



Nuclear Medicine Technologist Scope of Practice and Performance Standards

**Prepared by: Society of Nuclear Medicine and
Molecular Imaging Technologist Section
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1 **Overview of Document**

2
3 This document includes the Scope of Practice and the Performance Standards for health care
4 professionals that, for the purposes of this document, will be referred to as a nuclear
5 medicine technologist.

6
7 The spectrum of responsibilities for a nuclear medicine technologist varies widely across
8 the United States. Practice components presented in this document include what is taught in
9 Nuclear Medicine programs, tested by accrediting organizations, and practiced in the field.
10 This document provides a basis for establishing the areas of knowledge and performance for
11 the nuclear medicine technologist.

12
13 The nuclear medicine technologist **MUST BE IN COMPLIANCE WITH ALL FEDERAL,**
14 **STATE, AND INSTITUTIONAL GUIDELINES** including proper documentation of initial
15 and continued competency in those practices and activities.

16
17 Continuing education is a necessary component in maintaining the skills required to perform
18 all duties and tasks of the nuclear medicine technologist in this ever-evolving field.

19
20 **Limitation of Scope and Disclaimer**

21
22 This document is intended to set forth the standards in important areas of the nuclear
23 medicine technologist's responsibilities. It may not cover all areas which may present
24 themselves in actual practice. These standards do not supersede the judgment of the
25 individual nuclear medicine technologist and other healthcare professionals serving the
26 patient in light of all of the facts of the individual case. **THE SOCIETY OF NUCLEAR**
27 **MEDICINE AND MOLECULAR IMAGING AND THE SOCIETY OF NUCLEAR**
28 **MEDICINE AND MOLECULAR IMAGING TECHNOLOGIST SECTION DISCLAIM**
29 **ALL LIABILITY ARISING FROM USE OF THESE DOCUMENTS.**

30
31 **Overview**

32
33 Nuclear medicine is a medical technology that utilizes sealed and unsealed radioactive
34 materials for diagnostic, treatment, and research purposes. Nuclear medicine instrumentation
35 may be combined with, computed tomography (CT), magnetic resonance imaging (MRI), or
36 other modalities to produce three-dimensional images with or without adjunctive and other
37 imaging medications to enhance the evaluation of physiological processes at a molecular
38 level.

39
40 **Technologist Qualified to Perform Nuclear Medicine Procedures**

41
42 Under the supervision of an authorized user, the nuclear medicine technologist is
43 responsible for the safe use of ionizing and nonionizing radiation and molecular imaging for
44 diagnostic, therapeutic, and research purposes. The technologist will review the patient's
45 medical history to understand the patient's illness, medical issue, and pending diagnostic or
46 treatment procedure; instruct the patient before, during, and following the procedure;

47 evaluate the satisfactory preparation of the patient before beginning a procedure; and
48 recognize emergency patient conditions and initiate lifesaving first aid when appropriate.
49

50 Administrative functions may include supervising other technologists, students, and other
51 personnel; participating in procuring supplies and equipment; documenting laboratory
52 operations; participating in radiation safety protocols and taking an active role in radiation
53 reduction programs; participating in departmental inspections conducted by various licensing,
54 regulatory, and accrediting agencies; participating in departmental quality assurance or
55 quality improvement projects; and participating in scheduling patient procedures.
56

57 A certified nuclear medicine technologist is an individual who is registered or certified by the
58 Nuclear Medicine Technology Certification Board (NMTCB), the American Registry of
59 Radiologic Technologists (ARRT), Canadian Association of Medical Radiation
60 Technologists (CAMRT), and/or any other certification board accepted by your state or
61 institution. A certified nuclear medicine technologist is qualified to perform general nuclear
62 medicine procedures, nuclear medicine therapy, nuclear cardiology procedures, nuclear
63 breast procedures, positron emission tomography (PET) procedures, and CT attenuation
64 correction and localization at entry level. An advanced certification in CT through the
65 NMTCB, ARRT, CAMRT, and/or any other certification board accepted by your state or
66 institution qualifies a certified nuclear medicine technologist to perform diagnostic CT. A
67 certified nuclear medicine technologist is qualified to perform PET/MR with training and
68 education in MR.
69

70 **Education**

71 Nuclear Medicine Technologists may complete a one- or two- year certificate program, a
72 two-year associate's degree, bachelor's degree or Master's Degree. Didactic courses include
73 but are not limited to the physical sciences, biological effects of radiation exposure, radiation
74 protection, radiation procedures, CT anatomy and physics, the use of radiopharmaceuticals,
75 adjunctive medications, imaging medication, imaging techniques, and computer applications.
76 A structured clinical education component provides experience in the clinical environment.
77 Clinical education is designed to meet the requirements of the certification exams. Graduates
78 of accredited programs are eligible to sit for certification examinations offered by the
79 NMTCB, ARRT, and/or any other certification board accepted by your state or institution.
80 The Joint Review Committee on Education Programs in Nuclear Medicine Technology
81 accredits training programs in nuclear medicine technology.
82

83 **Licensure**

84 Requirements for licensure of all imaging technologists vary from state to state, so it is
85 important that technologists check the requirements of the state in which they plan to work.
86

87 **Certification**

88 Certification is available from the NMTCB, ARRT, and/or any other certification board
89 accepted by your state or institution
90

91 **Continuing Education**

92 In addition to the general certification requirements, certified technologists also must

93 complete a certain number of continuing education hours to maintain certification.
94 Continuing education is required because of the frequent technological and
95 radiopharmaceutical innovations.

