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ACR–AAPM PRACTICE PARAMETER FOR REFERENCE LEVELS AND ADMINISTERED ACTIVITY FOR NUCLEAR MEDICINE AND MOLECULAR IMAGING

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care[1]. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the practitioner in light of all the circumstances presented. Thus, an approach that differs from the guidance in this document, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in this document when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to the guidance in this document will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable

[1] Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, ___ N.W.2d ___ (Iowa 2013) Iowa Supreme Court refuses to find that the *ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures* (Revised 2008) sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, Stanley v. McCarver, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.

course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of this document is to assist practitioners in achieving this objective.

I. INTRODUCTION

This practice parameter has been developed collaboratively by the American College of Radiology (ACR) and the American Association of Physicists in Medicine (AAPM) to guide appropriately trained and licensed physicians and Qualified Medical Physicists involved in nuclear medicine and molecular imaging procedures. The establishment of reference levels (RLs) in nuclear medicine and molecular imaging requires close cooperation and communication between the physicians who are responsible for the clinical management of the patient and the Qualified Medical Physicist responsible for monitoring equipment and image quality and estimating patient dose. Adherence to this practice parameter should help to maximize the efficacious use of these procedures, minimize radiation dose to patients and staff, maintain safe conditions, and ensure compliance with applicable standards. This is particularly important for children who are more vulnerable than adults to the potential risks of ionizing radiation.

The goal of this practice parameter is to provide guidance to physicians and Qualified Medical Physicists on the establishment and implementation of diagnostic RLs in the practice of nuclear medicine and molecular imaging. The goal in medical imaging is to obtain image quality consistent with the medical imaging task. Diagnostic RLs are used to help manage the radiation dose to the patient. The medical radiation exposure must be optimized, avoiding unnecessary radiation that does not contribute to the clinical objective of the procedure. By the same token, a dose significantly lower than the achievable administered activity (AAA) may also be cause for concern, since it may indicate that adequate image quality is not being achieved. The specific purpose of the reference level (RL) is to provide a benchmark for comparison, not to establish regulatory limits.

Reference levels for nuclear medicine and molecular imaging should be based on administered activity or dosage[2]. There are published surveys and guidelines of administered activity from various professional organizations that can be used to establish RLs [1-13].

II. DEFINITION

A reference level is an investigational level to identify higher than typical radiation doses for common nuclear medicine and molecular imaging procedures [14-16]. Reference levels are suggested action levels above which a facility should review its methods and determine if acceptable image quality can be achieved at lower administered activity. If procedures are consistently causing the relevant RL to be exceeded, a local review of procedures and equipment should be done to determine whether protection is being optimized. References levels for nuclear medicine and molecular imaging are expressed as administered activities instead of radiation absorbed dose. Reference levels are set at the 75th percentile of the range of administered activity.

Achievable Administered Activity (AAA) is a concept that can be used with RLs to assist in optimization of image quality and dose. Although no formal system exists for determining AAA, the concept is based on the median administered activity in that 50% of facilities are producing images below that administered activity. Achievable administered activity for nuclear medicine and molecular imaging are set at approximately the 50th percentile of the range of administered activities. The AAA provides a goal to which a facility should strive through the optimization of its image quality and patient absorbed doses. Further information on establishment of RLs and AAAs in nuclear medicine and molecular imaging is available in the NCRP Report 172 [17].

[2] Dosage is term used by the U.S. Nuclear Commission and other agencies that regulate radioactive materials to describe the patient administered activity and differentiate it from absorbed dose.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

See the ACR–SNM Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals [5].

B. Qualified Medical Physicist

> A Qualified Medical Physicist is an individual who is competent to practice independently in one or more of the subfields in medical physics. The American College of Radiology considers certification, continuing education, and experience in the appropriate subfield(s) to demonstrate that an individual is competent to practice one or more of the subfields in medical physics, and to be a Qualified Medical Physicist. The ACR strongly recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR), the Canadian College of Physicists in Medicine, or the American Board of Medical Physics (ABMP).
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> A Qualified Medical Physicist should meet the ACR Practice Parameter for Continuing Medical Education (CME). (ACR Resolution 17, adopted in 1996 – revised in 2012, Resolution 42). [18]

The appropriate subfields of medical physics for this practice parameter is Nuclear Medical Physics (including medical physics certification categories of Radiological Physics, Medical Nuclear Physics and Nuclear Medicine Physics).

