strontium-89.

6. The identity of the radiopharmaceutical, patient and route of administration shall be verified prior to administration. Female patients who are post-menarche and pre-menopause should be asked about pregnancy, lactation and breast-feeding prior to administration. Pregnancy testing in females of childbearing capability should be performed prior to administration of any radiopharmaceutical that could potentially result in a dose to an embryo or fetus of 50 mSv (5 rems) or more (e.g., I-131 therapy).
 7. The quantity of each radiopharmaceutical dosage must be determined prior to patient administration and must be consistent with that ordered by the physician or addressed in the procedure manual of the nuclear medicine laboratory. The quantity of radioactivity dispensed should be within 10% of the prescribed dose or dosage range and the actual quantity administered must be recorded in the patient's medical record.
 8. Radiopharmaceuticals should not be used beyond the manufacturer's recommended expiration date/time unless specific quality control testing demonstrates that the product still meets applicable USP specifications at the time of use.
 9. Any discrepancies shall be resolved prior to administration.
- B. Elution of Generators and On-Site Preparation of Kits
1. Each time a generator is to be eluted, the generator to be eluted and the volume of eluent to be used should be selected based on the calibration and elution history of the generator. The quantity of radioactivity eluted and the concentration of parent nuclide breakthrough must be measured and recorded for each elution performed. The extent of breakthrough must be verified to be below the appropriate regulatory limit. The final volume of the eluate, the identity of the person performing the elution and the date and time of elution shall be recorded. Proper radiation safety procedures must be employed throughout the elution process.
 2. Radiopharmaceuticals should be prepared according to manufacturer's instructions. Deviations from the package insert instructions may be made by the prescribing physician or

nuclear pharmacist; in such instances, the physician or pharmacist responsible for preparing the radiopharmaceutical is responsible for assuring that it meets applicable USP specifications.

3. Aseptic procedures must be followed whenever handling parenteral or ophthalmic radiopharmaceutical preparations or their components.
 4. A comprehensive radiopharmaceutical quality control program should be developed and implemented. The scope of the program should be compatible with the type of practice and the availability of equipment and personnel. The parameters to monitor in a radiopharmaceutical quality control program include: (a) chemical purity; (b) radiochemical purity; (c) radionuclide purity; (d) biological purity (sterility and apyrogenicity); and (e) pharmaceutical purity (e.g., pH, particle size, absence of foreign particulate matter).
- C. Positron Emitting Radiopharmaceuticals
- Radiopharmaceuticals used in positron emission tomography require specialized personnel; facilities and equipment due primarily to the relatively short physical half-lives of the radionuclides used (2 min to 1.8 hr), their energetic photon emissions and the chemical syntheses necessary for their preparation. Preparation of PET radiopharmaceuticals must comply with USP compounding standards or FDA manufacturing requirements. Nuclear medicine practitioners involved in positron emission tomography should consult with qualified chemists, pharmacists, physicists and technologists in establishing and operating a PET program.
- D. Record Keeping
1. Records of receipt, usage, administration and disposal of all radiopharmaceuticals shall be kept in compliance with license conditions and applicable medical records and radiation control regulations.
 2. Records concerning the receipt of packages containing radioactive material should include proper identification of contents, inspection for physical damage and testing for external contamination, as required by the appropriate regulatory agency. Appropriate records of the receipt of radioactive material shall be maintained and stored in accordance with applicable local state and federal regulations. Such records shall address the identity of the radiopharmaceutical, its source, the amount of activity received and the results of radiation surveys and contamination testing.

Any discrepancies must be reported to the manufacturer and/or proper regulatory agency.

3. For all radiopharmaceuticals prepared on-site, records should include the date and time of preparation, quantity, volume and concentration of radioactivity used, reagent lot numbers, quality control data, expiration time, waste disposal information, and name or initials of the individual responsible for the preparation.
4. For all radiopharmaceuticals, the identity of the radiopharmaceutical, the amount of radioactivity administered, patient identity, identity of individual performing the administration, route of administration, and date and time of use must be recorded.
5. Appropriate records of radionuclide dose calibrator testing for constancy, accuracy, linearity and geometric variation shall be maintained.
6. Disposal of all radioactive material must be accomplished in accordance with institutional, state and federal regulations. Policy and procedures should be developed to assure that radioactive material does not enter the normal waste stream of the institution except in exempt quantities or in exempt forms (e.g., patient excreta).

E. Adverse Reactions/Product Problems

Adverse reactions associated with administration of radiopharmaceuticals should be investigated and documented. Reports of serious adverse reactions and product problems should be made to the manufacturer and to MedWatch.

F. Misadministration of Radiopharmaceuticals

Policies and procedures should be developed which assure that the correct patient receives the correct drug, at the correct time, at the correct dose and by the correct route of administration. Misadministrations, also known as medical events, have been defined by federal and state regulatory agencies and include a timely reporting requirement. When required, such events should be reported to the appropriate agency within the time frame specified.

G Special Considerations for Labeled Blood Products

While the misadministration of any radiopharmaceutical is serious, special precautions must be implemented to prevent the misadministration of radiopharmaceuticals containing blood products, i.e., Tc-99m red blood cells and In-111 and Tc-99m leukocytes. Procedures which involve the removal of blood for radiolabeling and subsequent reinjection have potential for misad-

ministration to the wrong patient. The handling and administration of blood products must be subject to special safeguards and procedures, the goal of which is to eliminate any possibility of administration to the wrong patient, contamination of the blood by environmental substances, and contamination of workers during radiolabeling procedures.

H. Drug Interactions and Altered Distribution Patterns

1. The in vivo distribution of radiopharmaceuticals can be altered by

Concurrent medications and prior diagnostic tests (including contrast dye and previous radiopharmaceuticals). The nuclear medicine practitioner should be familiar with documented drug interactions and consider this information when planning the nuclear medicine procedure to be performed and when altered distribution patterns are identified on patient studies.

2. Problems in the formulation of radiopharmaceuticals can result in altered distribution patterns. Appropriate quality control programs should identify such problems prior to patient administration. The possibility of a formulation-related cause of an altered distribution pattern should be considered in evaluation of any unexplained image findings.

V. Issues Requiring Further Clarification

None

VI. Concise Bibliography

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VIII. Disclaimer

The Society of Nuclear Medicine has written and ap-

proved guidelines to promote the cost-effective use of high quality nuclear medicine procedures. These generic recommendations cannot be applied to all patients in all practice settings. The guidelines should not be deemed inclusive of all proper procedures or exclusive of other procedures reasonably directed to obtaining the same results. The spectrum of patients seen in a specialized practice setting may be quite different than the spectrum of patients seen in a more general practice setting. The appropriateness of a procedure will depend in part on the prevalence of disease in the patient population. In addition, the resources available to care for patients may vary greatly from one medical facility to another. For these reasons, guidelines cannot be rigidly applied.

Advances in medicine occur at a rapid rate. The date of a guideline should always be considered in determining its current applicability.