96
97
98

Code of Ethics

99

100 Technologists qualified to perform nuclear medicine procedures are members of the health
101 care profession and must strive as individuals and as a group to maintain the highest ethical
102 standards by adhering to the *Nuclear Medicine Technologist Code of Ethics* approved by the
103 *Society of Nuclear Medicine and Molecular Imaging Technologist Section (SNMMITS)*.

104

105 The principles of the *Nuclear Medicine Technologist Code of Ethics* as listed below are not
106 laws, but standards of conduct to be used as ethical guidelines by nuclear medicine
107 technologists.

108

Principle 1

110 The nuclear medicine technologist will provide services with compassion and respect for
111 the dignity of the individual and with the intent to provide the highest quality of patient
112 care.

113

Principle 2

115 The nuclear medicine technologist will provide care without discrimination regarding the
116 nature of the illness or disease, gender, race, religion, sexual preference, or
117 socioeconomic status of the patient.

118

Principle 3

120 The nuclear medicine technologist will maintain strict patient confidentiality in
121 accordance with state and federal regulations.

122

Principle 4

124 The nuclear medicine technologist will comply with the laws, regulations, and policies
125 governing the practice of nuclear medicine.

126

Principle 5

128 The nuclear medicine technologist will continually strive to improve his or her
129 knowledge and technical skills.

130

Principle 6

132 The nuclear medicine technologist will not engage in fraud, deception, or criminal
133 activities.

134

Principle 7

136 The nuclear medicine technologist will be an advocate for his or her profession.

137

138

Definitions

139

140 **Adjunctive Medication:** Adjunctive medications are defined as those medications used
141 to evoke a specific physiological or biochemical response used in conjunction with
142 diagnostic imaging or therapeutic procedures.

143

144 **ALARA:** ALARA is an acronym for "as low as (is) reasonably achievable," which
145 means making every reasonable effort to maintain exposures to ionizing radiation as far
146 below the dose limits as practical. *The NRC definition under 10 CFR Part 20.1003 of*
147 *ALARA can be found here:* [http://www.nrc.gov/reading-rm/basic-](http://www.nrc.gov/reading-rm/basic-ref/glossary/alara.html)
148 [ref/glossary/alara.html](http://www.nrc.gov/reading-rm/basic-ref/glossary/alara.html).

149

150 **Authorized User:** A physician licensed to permit the medical use of byproduct
151 material. *The NRC definition under 10 CFR Part 35.2 of an Authorized User can be*
152 *found here:* [//www.nrc.gov/reading-rm/doc-collections/cfr/part /part - .html](http://www.nrc.gov/reading-rm/doc-collections/cfr/part/part-.html)

153

154 **Computed Tomography:** A medical imaging technology that uses a computer to
155 acquire a volume of x-ray-based images, generally reconstructed as two-dimensional
156 (2D) or three- dimensional (3D) pictures of inside the body.

157

158 **Diagnostic Imaging:** Diagnostic imaging uses technologies such as x-ray, CT, MR,
159 ultrasound, general nuclear medicine, PET, and single-photon emission computed
160 tomography (SPECT) to provide physicians with a way to look inside the body without
161 surgery.

162

163 **Diagnostic Nuclear Medicine:** The use of radioactive materials (called
164 radiopharmaceuticals or radiotracers) to evaluate molecular, metabolic, physiologic,
165 anatomic, and pathologic conditions of the body for the purposes of diagnosis and
166 research.

167

168 **Hybrid Imaging:** The combination of imaging technologies that allows information
169 from different modalities to be presented as a single set of images.

170

171 **Imaging Device:** A technological apparatus used to produce detailed images of the
172 inside of the body for diagnostic, therapeutic, or research purposes. Examples of these
173 devices include the gamma camera, CT scanner, PET scanner, MR unit, optical imaging
174 detector, and ultrasound device.

175

176 **Imaging Medication:** Medication that is administered immediately before or
177 during an imaging procedure and is used only to enhance imaging studies. It
178 includes but is not limited to iodinated contrast and gadolinium.

179

180 **Isotope:** Atoms of a single element that have differing masses. Isotopes are either
181 stable or unstable (radioisotope). Radioisotopes are radioactive: they emit
182 particulate (alpha, beta) or electromagnetic (gamma) radiation as they transform or
183 decay into stable isotopes.

184

185 **Magnetic Resonance Imaging:** Magnetic resonance (MR) imaging is a diagnostic scan

186 that uses high-strength magnetic fields and radio frequency transmission rather than
 187 ionizing radiation. MR imaging techniques are used primarily to study anatomy, but a
 188 special type of MR scan, functional MR imaging (fMRI), can be used to map blood flow
 189 for functional studies.

190
 191 **Molecular Imaging:** Molecular imaging is an array of non-invasive, diagnostic imaging
 192 technologies that can create images of physical, functional, and anatomical aspects of
 193 the living body at a molecular level. Molecular imaging technologies include, but are not
 194 limited to, nuclear medicine, optical imaging, spectroscopy, PET, and SPECT.

195
 196 **Nuclear Medicine Therapy:** The use of radioactive materials (called
 197 radiopharmaceuticals or radiotracers) to treat disease processes.

