Revised 2008 (Resolution 5)*

ACR TECHNICAL STANDARD FOR MEDICAL NUCLEAR PHYSICS PERFORMANCE MONITORING OF GAMMA CAMERAS

PREAMBLE

These standards are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these standards 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 physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the standards, 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 the standards 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 the standards. However, a practitioner who employs an approach substantially different from these standards 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 these standards will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable 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 these standards is to assist practitioners in achieving this objective.

I. INTRODUCTION

All nuclear medicine imaging equipment shall be tested upon installation and monitored at least annually by a Qualified Medical Physicist or other qualified individual to ensure that it is functioning within manufacturer specifications and accepted performance standards. Additional or more frequent performance monitoring may be necessary in certain situations (e.g., after major equipment maintenance). Although it is not possible to consider all variations of equipment performance to be monitored, adherence to this standard will maximize image quality and help to ensure the accuracy of numerical results in clinical procedures. Key points to consider are performance characteristics to be monitored, estimated patient radiation dose**,** qualifications of personnel, and follow-up procedures.

II. GOAL

The goal is to produce the highest quality diagnostic image consistent with the clinical use of the equipment and the information requirement of the examination and to establish performance standards for the imaging instruments.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

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 (ACR) considers certification and continuing education and experience in the appropriate subfield(s) to demonstrate that an individual is competent to practice in one or more of the subfields in medical physics and to be a Qualified Medical Physicist. The ACR recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR), the Canadian College of Physics in Medicine, or for MRI, by the American Board of Medical Physics (ABMP) in magnetic resonance imaging physics.

The appropriate subfields of medical physics for this standard are Medical Nuclear Physics and Radiological Physics.

A Qualified Medical Physicist should meet the ACR Practice Guideline for Continuing Medical Education (CME). (ACR Resolution 17, 1996 – revised 2008, Resolution 7)

In addition, the continuing education should include at least 15 hours in medical nuclear physics in the prior 36 month period; at least half of these hours should be category 1.

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

The medical physicist must be familiar with the principles of radiation protection; the guidelines of the National Council on Radiation Protection and Measurements (NCRP); laws and regulations governing the use of the equipment being tested; the function, clinical uses, and performance specifications of the imaging equipment; and calibration processes and limitations of the instruments and techniques used for testing performance.

The medical physicist may be assisted by properly trained individuals in obtaining data for performance monitoring. These individuals must be approved by the medical physicist in the techniques of performing tests, the function and limitations of the imaging equipment and test instruments, the reasons for the tests, and the importance of the test results. The medical physicist is responsible for, and must review, interpret, and approve all data as well as provide a signed report of the conclusions.

IV. PERFORMANCE CHARACTERISTICS TO BE MONITORED

A. Characteristics to be Monitored Annually

The following characteristics shall be evaluated for the equipment to which they apply on at least an annual basis.

1. Planar image quality
   a. System uniformity and intrinsic uniformity, if possible
   b. Spatial resolution (intrinsic or system)
   c. Spatial linearity
   d. Energy resolution
   e. Sensitivity
   f. Multiple window spatial registration
   g. Count rate capability
   h. Collimator integrity
2. Tomographic image quality
   a. Uniformity and noise
   b. Spatial resolution
   c. Contrast
3. Safety features and interlocks

B. Estimates of Organ Dose from Radiopharmaceuticals

The medical physicist shall prepare a table of organ dose estimates for all procedures that involve administration of radiopharmaceuticals to patients. The table shall specify the radiopharmaceutical dosage schedule used at the facility. All organs that receive significant doses shall be included. Separate values for patient size and gender shall be tabulated where applicable. The table shall be reviewed at least annually and updated when any of the following occur: 1) the addition of new procedures and/or radiopharmaceuticals**,** 2) a change in radiopharmaceutical dosage schedules, 3) a change in the route of administration, and 4) the availability of more accurate dosimetry data.

V. ACCEPTANCE TESTING

Initial performance testing of imaging equipment shall be performed upon installation and should be completed before clinical use. This testing should be more comprehensive than periodic performance testing and shall be consistent with current acceptance testing practices.

VI. FOLLOW-UP PROCEDURES AND WRITTEN SURVEY REPORT

The medical physicist shall report the findings to the physician(s), to the responsible professional(s) in charge of obtaining or providing necessary service to the equipment, and, in the case of the consulting physicist(s), to the representative of the hiring party, and, if appropriate, shall initiate the required service. Action

should be taken immediately by direct verbal communication if there is imminent danger to patients or staff using the equipment due to unsafe conditions. Written survey reports shall be provided in a timely manner consistent with the importance of any adverse findings. The medical physicist should confirm that the unit is performing in a safe and acceptable fashion as soon as possible after the required service is performed.

VII. RADIATION SAFETY

Radiologists, medical physicists, imaging technologists, and all supervising physicians have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This concept is known as "as low as reasonably achievable (ALARA)."

Facilities, in consultation with the radiation safety officer, should have in place and should adhere to policies and procedures for the safe handling and administration of radiopharmaceuticals, in accordance with ALARA, and 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.

VIII. 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 web page (http://www.acr.org/guidelines).

A continuous quality control (QC) program shall be established for the nuclear medicine imaging equipment with the assistance of a medical physicist as outlined in the ACR–SNM Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals. An on-site technologist shall be identified to be responsible for conducting routine QC.

The results of the QC program shall be monitored annually by the medical physicist. If measured values of QC parameters fall outside the control limits, the physicist should initiate appropriate investigative or corrective actions. A medical physicist should be available to assist in prescribing corrective actions for unresolved problems.

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Suggested Reading (Additional articles that are not cited in the document but that the committee recommends for further reading on this topic)

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*Guidelines and standards are published annually with an effective date of October 1in the year in which amended, revised, or approved by the ACR Council. For guidelines and standards published before 1999, the effective date was January 1 following the year in which the guideline or standard was amended, revised, or approved by the ACR Council.

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