

Introduction to Nuclear Medicine Practice Standards

Radioactive materials and a gamma camera are used in nuclear medicine to image various organs and body areas to aid in diagnosis, and in some instances treat, various pathological conditions. Although an interdisciplinary team of radiologists, nuclear medicine technologists and support staff plays a critical role in the delivery of health services, it is the nuclear medicine technologist who performs the actual patient examination or treatment. Nuclear medicine technology integrates scientific knowledge and technical skills with effective patient interaction to provide quality patient care and useful diagnostic information.

Nuclear Medicine Technologist

Nuclear medicine technologists must demonstrate an understanding of human anatomy and physiology, chemistry, nuclear physics, mathematics and pharmacology. The nuclear medicine technologist prepares and administers radiopharmaceuticals and other medications in accordance with state and federal regulations.

Nuclear medicine technologists must maintain a high degree of accuracy and awareness of radiation safety principles and continually perform and assess quality control measures on equipment and procedures.

Nuclear medicine technologists should possess oral and written communication skills to effectively interact with both patients and others in the health care environment. Daily situations require critical-thinking and decision-making skills.

Nuclear medicine technologists embrace continuing education for optimal patient care, public education and enhanced knowledge and technical competence.

Education and Certification

Nuclear medicine technologists prepare for their role on the interdisciplinary team by satisfactorily completing an accredited educational program in nuclear medicine. One- and two-year certificate, associate degree and four-year baccalaureate degree programs exist throughout the United States.

Accredited programs must meet specific curricular and educational standards. The Joint Review Committee on Educational Programs in Nuclear Medicine Technology (JRCNMT) is the accrediting agency for nuclear medicine programs recognized by the U.S. Department of Education.

Upon completion of a course of study in nuclear medicine, individuals may apply to take a national certification examination. The American Registry of Radiologic Technologists (ARRT) is a recognized certifying agency for nuclear medicine. Those who successfully complete the certification examination in nuclear medicine may use the credential R.T.(N) following their

name; the R.T. signifies registered technologist and the (N) indicates nuclear medicine technologist.

To maintain ARRT certification, a level of expertise and awareness of changes and advances in practice, nuclear medicine technologists must complete 24 hours of appropriate continuing education every two years.

The Nuclear Medicine Technology Certification Board (NMTCB) also is a certifying agency. Once the NMTCB determines an applicant is eligible for the examination, the applicant must take the board within a three-month period. Those who successfully complete this certification examination may use the credential CNMT, indicating certified nuclear medicine technologist.

Practice Standards

The practice standards define the practice and establish general criteria to determine compliance. Practice standards are authoritative statements enunciated and promulgated by the profession for judging the quality of practice, service and education. They include desired and achievable levels of performance against which actual performance can be measured.

Professional practice constantly changes and actual practice varies from state to state as determined by local law and community custom. Recognizing this, the profession has adopted standards that are general in nature. The general format was favored over a “cookbook” style or “step-by-step” approach that would be difficult to maintain in a changing environment and confining for those practitioners with an expanded practice.

The standards focus on the dynamic nature of the health care delivery system. The standards are adaptable not only to the area of practice but also the locality of practice and institutional needs. While a minimum standard of acceptable performance is appropriate and should be followed by all practitioners in a specific area, it is unrealistic and highly inappropriate to assume that professional practice is the same in all regions of the United States.¹ State statute or regulation may dictate practice parameters. To conduct an appropriate review of the standards, one must look to the professional standard as well as local or state law that may impact the nature and scope of practice.

Format

The cohesive nature and inherent differences of medical imaging and radiation therapy are recognized in the general format of the standards. The standards are divided into three sections: clinical performance, quality performance and professional performance.

Clinical Performance Standards. The clinical performance standards define the activities of the practitioner in the care of patients and delivery of diagnostic or therapeutic

¹ The term “practitioner” is used in all areas of the standards in place of the various names used in medical imaging and radiation therapy, such as radiologic technologist, sonographer or radiation therapist. Practitioner is defined as any individual practicing in a specific area or discipline. The profession believes that any individual practicing in one of the defined disciplines or specialties should be held to a minimum standard of performance to protect the patients who receive professional services.

procedures and treatments. The section incorporates patient assessment and management with procedural analysis, performance and evaluation.

Quality Performance Standards. The quality performance standards define the activities of the practitioner in the technical areas of performance including equipment and material assessment, safety standards and total quality management.

Professional Performance Standards. The professional performance standards define the activities of the practitioner in the areas of education, interpersonal relationships, personal and professional self-assessment and ethical behavior.