198
 199 **Positron Emission Tomography:** Positron emission tomography is a medical imaging
 200 technology using radiopharmaceuticals emitting positrons that annihilate into two
 201 photons. These photon pairs are detected by the PET scanner to produce images.

202
 203 **Radiopharmaceuticals:** Radioactive chemicals used to diagnose, treat, or prevent disease.
 204

205 **Single Photon Computed Tomography:** SPECT imaging uses a gamma camera to
 206 acquire multiple 2-D images (projections) from multiple angles. Tomographic
 207 reconstruction algorithms are applied to the multiple projections, yielding a 3-D dataset.
 208 This dataset may then be manipulated to show thin slices along any chosen axis of the
 209 body, similar to those obtained from other tomographic techniques, such as CT, PET and
 210 MRI.

211
 212 **The Scope of Practice**

213
 214 The scope of practice in nuclear medicine technology includes, *but is not*
 215 *limited to*, the following areas and responsibilities:

216
 217 **Patient Care:** Requires the exercise of judgment to assess and respond to the patient’s
 218 needs before, during, and following diagnostic imaging and treatment procedures and in
 219 patient medication reconciliation. This includes record keeping in accordance with the
 220 Health Insurance Portability and Accountability Act (HIPAA).

221
 222 **Instrumentation/Quality Control:**
 223 Involves the operation of:

224
 225 Nuclear medicine and PET imaging systems:
 226 With or without sealed sources of radioactive materials, x-ray tubes, or MR
 227 systems for attenuation correction, transmission imaging, or diagnostic CT or
 228 MR (when appropriately trained and/or credentialed).

229
 230 Non-imaging
 231 instrumentation:
 232 Dose calibrators

233 Survey instrumentation for exposure and contamination
 234 Probe and well instrumentation
 235 Ancillary patient care equipment as authorized by institutional policies
 236 Infusion systems
 237 Radionuclide generators

238
 239 Quality control:
 240 The evaluation and maintenance of a quality control program for all
 241 instrumentation to ensure optimal performance and stability.
 242

243 **Diagnostic Procedures:** Requires the utilization of appropriate techniques,
 244 radiopharmaceuticals, imaging medications and adjunctive medications as part of a
 245 standard protocol to ensure quality diagnostic images and/or laboratory results.
 246 Obtains biological samples to perform testing as required for the optimization of
 247 patient care and quality of diagnostic procedures.
 248

249 **Therapeutic Procedures:** Requires the utilization of appropriate techniques,
 250 radiopharmaceuticals, and adjunctive medications as part of a standard protocol to ensure
 251 proper treatment of the disease process. Obtains biological samples to perform testing as
 252 required for the optimization of patient care.
 253

254 **Adjunctive Medications:** Involves the identification, preparation, calculation,
 255 documentation, administration, and monitoring of adjunctive medication(s) used during
 256 diagnostic imaging, or therapeutic procedures.
 257

258 **Imaging Medications:** Involves the identification, preparation, calculation, documentation,
 259 administration, and monitoring of imaging medication(s) used during diagnostic imaging
 260 studies.
 261

262 **Radiopharmaceuticals:** Involves the safe handling and storage of
 263 radiopharmaceuticals. This includes, but is not limited to, the procurement,
 264 identification, preparation, dose calculation, and administration of
 265 radiopharmaceuticals. It also includes all associated documentation and disposal as
 266 appropriate.
 267

268 **Radiation Safety:** Involves practicing techniques that will minimize radiation exposure
 269 to the patient, health care personnel, and general public. These include using protective
 270 devices, shields, dose reduction, and monitors consistent with ALARA principles.
 271 Establishing protocols for managing spills and unplanned releases of radiation.
 272

273
 274
 275

The Clinical Performance Standards

276 The clinical performance standards for the nuclear medicine technologist include,
 277 *but are not limited to*, the following areas and responsibilities:

278
 279

I. Patient Care

- 280 A. A nuclear medicine technologist prepares the patient by:
- 281 1. Verifying patient identification, date of last menstrual period, pregnancy
- 282 or breastfeeding status (and alerting the authorized user if there are
- 283 concerns about possible pregnancy), and written orders for the procedure.
- 284 2. Assuring study appropriateness based on indication and patient symptoms.
- 285 Consulting with the authorized user and/or referring physician whenever the request
- 286 is called into question.
- 287 3. Obtaining a pertinent medical history, including medications and allergies,
- 288 and confirming the patient’s candidacy for the procedure.
- 289 4. Ensuring that any pre-procedural preparation has been completed (e.g.,
- 290 fasting, diet, hydration, glucose levels, voiding, bowel cleansing, and
- 291 suspension of interfering medications).
- 292 5. Ensuring that informed consent has been obtained and witnessed, as prescribed
- 293 by the institution, whenever necessary.
- 294 6. Properly explaining the procedure to the patient and/or family and, where
- 295 appropriate, to the parent and/or legal guardian, and when necessary, obtaining
- 296 the assistance of an interpreter or translator. This includes, but is not limited to,
- 297 patient involvement, length of study, radiation safety issues, and post-
- 298 procedure instructions.
- 299
- 300 B. A nuclear medicine technologist provides patient care by:
- 301 1. Assuring comfort and care to the patient prior to, during, and following a procedure.
- 302 This includes, but is not limited to, the use and monitoring of intravenous lines (i.e.,
- 303 central lines, peripherally inserted central catheters (PICC)), oxygen supplies, and
- 304 drains. This also includes the operation of blood pressure cuffs, electrocardiogram
- 305 (ECG) machines, pulse oximeters, glucometers, intravenous pumps, and oxygen
- 306 delivery regulators as authorized by institutional policies.
- 307 2. Inserting and monitoring peripheral intravenous catheters.
- 308 3. Nuclear Medicine Technologists administer radioactive, adjunctive, and imaging
- 309 medications. This includes, but is not limited to, the following: oral, intravenous,
- 310 intramuscular, intradermal, subcutaneous, inhalation.
- 311 4. Monitoring patients who are under minimal sedation in accordance with the
- 312 American Society of Anesthesiologists [ASA] guidelines for conscious sedation and
- 313 per institutional guidelines and documenting during the monitoring period.
- 314 5. Collecting specimens and performing pertinent laboratory procedures. Performing in
- 315 vitro diagnostic testing laboratory analyses as required by established protocols.
- 316 Additionally, performing in vitro diagnostic testing laboratory procedures to measure
- 317 the biodistribution of radiopharmaceuticals.
- 318 6. Establishing and maintaining proper communication with patients (i.e., proper
- 319 introduction, appropriate explanation of procedure, etc.).
- 320 7. Maintaining a professional demeanor at all times to assure the preservation of
- 321 patients’ rights, resulting in the provision of the highest-quality patient care possible.
- 322 8. Following recognized infection control practices to provide a safe and sanitary
- 323 working environment for patients and the general public.
- 324 9. Recognizing and responding to an emergency situation at a level commensurate
- 325 with one’s training and competency, including cardiopulmonary resuscitation