Certification by the American Board of Science in Nuclear Medicine in Nuclear Medicine Physics and Instrumentation is also acceptable.

The Qualified Medical Physicist must be familiar with the principles of imaging physics and radiation protection; the guidelines of the National Council on Radiation Protection and Measurements (NCRP); the laws and regulations pertaining to nuclear medicine; the function, clinical uses, and performance specifications of nuclear medicine imaging equipment; and calibration processes and limitations of the equipment. The Qualified Medical Physicist must also be familiar with relevant clinical procedures.

IV. NUCLEAR MEDICINE REFERENCE LEVELS FOR IMAGING WITH IONIZING RADIATION

The concept of the RL can be a practical tool in nuclear medicine. Achieving acceptable adequate diagnostic information, consistent with the medical imaging task, is the overriding clinical objective. The quantity that will be measured is the administered activity or dosage. Administered activity RLs (in MBq or MBq/kg of body weight) are then used to help manage the radiation dose to patients so that the organ doses are appropriate for the clinical purpose.

The physician listed on the regulatory license or certificate (often called the authorized user) is ultimately responsible for the supervision and appropriate utilization of all radiopharmaceuticals received, prepared or administered under his or her direction.

It is strongly recommended that each administered dosage be assayed on site at the medical facility prior to administration to verify the prescribed activity [5].

Determining RLs for nuclear medicine procedures is difficult due to the limited available survey data, number of radiopharmaceuticals used and variability in procedures used. Reference levels are expressed as administered

activities instead of radiation dose. Due to the limited availability of survey data, local assessment may be necessary. For pediatric procedures, the standard is based on recommended activity per unit body mass, which is given in Table 2. For adults, manufacturer's recommend a standard administered activity based on a 70 kg person in their package insert as required by the Food and Drug Administration. Guidelines for minimum and maximum administered activities for adults and children are available from various publications and provided in Tables 1, 2 and 3 [1,3,4,6-13].

Tables 1 and 2 (below) summarize recommended RLs and AAAs for common radiopharmaceuticals administered in procedures for children, adolescents, and adults. They include the recommendations made by NCRP 172. Table 3 uses data obtained from Collaborative Practice Parameters and Procedural Guidelines. It is important to note that the NCRP 172 data tables are the results of multiple surveys. The Collaborative Practice Parameters and Procedural Guidelines are recommended administered activity ranges. The recommended RLS and AAAs for Table 3 were determined using 75% and 50% of the minimum range of recommended administered activities.

Reference levels and AAAs are all part of the optimization process. It is essential to assure that image quality appropriate for the diagnostic purpose is maintained when modifying administered activity. Optimization must balance image quality and patient absorbed dose, ie, image quality must be maintained at an appropriate level as administered activity is decreased. If diagnostic quality images are not achievable for these RLs or AAAs, presented in Tables 1,2, and 3 due to requirements of particular imaging devices or patient weight, the recommended RLs may need to be exceeded.

TABLE 1
Recommended Radiopharmaceutical Administered Activity for Adults
Derived from NCRP Report 172, Table 6.16 [2]