Each section of the standards is subdivided into individual standards. The standards are numbered and followed by a term or set of terms that identify the standards, such as “assessment” or “analysis/determination.” The next statement is the expected performance of the practitioner when performing the procedure or treatment. A rationale statement follows and explains why a practitioner should adhere to the particular standard of performance.

Criteria. Criteria are used in evaluating a practitioner’s performance. Each set of criteria is divided into two parts, the general criteria and the specific criteria. Both the measurement and specific criteria should be used when evaluating performance.

General Criteria. General criteria are written in a general style that applies to either medical imaging or radiation therapy practitioners. These criteria are the same in all sections of the standards and should be used for the appropriate area of practice. For example, a radiographer should use good professional judgment to make decisions concerning the adaptation of equipment and technical variables for a diagnostic procedure. Under these circumstances, the evaluation of the decision-making process concerning radiation therapy procedures would not be appropriate and should not be applied unless the procedure is diagnostic in nature, such as simulation.

Specific Criteria. While many areas of performance within medical imaging and radiation therapy are similar, others are not. The specific criteria are drafted with these differences in mind. For example, a criterion that calls for daily review of patient treatment records and doses to ensure that treatment does not exceed prescribed dose or normal tissue tolerance is imperative for those who practice in radiation therapy yet is not applicable to those who practice in the imaging professions.

A profession’s practice standards serve as a guide for appropriate practice. Standards provide role definition for practitioners that can be used by individual facilities to develop job descriptions and practice parameters. Those outside the medical imaging and radiation therapy community can use the standards as an overview of the role and responsibilities of the practitioner as defined by the profession.

Nuclear Medicine Clinical Performance Standards

Standard One – Assessment

The practitioner collects pertinent data about the patient and the procedure.

Rationale

Information about the patient's health status is essential in providing appropriate imaging and therapeutic services.

General Criteria

The practitioner:

1. Uses consistent and appropriate techniques to gather relevant information from the medical record, significant others and health care providers. The collection of information is determined by the patient's needs or condition.
2. Reconfirms patient identification and verifies the procedure requested or prescribed.
3. Verifies the patient's pregnancy status when appropriate.
4. Determines whether the patient has been appropriately prepared for the procedure.
5. Assesses factors that may contraindicate the procedure, such as medications, insufficient patient preparation or artifacts.

Specific Criteria

None added.

Standard Two – Analysis/Determination

The practitioner analyzes the information obtained during the assessment phase and develops an action plan for completing the procedure.

Rationale

Determining the most appropriate action plan enhances patient safety and comfort, optimizes diagnostic and therapeutic quality and improves cost effectiveness.

General Criteria

The practitioner:

1. Selects the most appropriate and cost-effective action plan after reviewing all pertinent data and assessing the patient's abilities and condition.
2. Uses his or her professional judgment to adapt imaging and therapeutic procedure to improve diagnostic quality and therapeutic outcome.
3. Consults appropriate medical personnel to determine a modified action plan when necessary.
4. Determines the need for accessory equipment.

Specific Criteria

None added.

Standard Three – Patient Education

The practitioner provides information about the procedure to the patient, significant others and health care providers.

Rationale

Communication and education are necessary to establish a positive relationship with the patient, significant others and health care providers.

General Criteria

The practitioner:

1. Verifies that the patient has consented to the procedure and fully understands its risks, benefits, alternatives and follow-up. When appropriate, the practitioner verifies that written consent has been obtained.
2. Provides accurate explanations and instructions at an appropriate time and at a level the patient can understand. Addresses and documents patient questions and concerns regarding the procedure when appropriate.
3. Refers questions about diagnosis, treatment or prognosis to the patient's physician.
4. Provides appropriate information to any individual involved in the patient's care.

Specific Criteria

The practitioner:

1. Provides answers to patient questions about the procedure and use of radioactive materials and documentation when necessary.

Standard Four – Implementation

The practitioner implements the action plan.

Rationale

Quality patient services are provided through the safe and accurate implementation of a deliberate plan of action.

General Criteria

The practitioner:

1. Implements an action plan that falls within established protocols and guidelines.
2. Elicits the cooperation of the patient to carry out the action plan.
3. Uses an integrated team approach as needed.
4. Modifies the action plan according to changes in the clinical situation.
5. Administers first aid or provides life support in emergency situations.
6. Uses accessory equipment when appropriate.
7. Assesses and monitors the patient's physical and mental status.

Specific Criteria

The practitioner:

1. Prepares and administers radiopharmaceutical dosages according to established guidelines.

2. Performs venipuncture, IV patency and maintenance procedures according to established guidelines.

Standard Five – Evaluation

The practitioner determines whether the goals of the action plan have been achieved.