326 (CPR); the use of automatic external defibrillators (AED), if applicable; advanced
327 cardiac life support (ACLS); and advanced pediatric life support (PALS).
328 10. Recognizing, responding to, reporting, and documenting adverse events.

329

330 C. A nuclear medicine technologist performs administrative procedures by:

- 331 1. Maintaining an adequate volume of medical/surgical supplies, imaging
332 medications, adjunctive medications, radiopharmaceuticals, storage media, and
333 other items required to perform procedures in a timely manner.
- 334 2. Scheduling patient procedures appropriate to the indication and in the proper
335 sequence.
- 336 3. Maintaining appropriate records of administered radioactivity, quality control
337 procedures, patient reports, and other required records.
- 338 4. Developing and revising, when necessary, policies and procedures in accordance
339 with applicable regulations.
- 340 5. Actively participating in total quality management/continuous quality
341 improvement programs (i.e., age-specific competencies, patient education, and
342 patient restraint and immobilization).
- 343 6. Complying with licensing standards and institutional policies. The nuclear
344 medicine technologist involved with research must also follow Institutional
345 Research Board protocols, comply with Institutional Animal Care and Use
346 Committee, and Food and Drug Administration standards.

347

348 **II. Instrumentation/Quality Control**

349 A. A nuclear medicine technologist evaluates equipment performance, initiates corrective
350 action when necessary, and maintains required records for the quality control program of
351 gamma camera imaging systems, PET systems, hybrid imaging systems, CT, and/or MR
352 in accordance with applicable regulations, accrediting agencies, and recommendations
353 from camera manufacturers. Responsibilities include but are not limited to:

- 354 1. Identifying system-specific quality control requirements by following
355 recommended initial acceptance quality control procedures and daily, weekly,
356 monthly, quarterly, and annual quality control procedures to evaluate allowable
357 parameter ranges for uniformity, photon detection/discrimination, spatial
358 resolution, scatter correction, count loss, measurement of random interactions,
359 sensitivity, dead-time loss, and random count correction accuracy as
360 recommended by the manufacturer, and required by institutional and
361 accreditation policies.
- 362 2. Recognizing image artifacts requiring imaging system correction and performing
363 corrections and quality assurance.
- 364 3. Performing and evaluating sinogram acquisition or other routine quality control
365 procedures to evaluate detector integrity.
- 366 4. Performing imaging system quality assurance is based upon recommendations
367 from the physicist, service engineer, and/or camera manufacturer. It includes,
368 but is not limited to:
 - 369 a. Obtaining uniformity images on imaging detectors.
 - 370 i. Selecting a radionuclide source of appropriate type, size,
371 quantity, and energy.

- 372 ii. Selecting an appropriate pulse height analyzer (PHA), photopeak,
373 and window.
- 374 iii. Obtaining uniformity images using standardized imaging
375 parameters.
- 376 iv. Evaluating the images qualitatively and/or
377 quantitatively in comparison to the manufacturer's
378 specifications and the performance requirements based
379 on the studies for which the unit is used.
- 380 v. Identifying the source of any significant nonuniformity
381 (e.g., checking collimator and PHA peak setting).
- 382 vi. Initiating corrective action when necessary.
- 383 b. Performing a detector linearity evaluation on imaging detectors.
- 384 i. Selecting a radionuclide, selecting a linearity phantom,
385 and obtaining images.
- 386 ii. Identifying any nonlinear distortion in the
387 image.
- 388 iii. Determining the source of nonlinearity (e.g., detector–
389 source geometry).
- 390 iv. Initiating corrective action when necessary.
- 391 c. Performing spatial resolution checks on imaging detectors.
- 392 i. Selecting an appropriate radionuclide.
- 393 ii. Choosing a phantom that is compatible with the
394 specified resolution of the camera.
- 395 iii. Analyzing the resulting images for degradation of resolution
396 and determining the causes.
- 397 iv. Initiating corrective action when necessary.
- 398 d. Conducting sensitivity checks on imaging detectors yearly in
399 conjunction with a physicist.
- 400 i. Selecting a source with an appropriate level of activity and half-
401 life.
- 402 ii. Ensuring identical geometry, source placement, and
403 measurement parameters for repetitive checks.
- 404 iii. Evaluating results.
- 405 iv. Initiating corrective action when necessary.
- 406 e. Performing single-photon emission computed tomography (SPECT) quality
407 control procedures based on camera manufacturer recommendations,
408 including but not limited to:
- 409 i. Obtaining a high-count uniformity calibration flood.
- 410 ii. Obtaining a center-of-rotation calibration to ensure
411 detector alignment.
- 412 iii. Evaluating reconstruction results of an acquired cylindrical SPECT
413 phantom with contrast and spatial resolution inserts:
- 414 a. Detector quality control may include but is not limited to
415 the evaluation of system uniformity, sensitivity, linearity
416 and spatial resolution.
- 417 b. Record and evaluate results according to manufacturer