Radiopharmaceutical	Minimum Administered Activity	Maximum Administered Activity	Recommended Reference Levels[1]	Recommended Achievable Administered Activity[2]
^{18}F-Fluorodeoxyglucose (FDG)	269 MBq (8.0 mCi)	814 MBq (22.0 mCi)	710 MBq (19.0 mCi)	666 MBq (18.0 mCi)
^{123}I-Metaiodobenzylguanidine (MIBG)	19.0 MBq (0.5 mCi)	407 MBq (11.0 mCi)	391 MBq (11.0 mCi)	370 MBq (10.0 mCi)
^{123}I-Sodium Iodide (Nal)	3.7 MBq (0.1 mCi)	22 MBq (0.6 mCi)	26 MBq (0.7 mCi)	12 MBq (0.3 mCi)
^{99m}Tc-Dimercaptosuccinic Acid (DMSA)	3.7 MBq (0.1 mCi)	407 MBq (11.0 mCi)	289 MBq (7.8 mCi)	185 MBq (5.0 mCi)
^{99m}Tc-Disofenin or Mebrofenin (hepatobiliary)	19.0 MBq (0.5 mCi)	370 MBq (10.0 mCi)	282 MBq (7.6 mCi)	222 MBq (6.0 mCi)
^{99m}Tc-Labeled Solids (GI emptying)	3.7 MBq (0.1 mCi)	74 MBq (2.0 mCi)	50 MBq (1.3 mCi)	41 MBq (1.1 mCi)
^{99m}Tc-Macroaggregated Albumin	19.0 MBq (0.5 mCi)	244 MBq (6.6 mCi)	226 MBq (6.1 mCi)	222 MBq (6.0 mCi)
^{99m}Tc-Mertiatide (MAG3)	11.1 MBq (0.3 mCi)	407 MBq (11.0 mCi)	379 MBq (10.0 mCi)	370 MBq (10.0 mCi)

TABLE 1 CONTINUED

Radiopharmaceutical	Minimum Administered Activity	Maximum Administered Activity	Recommended Reference Levels[1]	Recommended Achievable Administered Activity[2]
^{99m}Tc-Medronate (MDP)	370 MBq (10.0 mCi)	1480 MBq (40 mCi)	1185 MBq (32.0 mCi)	1064 MBq (29.0 mCi)
^{99m}Tc-Sestamibi (cardiac rest)	148 MBq (4.0 mCi)	1665 MBq (45.0 mCi)	1153 MBq (31.0 mCi)	907 MBq (25.0 mCi)
^{99m}Tc-Sestamibi (cardiac stress)	148 MBq (4.0 mCi)	1665 MBq (45.0 mCi)	1452 MBq (39.0 mCi)	1277 MBq (35.0 mCi)
^{99m}Tc-Tetrofosmin (cardiac rest)	148 MBq (4.0 mCi)	1665 MBq (45.0 mCi)	1089 MBq (29.0 mCi)	907 MBq (25.0 mCi)
^{99m}Tc-Tetrofosmin (cardiac stress)	148 MBq (4.0 mCi)	1776 MBq (48.0 mCi)	1459 MBq (39.0 mCi)	1295 MBq (35.0 mCi)
^{201}Tl-Chloride (cardiac rest/stress)	37 MBq (1.0 mCi)	185 MBq (5.0 mCi)	172 MBq (4.6 mCi)	165 MBq (4.4 mCi)

[1] 75th percentile maximum value used

[2] Median maximum value used

TABLE 2
Recommended Radiopharmaceutical Administered Activity for Children
Derived from NCRP Report 172, Table 6.17 [2]