Rationale

Careful examination of the procedure is important to determine that all goals have been met.

General Criteria

The practitioner:

1. Evaluates the patient and the procedure to identify variances that may affect patient outcome. The evaluation process should be timely, accurate and comprehensive.
2. Measures the procedure against established protocols and guidelines.
3. Identifies any exceptions to the expected outcome.
4. Documents any exceptions clearly and completely.
5. Develops a revised action plan to achieve the intended outcome if necessary.
6. Disseminates reasons for revisions to all team members.

Specific Criteria

None added.

Standard Six – Implementation

The practitioner implements the revised action plan.

Rationale

It may be necessary to make changes to the action plan to achieve the intended outcome.

General Criteria

The practitioner:

1. Bases the revised plan on the patient's condition and the most appropriate means of achieving the intended outcome.
2. Takes action based on patient and procedural variances.
3. Measures and evaluates the results of the revised action plan.
4. Notifies appropriate health provider when immediate clinical response is necessary based on procedural findings and patient condition.

Specific Criteria

The practitioner:

1. Adjusts imaging parameters or computer-generated information to improve the outcome of the procedure.
2. Assesses images for technical quality, and when necessary, makes technical modifications to the data presentations.

Standard Seven – Outcomes Measurement

The practitioner reviews and evaluates the outcome of the procedure.

Rationale

To evaluate the quality of care, the practitioner compares the actual outcome with the intended outcome.

General Criteria

The practitioner:

1. Reviews all diagnostic or therapeutic data for completeness and accuracy.
2. Determines whether the actual outcome is within established criteria.
3. Evaluates the process and recognizes opportunities for future changes.
4. Assesses the patient's physical and mental status prior to discharge from the practitioner's care.

Specific Criteria

None added.

Standard Eight – Documentation

The practitioner documents information about patient care, the procedure and the final outcome.

Rationale

Clear and precise documentation is necessary for continuity of care, accuracy of care and quality assurance.

General Criteria

The practitioner:

1. Documents diagnostic, treatment and patient data in the appropriate record. Documentation must be timely, accurate, concise and complete.
2. Documents any exceptions from the established criteria or procedures.
3. Records diagnostic or treatment data.

Specific Criteria

The practitioner:

1. Maintains records about the use of radioactive materials according to established guidelines.

Quality Performance Standards

Standard One - Assessment

The practitioner collects pertinent information regarding equipment, procedures and the work environment.

Rationale

The planning and provision of safe and effective medical services relies on the collection of pertinent information about equipment, procedures and the work environment.

General Criteria

The practitioner:

1. Ensures that services are performed in a safe environment in accordance with established guidelines.
2. Ensures that equipment maintenance and operation comply with established guidelines.
3. Assesses equipment to determine acceptable performance based on established guidelines.
4. Ensures that protocol and procedure manuals include recommended criteria and are reviewed and revised on a regular basis.

Specific Criteria

The practitioner:

1. Performs area monitoring and surveys to assess radiation exposure levels and contamination sites.
2. Follows federal and state guidelines to minimize radiation exposure levels.

Standard Two - Analysis/Determination

The practitioner analyzes information collected during the assessment phase and determines whether changes need to be made to equipment, procedures or the work environment.

Rationale

Determination of acceptable performance is necessary for the provision of safe and effective services.

General Criteria

The practitioner:

1. Assesses whether services, procedures and environment meet or exceed established guidelines. If not, the practitioner develops an action plan.
2. Evaluates equipment to determine if it meets or exceeds established standards. If not, the practitioner develops an action plan.
3. Analyzes information collected during the assessment phase to determine whether optimal services are being provided. If not, the practitioner develops an action plan.

Specific Criteria

The practitioner:

1. Evaluates results of quality control testing on the radiopharmaceutical for compliance with established guidelines.

Standard Three - Education

The practitioner informs the patient, public and other health care providers about procedures, equipment and facilities.

Rationale

Open communication promotes safe practices.

General Criteria

The practitioner:

1. Elicits confidence and cooperation from the patient, the public and other health care providers by providing timely communication and effective instruction.
2. Presents explanations and instructions at the learner's level of understanding and learning style.

Specific Criteria

The practitioner:

1. Addresses patient questions about nuclear medicine procedures and radiation safety.
2. Educates the public about nuclear medicine procedures and radiation safety.

Standard Four – Performance

The practitioner performs quality assurance activities or acquires information on equipment and materials.

Rationale

Quality assurance activities provide valid and reliable information regarding the performance of materials and equipment.