- 418 guidelines' institutional and accreditation policy.
 419 c. Initiating corrective action when necessary.
 420 f. Performing CT system quality assurance based on camera manufacturer
 421 recommendations, including but not limited to:
 422 i. Daily: Follow camera manufacturers' described warm-up procedure
 423 and automatic monitoring, at various tube voltage (kVp) or current
 424 (mAs) settings, of the tube output and detector response.
 425 ii. Follow camera manufacturers' recommendations: Perform a phantom
 426 evaluation to determine tomographic uniformity accuracy of the CT
 427 number for water, image noise, and slice thickness.
 428 iii. Initiating corrective action when necessary.
 429 g. Performing PET or PET/CT system quality assurance based on camera
 430 manufacturer recommendations, including but not limited to:
 431 i. Acquiring consistent 2D and/or 3D PET images, using appropriate
 432 reconstruction techniques, to display sinogram images for QC
 433 interpretation.
 434 ii. Working in conjunction with medical director or medical
 435 physicists verifying CT/AC protocols, including mAs, kVp, pitch,
 436 and helical scanning.
 437 iii. Initiating corrective action when necessary.
 438 5. Performing radionuclide generator quality assurance, daily and before the use of the
 439 generator, to include dose calibrator/generator calibration and parent/daughter
 440 breakthrough.
 441 6. Performing infusion device quality control per manufacturer recommendations.
 442 7. Operating imaging systems, storage media, and radiation detection and counting
 443 devices, including but not limited to imaging detectors, dose calibrators, survey
 444 instruments, scintillation probes, well counters, and data processing and image
 445 production devices:
 446 a. Maintaining and operating auxiliary equipment used in procedures.
 447 b. Actively participating in total quality management/continuous quality
 448 improvement programs by:
 449 i. Identifying indicators to be analyzed.
 450 ii. Gathering and presenting data in appropriate formats, analyzing
 451 data, and recommending changes.
 452 8. Operating scintillation probes, well counters, and other laboratory equipment:
 453 a. Calibrating a spectrometer with a long-half-life radionuclide source.
 454 b. Determining energy resolution.
 455 c. Conducting sensitivity and constancy measurements at appropriate
 456 energies with a standard, long-lived source Cs-137 or I-129.
 457 d. Checking background and determining the cause for levels greater than
 458 established normal levels.
 459 e. Conducting a chi-square test.
 460 f. Maintaining required records for quality control programs in
 461 accordance with federal and state regulations and institutional policies.
 462 g. Performing glucometer quality assurance using high and low standards.
 463 9. Operating survey meters:

- 464 a. Ensuring that calibration has been completed within the last 12 months.
 465 b. Performing a battery check to verify the meter is operational.
 466 c. Performing a check-source test and comparing with previous results.
 467 d. Maintaining required records for the quality control program.
- 468 10. Operating dose calibrator:
- 469 a. Verifying constancy every day that isotopes are administered to patients,
 470 including weekends and on-call hours, and checking channels of the
 471 isotopes used that day using a check source with a long half-life.
- 472 b. Verifying linearity quarterly over the entire range of radionuclide activity
 473 to be administered to patients, comparing calculated activities to measured
 474 activities, and determining correction factors when necessary.
 475 Determining accuracy annually by comparing a set of known activities to
 476 measured activities using isotopes of varying energy emissions such as
 477 Co-57, Ba-133, and Cs-137.
- 478 c. Upon installation, testing for significant geometric variation in activity
 479 measured as a function of sample volume or configuration and
 480 determining correction factors when necessary.
- 481 d. Maintaining required records for the quality control program in
 482 accordance with federal and state regulations and institutional policies.
- 483 11. Operating image processors/computer monitors:
- 484 a. Verifying the calibration of the instrument.
 485 b. Maintaining required records for the quality control program.