Radiopharmaceutical	Recommended Administered Activity (based on weight only)	Minimum Administered Activity	Maximum Administered Activity	Reference Level (Administered Activity)[1]	Achievable Administered Activity[2]
^{18}F-Fluorodeoxyglucose (FDG)	5.18 – 7.4 MBq/kg (0.14 – 0.2 mCi/kg)	19 MBq (0.5 mCi)	555 MBq (15.0 mCi)	430 MBq (12.0 mCi)	407 MBq (11.0 mCi)
^{67}Ga (for inflammatory disease)	1.48 – 2.59 MBq/kg (0.04 – 0.07 mCi/kg)	9.25 MBq (0.25 mCi)	185 MBq (5.0 mCi)	167 MBq (4.5 mCi)	167 MBq (4.5 mCi)
^{67}Ga (for tumor imaging)	2.96 – 5.25 MBq/kg (0.08 – 0.14 mCi/kg)	9.25 MBq (0.25 mCi)	370 MBq (10.0 mCi)	333 MBq (9.0 mCi)	333 MBq (9.0 mCi)
^{123}I-Metaiodobenzylguanidine (MIBG)	5.18 – 7.4 MBq/kg (0.14 – 0.2 mCi/kg)	37 MBq (1.0 mCi)	370 MBq (10.0 mCi)	370 MBq (10.0 mCi)	370 MBq (10.0 mCi)
^{123}I-Sodium Iodide (Nal) for Thyroid	0.06 – 0.22 MBq/kg (0.002 – 0.006 mCi/kg)	0.56 MBq (0.015 mCi)	20 MBq (0.54 mCi)	9.45 MBq (0.3 mCi)	8.14 MBq (0.2 mCi)
^{99m}Tc-Dimercaptosuccinic Acid (DMSA)	1.11 – 3.7 MBq/kg (0.03 – 0.1 mCi/kg)	5.55 MBq (0.15 mCi)	222 MBq (6.0 mCi)	185 MBq (5.0 mCi)	185 MBq (5.0 mCi)
^{99m}Tc-Disofenin (hepatobiliary)	1.85 – 3.7 MBq/kg (0.05 – 0.1 mCi/kg)	15 MBq (0.4 mCi)	370 MBq (10.0 mCi)	201 MBq (5.4 mCi)	185 MBq (5.0 mCi)
^{99m}Tc-Macroaggregated Albumin	1.11 – 4.88 MBq/kg (0.03 – 0.13 mCi/kg)	7.4 MBq (0.2 mCi)	222 MBq (6.0 mCi)	144 MBq (3.9 mCi)	139 MBq (3.8 mCi)
^{99m}Tc-Mertiatide (MAG3)	1.85 – 10.0 MBq/kg (0.05 – 0.28 mCi/kg)	19 MBq (0.5 mCi)	370 MBq (10.0 mCi)	370 MBq (10.0 mCi)	370 MBq (10.0 mCi)
^{99m}Tc-Medronate (MDP)	7.4 – 13.0 MBq/kg (0.20 – 0.36 mCi/kg)	22 MBq (0.6 mCi)	925 MBq (25.0 mCi)	820 MBq (22.0 mCi)	740 MBq (20.0 mCi)

TABLE 2 CONTINUED

Radiopharmaceutical	Recommended Administered Activity (based on weight only)	Minimum Administered Activity	Maximum Administered Activity	Reference Level Administered Activity[1]	Achievable Administered Activity[2]
^{99m}Tc-Pertechnetate (meckel diverticulum imaging)	1.63 – 5.92 MBq/kg (0.04 – 0.16 Ci/kg)	7.4 MBq (0.2 mCi)	555 MBq (15.0 mCi)	370 MBq (10.0 mCi)	370 MBq (10.0 mCi)
^{99m}Tc-Ultratage (for GI bleeding)	3.7 – 11.0 MBq/kg (010 – 0.30 Ci/kg)	37 MBq (1.0 mCi)	740 MBq (20.0 mCi)	740 MBq (20.0 mCi)	740 MBq (20.0 mCi)
^{99m}Tc-Sestamibi	5.7 – 19.0 MBq/kg (0.154 – 0.50 Ci/kg)	37 MBq (1.0 mCi)	1110 MBq (30.0 mCi)	792 MBq (21.0 mCi)	777 MBq (21.0 mCi)

[1] Mean value was used, unless it was less than the median value, in which case the median value was used

[2] Median value was used

TABLE 3
Recommended Radiopharmaceutical Administered Activity in Adults
Derived from Consensus Recommendations [3-13]