General Criteria

The practitioner:

1. Performs quality assurance activities based on established protocols.
2. Provides evidence of ongoing quality assurance activities.

Specific Criteria

The practitioner:

1. Performs appropriate quality testing on radiopharmaceuticals prior to administration.

Standard Five – Evaluation

The practitioner evaluates quality assurance results and establishes an appropriate action plan.

Rationale

Materials, equipment and procedure safety depend on ongoing quality assurance activities that evaluate performance based on established guidelines.

General Criteria

The practitioner:

1. Compares quality assurance results to established acceptable values.
2. Verifies quality assurance testing conditions and results.
3. Formulates an action plan following verification of testing.

Specific Criteria

The practitioner:

1. Monitors test results to determine variance from quality standards.

Standard Six – Implementation

The practitioner implements the quality assurance action plan.

Rationale

Implementation of a quality assurance action plan is imperative for quality diagnostic and therapeutic procedures and patient care.

General Criteria

The practitioner:

1. Obtains assistance from appropriate personnel to implement the quality assurance action plan.
2. Implements the quality assurance action plan.

Specific Criteria

The practitioner:

1. Stores rejected radiopharmaceuticals and prepares new radiopharmaceuticals properly.
2. Employs devices to decrease radiation levels when necessary.
3. Uses decontamination procedures when necessary.

Standard Seven – Outcomes Measurement

The practitioner assesses the outcome of the quality assurance action plan in accordance with established guidelines.

Rationale

Outcomes assessment is an integral part of the ongoing quality assurance plan to enhance diagnostic and therapeutic services.

General Criteria

The practitioner:

1. Reviews the implementation process for accuracy and validity.
2. Determines whether the performance of equipment and materials is safe for practice based on outcomes assessment.
3. Develops and implements a modified action plan when testing results are not in compliance with guidelines.

Specific Criteria

The practitioner:

1. Evaluates repeat quality testing to determine compliance with acceptable values.

Standard Eight – Documentation

The practitioner documents quality assurance activities and results.

Rationale

Documentation provides evidence of quality assurance activities designed to enhance the safety of patients, the public and health care providers during diagnostic and therapeutic services.

General Criteria

The practitioner:

1. Maintains documentation of quality assurance activities, procedures and results in accordance with established guidelines.
2. Provides timely, concise, accurate and complete documentation.
3. Provides documentation that adheres to current protocol, policy and procedures.

Specific Criteria

The practitioner:

1. Documents radiopharmaceutical quality testing procedures and maintains results for inspection.
2. Documents instrumentation quality testing procedures and maintains results for review.

Professional Performance Standards

Standard One – Quality

The practitioner strives to provide optimal care to all patients.

Rationale

All patients expect and deserve optimal care during diagnosis and treatment.

General Criteria

The practitioner:

1. Works with others to elevate the quality of care.
2. Participates in quality assurance programs.
3. Adheres to the accepted standards, policies and procedures adopted by the profession and regulated by law.
4. Provides the best possible diagnostic study or therapeutic treatment for each patient by applying professional judgement and discretion.
5. Anticipates and responds to the needs of the patient.

Specific Criteria

None added.

Standard Two – Self-Assessment

The practitioner evaluates personal performance, knowledge and skills.

Rationale

Self-assessment is an important tool in professional growth and development.

General Criteria

The practitioner:

1. Monitors personal work ethics, behaviors and attitudes.
2. Monitors and evaluates orientation guidelines and recommends improvements or changes as needed.
3. Evaluates performance and recognizes opportunities for improvement.
4. Recognizes his or her strengths and uses them to benefit patients, coworkers and the profession.
5. Performs procedures only after receiving appropriate education and training.
6. Recognizes and takes advantage of opportunities for educational growth and improvement in technical and problem-solving skills.
7. Actively participates in professional societies and organizations.

Specific Criteria

None added.

Standard Three – Education

The practitioner acquires and maintains current knowledge in clinical practice.

Rationale

Advancements in medical science require enhancement of knowledge and skills through education.

General Criteria

The practitioner:

1. Demonstrates completion of the appropriate education related to clinical practice.
2. Maintains appropriate credentials and certification related to clinical practice.
3. Participates in educational activities to enhance knowledge, skills and performance.
4. Shares knowledge and expertise with others.

Specific Criteria

None added.

Standard Four – Collaboration and Collegiality

The practitioner promotes a positive, collaborative practice atmosphere with other members of the health care team.

Rationale

To provide quality patient care, all members of the health care team must communicate effectively and work together efficiently.