III. Diagnostic Procedures

- 488 A. A nuclear medicine technologist performs imaging procedures by:
- 489 1. Determining appropriate imaging parameters.
- 490 a. Preparing (see Section V.C.), evaluating, and properly administering the
 491 prescribed amount of various radiopharmaceuticals, adjunctive
 492 medications, and/or imaging medications.
- 493 b. Selecting the appropriate imaging or data collection parameters.
- 494 2. Administering radiopharmaceuticals, adjunctive medications, and/or imaging
 495 medications through various routes (including but not limited to oral, intravenous,
 496 intramuscular, intradermal, subcutaneous, inhalation) in accordance with
 497 established protocols and verifying that the radiopharmaceutical meets quality
 498 specifications prior to administration (i.e., expiry time, pH, half-life, etc.).
- 499 3. Administering radiopharmaceuticals, adjunctive medications, and imaging
 500 medications:
- 501 a. Verifying patient ID according to institutional policy.
 502 b. Determining route of administration according to established protocol.
 503 c. Establishing and/or verifying venipuncture access using aseptic technique.
 504 d. Using and maintaining established venous access routes (e.g., heparin
 505 infusion set, infusion pump, peripherally inserted central catheter (PICC),
 506 and central line).
- 507 e. Reconciling patient medications according to institutional policy to ensure
 508 that the patient's current medications will not interact with the
 509 radiopharmaceutical, adjunctive medications, and imaging medications

- 510 used for the ordered exam.
- 511 f. Preparing (see Section IV.C.) and administering adjunctive medications
512 and imaging medications per the appropriate route.
- 513 g. Documenting medications and/or radiopharmaceutical administrations in
514 the patient medical record in accordance with federal and state regulations
515 and institutional policies.
- 516 h. Observing the patient carefully after any administration for side effects,
517 and handling such side effects appropriately as described in established
518 policies or as directed by medical staff.
- 519 4. Positioning the patient and obtaining images:
- 520 a. Verifying energy peak on NM cameras.
- 521 b. Waiting an appropriate time following the administration of a
522 radiopharmaceutical, adjunctive medication, or imaging medication to
523 begin the imaging procedure protocol, and acquiring additional views as
524 necessary to optimize information content.
- 525 c. Exercising professional judgment in positioning a patient to best
526 demonstrate pathology and to adapt to the patient's limitations.
- 527 d. Positioning the patient using supportive materials and immobilizers, as
528 necessary.
- 529 e. Indicating appropriate anatomic landmarks for each view of the
530 procedure.
- 531 f. Reviewing images to ensure that the required information has been
532 acquired and that the images have been processed properly and are of
533 the highest quality.
- 534 5. Assisting in exercise and pharmacologic cardiac testing procedures:
- 535 a. Preparing patients to include the correct placement of ECG electrodes.
- 536 b. Determining if the appropriate test has been ordered based on the ECG
537 rhythm, medical history, and current medications.
- 538 c. Recognizing and responding to ECG changes.
- 539 d. Recognizing the parameters that indicate termination of a cardiac stress
540 study.
- 541 e. Recognizing ECG patterns that are appropriate for image gating.
- 542 6. Performing data collection, processing, and analysis:
- 543 a. Performing data collection, processing, and analysis in accordance with
544 institutional protocols.
- 545 b. Exercising independent judgment in selecting appropriate images for
546 processing.
- 547 c. Obtaining quantitative measurements such as SUV, coronary flow reserve,
548 kinetic modeling, regional brain analysis, biliary and cardiac ejection
549 fractions, and renal function, as appropriate for the procedure performed.
- 550 d. Defining regions of interest (ROIs) with reproducible results and correctly
551 applying background subtraction.
- 552 e. Performing computer data manipulations as required.
- 553 f. Labeling processed images (e.g., anatomical positioning, ROIs, date, and
554 time).
- 555 g. Archiving to and retrieving data from storage media.

- 556
557 B. A nuclear medicine technologist may perform non-imaging in vitro and/or radioassay
558 studies by:
- 559 1. Operating laboratory equipment, including well counters, probes, and other
560 detection devices to measure the biodistribution of radiopharmaceuticals.
 - 561 2. Preparing doses:
 - 562 a. Quantitating doses:
 - 563 i. Calculating and confirming the activity to be used
 - 564 ii. Calculating the volume necessary to deliver activity for the
565 prescribed dose.
 - 566 iii. Preparing standard solutions or dosage for phantom use as
567 needed using appropriate volumetric or gravimetric
568 techniques to dilute the standard per institutional protocol.
 - 569 3. Collecting appropriate biological specimens for procedures using standard
570 precaution techniques as required by protocol:
 - 571 a. Collecting blood samples:
 - 572 i. Selecting proper supplies (e.g., needles, syringes, evacuated tubes,
573 or anticoagulants).
 - 574 ii. Identifying and verifying the patient and labeling patient
575 demographics on collection containers.
 - 576 iii. Performing venipuncture at appropriate intervals using aseptic
577 technique.
 - 578 iv. Adding hemolyzing compounds or anticoagulants to samples
579 according to protocol.
 - 580 v. Centrifuging blood and separating blood components, according to
581 protocol.
 - 582 vi. Storing aliquots of serum, plasma, or whole blood according to
583 protocol.
 - 584 b. Collecting urine samples by:
 - 585 i. Instructing the patient and/or nursing staff regarding the correct
586 method and time of urine collection.
 - 587 ii. Aliquoting the urine sample and measuring total urine volume.
 - 588 iii. Measuring the specific gravity of urine, if required.
 - 589 iv. Recognizing and documenting all technical circumstances that
590 would produce invalid results
 - 591 4. Gathering, validating, and documenting data:
 - 592 a. Subtracting room background or patient background from appropriate
593 samples.
 - 594 b. Applying appropriate formulas, including conversion and dilution factors.
 - 595 c. Calculating results according to the procedure used.
 - 596 d. Plotting a graph, if necessary, and determining half time by extrapolating
597 to zero time.
 - 598 e. Reporting both calculated values for a patient and normal range of specific
599 procedures used.
 - 600 f. Evaluating results for potential error.
 - 601 5. Managing biohazardous, chemical, and radioactive waste in accordance with

602 applicable state and federal regulations and institutional policy.