Radiopharmaceutical	Minimum Administered Activity	Maximum Administered Activity	Recommended Reference Level Administered Activity	Recommended Achievable Administered Activity
^{18}F-Fluorodeoxyglucose (FDG) (1)	370 MBq (10.0 mCi)	740 MBq (20.0 mCi)	650 MBq (17.5 mCi)	555 MBq (15 mCi)
^{67}Ga-Citrate	185 MBq (5.0 mCi)	370 MBq (10 mCi)	325 MBq (8.8 mCi)	280 MBq (7.5 mCi)
^{123}I-Metaiodobenzylguanidine (MIBG) (1)	185 MBq (5.0 mCi)	370 MBq (10 mCi)	325 MBq (8.8 mCi))	280 MBq (7.5 mCi)
^{123}I-Sodium Iodide (Nal) (1)	7.4 MBq (0.2 mCi)	14.8 MBq (0.4 mCi)	13.0 MBq (0.35 mCi)	11 MBq (0.3 mCi)
^{111}In-Oxine Leukocytes	11 MBq (0.3 mCi)	37 MBq (1.0 mCi)	30 MBq (0.8 mCi)	24 MBq (0.7 mCi)
^{99m}Tc-Dimercaptosuccinic Acid (DMSA) (1)	130 MBq (3.5 mCi)	185 MBq (5.0 mCi)	170 MBq (4.6 mCi)	160 MBq (4.25 mCi)
^{99m}Tc-Disofenin or Mebrofenin (hepatobiliary) (1)	111 MBq (3.0 mCi)	185 MBq (5.0 mCi)	167 MBq (4.5 mCi)	150 MBq (4.0 mCi)
^{99m}Tc-Exametazime (HMPAO) Leukocytes	185 MBq (5.0 mCi)	740 MBq (20.0 mCi)	600 MBq (16.2 mCi)	460 MBq (12.5 mCi)
^{99m}Tc-Macroaggregated Albumin (1)	111 MBq (3.0 mCi)	185 MBq (5.0 mCi)	167 MBq (4.5 mCi)	150 MBq (4.0 mCi)
^{99m}Tc-Mertiatide (MAG3) (1)	130 MBq (3.5 mCi)	370 MBq (10.0 mCi)	310 MBq (8.4 mCi)	250 MBq (6.8 mCi)
^{99m}Tc-Medronate (MDP) (1)	555 MBq (15 mCi)	1110 MBq (30 mCi)	970 MBq (26 mCi)	835 MBq (23 mCi)

TABLE 3 CONTINUED

Radiopharmaceutical	Minimum Administered Activity	Maximum Administered Activity	Recommended Reference Level Administered Activity	Recommended Achievable Administered Activity
^{99m}Tc-Sestamibi or Tetrofosmin One-day Protocol (cardiac rest/stress)	296/888 MBq (8/24 mCi)	444/1332 MBq (12/36 mCi)	407/1221 MBq (11/33 mCi)	370/1110 MBq (10/30 mCi)
^{99m}Tc-Sestamibi or Tetrofosmin Two-day Protocol (cardiac rest/stress)	925 MBq per day (25 mCi per day)	1110 MBq per day (30 mCi per day)	1073 MBq per day (29 mCi per day)	1018 MBq per day (27.5 mCi per day)
^{99m}Tc-Sestamibi or Tetrofosmin, (cardiac stress-only protocol)	518 MBq (14 mCi)	1258 MBq (34 mCi)	1073 MBq (29 mCi)	888 MBq (24 mCi)

V. PATIENT SPECIFIC DOSIMETRY

The internal dose RLs are derived from estimates from anthropomorphic computer models and are used as benchmarks for comparison of radiation dose among procedures; they should not be used as a substitute for estimating specific doses delivered to a patient. Although dose estimates are available for children of various ages, adult males and females as well as for pregnant females at different gestational stages, they are based on specific body size estimates and tracer kinetics which may be very different for any individual patient [19].

On occasion the need may arise to estimate the dose delivered to an individual patient because of a specific situation (eg, pregnancy or referring physician request). In these situations it is recommended that the physician consider executing a formal written medical physics consultation with the Qualified Medical Physicist. Using the information about the patient's weight, administered activity, and the radiopharmaceutical the Qualified Medical Physicist can render an estimate of the specific dose to tissue and organs in the patient. The consultation request and the Qualified Medical Physicist's report should be duly signed by the requesting physician and the Qualified Medical Physicist, and should be incorporated into the patient's medical record.

At times effective dose estimates may be used to assess the risk associated with radionuclide procedures. It should be understood that all radiation risk estimates are population based and cannot be accurately applied to an individual. Deterministic effects are associated with radionuclide therapy and are manifested when the radiation dose to tissues and organs exceeds a toxicity threshold. Radiation induced cancer is a stochastic effect that is a larger concern in children because the risk is higher than for adults and because they have a longer lifespan over which the cancer can be expressed.

VI. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, registered radiologist assistants, radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, "as low as reasonably achievable" (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel that work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection and application of dose limits) and the principles of proper management of radiation dose to patients (justification, optimization and the use of dose reference levels) http://www-pub.iaea.org/MTCD/Publications/PDF/p1531interim_web.pdf.