General Criteria

The practitioner:

1. Shares knowledge and expertise with colleagues, peers, students and all members of the health care team.
2. Develops collaborative partnerships with other health care providers in the interest of diagnostic and therapeutic quality and cost effectiveness and safety.

Specific Criteria

The practitioner:

1. Instructs health care providers in the safe handling and use of ionizing radiation as it relates to patient care.
2. Promotes understanding of nuclear medicine procedures through in-service workshops for other health care providers.

Standard Five – Ethics

The practitioner adheres to the profession's accepted Code of Ethics.

Rationale

All decisions and actions made on behalf of the patient are based on a sound ethical foundation.

General Criteria

The practitioner:

1. Provides health care services with respect for the patient's dignity and age-specific needs.
2. Acts as a patient advocate to support patients' rights.
3. Takes responsibility for professional decisions.
4. Delivers patient care and service without bias based on personal attributes, nature of the disease, sex, race, creed, religion or socioeconomic status.
5. Respects the patient's right to privacy and confidentiality.
6. Adheres to the established practice standards of the profession.

Specific Criteria

None added.

Standard Six – Exploration and Investigation

The practitioner participates in the acquisition, dissemination and advancement of the professional knowledge base.

Rationale

Scholarly activities such as research, scientific investigation, presentation and publication advance the profession and thereby improve the quality and efficiency of patient services.

General Criteria

The practitioner:

1. Reads and critically evaluates research in diagnostic and therapeutic services.
2. Investigates new, innovative methods and applies them in practice.
3. Shares information with colleagues through publication, presentation and collaboration.
4. Pursues lifelong learning.
5. Participates in data collection.

Specific Criteria

The practitioner:

1. Reads and evaluates technical research in diagnostic nuclear medicine and systemic radionuclide therapy procedures.

Nuclear Medicine Glossary

Becquerel – A quantity of radioactive material that decays at a rate of one disintegration per second.

Curie – A quantity of radioactive material that decays at a rate of 3.7×10^{10} disintegrations per second. One Curie of activity is equivalent to 3.7×10^{10} Becquerels of activity.

Decay – A change or transformation that occurs spontaneously within the nucleus of an atom. It results in the emission of some form of radiation.

Dosage – The amount or quantity of radioactive material administered to a patient or used in a nuclear medicine procedure. Its units are in submultiples of Becquerels or Curies.

Gamma photon – A bundle of energy emitted by the nucleus of an atom during a radioactive decay process.

Half-life (physical half-life) – The time it takes for one-half of the nuclei present in a radioactive sample to decay. Every radioactive material has its own unique half-life.

In vitro procedure – A laboratory testing procedure done on patient fluid or tissue samples that may use radiochemicals for the detection and measurement of various substances found within the body.

In vivo nonimaging procedure – A nuclear medicine procedure in which the radiopharmaceutical is administered to a patient, but no images are produced. Analysis is done on patient blood or urine samples, or measurements and graphs are produced.

Ion pair – A positively charged ion and the electron that was ejected during the formation of that positively charged ion.

Ionizing radiation – Any type of radiation which, during its interaction with matter, can cause the formation of an ion pair.

PET scanning (positron emission tomography) – Using a special group of radiopharmaceuticals to image areas of the body to determine function of the area or organ.

Planar image - A nuclear medicine image representing only one body plane.

Positron – A type of radiation emitted from the nucleus of a radioactive atom during a decay process. A positron is similar to an electron except that it is positively charged.

Radioactive atom – An atom whose nucleus is in an unstable state such that at some point in time, the nucleus will undergo a transformation or change resulting in the emission of radiation.

Radiochemical – A radioactive substance used in laboratory testing of a patient’s fluid or tissue sample to detect and measure various substances found in the sample. Radiochemicals have not been approved for administration directly to the patient.

Radiopharmaceutical – A radioactive substance approved for administration to a patient to provide diagnostic information or deliver treatment for a specific disease state.

SPECT (single photon emission computed tomography) – A method of producing a cross-sectional image of the body by using radiation detection equipment, a radiopharmaceutical and computer processing. Results may be displayed in all three imaging dimensions: transverse, sagittal and coronal.

Scintillation – Flash of light.

Scintillation (gamma) camera – A radiation detection device used to produce electronic signals for processing and image formation.

Scintillation detector – A radiation detector that uses an appropriate crystal or liquid for the detection of a gamma photon’s interaction with matter.

Survey meter – A radiation detector used to measure radiation levels or check for areas of radioactive contamination.

Systemic radionuclide therapy – The use of administered radiopharmaceuticals in the treatment of a limited number of disease states.