603

604 **IV. Adjunctive Medications**

605 A nuclear medicine technologist displays:

606 A. A thorough understanding and knowledge of indications, contraindications, warnings,
607 precautions, proper use, drug interactions, and adverse reactions for each adjunct
608 medication to be used.

609

610 B. The ability to procure and maintain adjunctive medications and supplies by:

611 1. Anticipating and procuring a sufficient supply of medications for an appropriate
612 period in accordance with anticipated need.

613 2. Storing medications and supplies in a manner consistent with labeled product
614 safeguards and established institutional policies.

615 3. Identifying and properly disposing of expired medications.

616

617 C. The ability to properly prepare and administer adjunctive medications under the
618 supervision of an authorized user by:

619 1. Employing aseptic technique for manipulation of sterile products and
620 preparations.

621 2. Selecting and preparing adjunctive medications.

622 3. Confirming the quality of an adjunctive medication in accordance with accepted
623 techniques and official standards.

624 4. Documenting the administered dose, date, and time of all adjunctive medications
625 in a permanent medical record.

626 5. Observing the patient for possible complications (e.g., adverse reactions) of
627 adjunctive medication administration, and handling such complications
628 appropriately in conjunction with other available staff.

629

630 **V. Imaging Medications**

631 A nuclear medicine technologist displays:

632 A. A thorough understanding and knowledge of indications, contraindications, warnings,
633 precautions, proper use, drug interactions, and adverse reactions for each imaging
634 medication to be used.

635

636 B. The ability to procure and maintain imaging medications and supplies by:

637 1. Anticipating and procuring a sufficient supply of medications for an appropriate
638 period in accordance with anticipated need.

639 2. Storing medications and supplies in a manner consistent with labeled product
640 safeguards and established institutional policies.

641 3. Identifying and properly disposing of expired medications.

642

643 C. The ability to properly prepare and administer imaging medications under the
644 supervision of an authorized user by:

645 1. Employing aseptic technique for manipulation of sterile products and
646 preparations.

647 2. Selecting and preparing imaging medications in accordance with the
648 manufacturer's specifications and institutional policy.

- 649 3. Confirming the quality of an imaging medication in accordance with accepted
650 techniques and official standards.
- 651 4. Documenting the administered dose, date, and time of all imaging medications in
652 a permanent medical record.
- 653 5. Observing the patient for possible complications (e.g., adverse reactions) of
654 imaging medication administration, and handling such complications
655 appropriately in conjunction with other available staff.

656
657 **VI. Radiopharmaceuticals**

658 A. A nuclear medicine technologist displays a:

- 659 1. Thorough knowledge of indications, contraindications, warnings, precautions,
660 proper use, drug interactions, and adverse reactions for each radiopharmaceutical
661 to be used.
- 662 2. Thorough knowledge of biochemical and molecular functions that relate to, but
663 not limited to, glucose metabolism, blood flow, brain oxygen utilization,
664 perfusion, and receptor–ligand binding rates.
- 665 3. Thorough knowledge of the physiological and biochemical processes that
666 relate to organ system function and anatomy and radiopharmaceutical
667 demonstration of normal and pathologic states.

668
669 B. A nuclear medicine technologist maintains radiopharmaceutical products by:

- 670 1. Anticipating and procuring a sufficient supply of radiopharmaceuticals for an
671 appropriate period in accordance with anticipated need and license possession
672 limits.
- 673 2. Maintaining security while storing radiopharmaceuticals in a manner consistent
674 with the manufacturer’s labeled product safeguards, radiation safety
675 considerations, and established policies.
- 676 3. Performing and documenting radiation survey and wipe tests upon receipt of
677 radioactive materials.
- 678 4. Recording receipt of radioactive materials in a permanent record.
- 679 5. Following Department of Transportation (DOT) regulations and radiation safety
680 guidelines in the transport, receipt, and shipment of radioactivity.

681
682 C. A nuclear medicine technologist properly prepares and administers
683 radiopharmaceuticals under the direction of an authorized user in accordance with all
684 federal and state regulations and institutional policies by:

- 685 1. Preparing all sterile radiopharmaceuticals in appropriate environments in compliance
686 with USP and FDA Standards.
- 687 2. Following appropriate personnel cleansing and garbing protocols when entering
688 “clean” areas in accordance with USP Standards.
- 689 3. Employing aseptic technique, consistent with USP Standards, when mixing and
690 manipulating sterile products
- 691 4. Following appropriate USP Standards for beyond-use date (time-of-use) and vial
692 puncture standards.
- 693 5. Assembling and maintaining radionuclide generators.
- 694 6. Eluting radionuclide generators according to the manufacturer’s specification in a