Facilities and their responsible staff should consult with the radiation safety officer to ensure that there are policies and procedures for the safe handling and administration of radiopharmaceuticals and that they are adhered to in accordance with ALARA. These policies and procedures must comply with all applicable radiation safety regulations and conditions of licensure imposed by the Nuclear Regulatory Commission (NRC) and by state and/or other regulatory agencies. Quantities of radiopharmaceuticals should be tailored to the individual patient by prescription or protocol.

Nationally developed guidelines, such as the ACR's Appropriateness Criteria®, should be used to help choose the most appropriate imaging procedures to prevent unwarranted radiation exposure.

Additional information regarding patient radiation safety in imaging is available at the Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org) websites. These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be measured and patient radiation dose estimated for representative examinations and types of patients by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Regular auditing of patient dose indices should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry, the NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends. (ACR Resolution 17 adopted in 2006 – revised in 2009, 2013, Resolution 52).

For the purpose of this practice parameter the radiation dose index used is administered activity of the radiopharmaceutical.

VII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR website (http://www.acr.org/guidelines).

Performance evaluation, quality control, acceptance testing, written survey reports and follow-up procedures should be in accordance with the appropriate ACR Medical Physics Technical Standards (http://www.acr.org/Quality-Safety/Standards-Guidelines/Technical-Standards-by-Modality/Medical-Physics).

The Qualified Medical Physicist's annual survey report should include estimates of radiation dose based on administered activity for representative examinations and types of patients (eg, adults, pediatric) as applicable. The Qualified Medical Physicist should also compare these values with current RLs and provide recommendations for improvement if the dose estimates or administered activity exceed the RLs.

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Standards – Nuclear Medicine and Molecular Imaging of the ACR Commission on Nuclear Medicine and Molecular Imaging in collaboration with the AAPM.

Collaborative Committee
Members represent their societies in the initial and final revision of this practice parameter.

ACR	AAPM
Thomas G. Ruckdeschel, MS, Chair	Jerry Allison, PhD, FACR, FAAPM
Maxwell R. Amurao, PhD, MBA	Beth Harkness, MS, FACR
Murray D. Becker, MD, PhD	Mark Madsen, PhD, FACR, FAAPM
Bennett S. Greenspan, MD, MS, FACR	
Ralph P. Lieto, MS, FACR	
Osama Mawlawi, PhD	
Susan Passalaqua, MD	

Committee on Practice Parameters and Technical Standards – Medical Physics
(ACR Committee responsible for sponsoring the draft through the process)

Tariq A. Mian, PhD, FACR, FAAPM, Chair
Charles M. Able, MS
Maxwell R. Amurao, PhD, MBA
Ishtiaq H. Bercha, MSc
Caridad Borras, DSc, FACR
Chee-Wai Cheng, PhD, FAAPM
Ralph P. Lieto, MS, FACR, FAAPM
Matthew A. Pacella, MS
William Pavlicek, PhD
Douglas E. Pfeiffer, MS, FACR, FAAPM
Thomas G. Ruckdeschel, MS
Christopher J. Watchman, PhD
John W. Winston, Jr., MS

Committee on Practice Parameters and Technical Standard – Nuclear Medicine and Molecular Imaging
(ACR Committee responsible for sponsoring the draft through the process)

Bennett S. Greenspan, MD, MS, FACR, Co-Chair
Christopher J. Palestro, MD, Co-Chair
Thomas W. Allen, MD
Kevin P. Banks, MD
Murray D. Becker, MD, PhD
Richard K.J. Brown, MD, FACR
Shana Elman, MD
Perry S. Gerard, MD, FACR
Warren R. Janowitz, MD, JD, FACR
Chun K. Kim, MD
Charito Love, MD
Joseph R. Osborne, MD, PhD
Darko Pucar, MD, PhD
Rathan M. Subramaniam, MD, PhD, MPH
Scott C. Williams, MD

Richard A. Geise, PhD, FACR, FAAPM, Chair, Commission on Medical Physics
M. Elizabeth Oates, MD, Chair, Commission on Nuclear Medicine and Molecular Imaging
Debra L. Monticciolo, MD, FACR, Chair, Commission on Quality and Safety
Julie K. Timins, MD, FACR, Chair, Committee on Practice Parameters and Technical Standards

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