- 695 “clean” environment that complies with USP Standards.
 696 7. Verifying the radionuclidic purity of generator eluates.
 697 8. Selecting and preparing radiopharmaceuticals in accordance with the
 698 manufacturer’s specifications.
 699 9. Measuring the radioactivity of the radiopharmaceutical using a dose calibrator.
 700 10. Confirming the quality of a radiopharmaceutical in accordance with accepted
 701 techniques and official standards (e.g., radiochemical purity and physical
 702 appearance).
 703 11. Handling and preparing blood or blood products for labeling and/or labeled blood
 704 cells in accordance with established regulations and protocols and in an
 705 environment in compliance with USP Standards, and ensuring that when blood
 706 products are handled and compounded they are separated from other
 707 radiopharmaceuticals.
 708 12. Recording use and/or disposition of all radioactive materials in a permanent
 709 record:
 710 a. Properly storing radiopharmaceutical kits, and radiopharmaceuticals as
 711 stated in USP Standards.
 712 b. Recording results of radionuclide generator eluates’ quality assurance tests
 713 to include dose calibrator/generator calibration and radionuclidic purity of
 714 eluates.
 715

716 D. A nuclear medicine technologist is responsible for the identification and labeling of all
 717 radiopharmaceutical preparations by:

- 718 1. Labeling vials and syringes.
 719 2. Recording radiopharmaceutical and medication information on a patient's
 720 administration form and permanent preparation records.
 721 3. Labeling and segregating radioactive waste and recording the information in a
 722 permanent record.
 723

724 E. A nuclear medicine technologist prepares individual dosages under the supervision of
 725 an authorized user by:

- 726 1. Applying radioactive decay calculations to determine the required volume or unit
 727 form necessary to deliver the prescribed radioactive dose.
 728 2. Selecting and preparing prescribed dosages and entering the information on a
 729 patient’s administration form and other permanent records.
 730 3. Appropriately labeling the dose for administration.
 731 4. Checking the dose activity prior to administration in a dose calibrator and
 732 comparing this measurement against the shipment documentation.
 733 5. Recording use and/or disposition of radioactive materials in a permanent
 734 record by properly storing radiopharmaceuticals.
 735

736 **VII. Radionuclide Therapy**

737 A. A nuclear medicine technologist properly prepares and/or administers therapeutic
 738 radiopharmaceuticals when these agents are part of a standard procedure that is required
 739 for treatment under the direct supervision of an authorized user by:

- 740 1. Ensuring that the correct radiopharmaceutical and dosage is prepared.

- 741 2. Following the quality management program in effect at the facility in regard to
742 patient identification and verification and the use of therapeutic
743 radiopharmaceuticals.
- 744 3. Observing prescribed radiation safety using FDA and USP Standards during the
745 preparation and administration of such treatment.
- 746 4. Assisting the authorized user in supplying proper patient care instructions to
747 hospital staff, patient, and/or caregivers.
- 748 5. Conducting and documenting radiation surveys of designated patient areas, when
749 indicated.
- 750 6. Instructing the patient, family, and staff in radiation safety precautions after the
751 administration of therapeutic radiopharmaceuticals.
- 752 7. Coordinating/scheduling pre-/post treatment blood/urine draws and/or imaging.
- 753 8. Maintaining all appropriate records.

754
755 **VIII. Radiation Safety**

756 A. A nuclear medicine technologist performs all procedures utilizing ionizing radiation
757 safely and effectively by:

- 758 1. Maintaining security of radioactive materials.
- 759 2. Notifying the appropriate authority when changes occur in the radiation safety
760 program.
- 761 3. Assisting in the preparation of license amendments when necessary.
- 762 4. Keeping up to date on regulatory changes and complying with all applicable
763 regulations.
- 764 5. Maintaining required records.
- 765 6. Posting appropriate radiation signage in designated areas.
- 766 7. Following federal and state regulations regarding receipt, storage, disposal, and
767 usage of all radioactive materials.
- 768 8. Recommending the purchase of radiation protection equipment to meet federal
769 and state regulations and institutional policies.
- 770 9. Packaging and monitoring radioactive material for transport according to federal
771 and state regulations, and keeping accurate records of transfer.

772
773 B. A nuclear medicine technologist follows appropriate radiation protection procedures
774 by:

- 775 1. Using personnel monitoring devices (film badges, optically stimulated
776 luminescence [OSL] thermoluminescent dosimeters, etc.).
- 777 a. Reviewing personnel exposure records in regard to maximum
778 permissible dose limits.
- 779 b. Taking appropriate measures to reduce exposure.
- 780 c. Notifying proper authorities of excessive exposure
781 upon discovery/occurrence.
- 782 2. Selecting and using proper syringe shields and other shielding configurations to
783 reduce radiation exposure to patients, personnel, and the general public.
- 784 3. Using proper shielding and disposal procedures to maximize patient, technologist,
785 and public protection.
- 786 4. Working in a safe but timely manner in order to decrease radiation exposure in

- 787 consideration of ALARA guidelines.
- 788 5. Reviewing personnel monitoring device readings to determine if radiation
789 exposure can be further reduced.
- 790 6. Working in a manner that minimizes potential contamination of patients,
791 technologists, the public, and work areas.
- 792
- 793 C. A nuclear medicine technologist monitors for radioactive contamination at
794 regular intervals or after repairs by:
- 795 1. Ensuring that instruments are calibrated.
- 796 2. Setting the frequency and locations for surveys and following schedules.
- 797 3. Using appropriate survey meters for each type and level of activity.
- 798 4. Following federal and state regulations regarding personnel surveys and reporting
799 to the designated authorized user or radiation safety officer.
- 800 5. Performing constancy checks on survey meters.
- 801 6. Performing wipe tests where applicable.
- 802 7. Performing leak tests on sealed sources.
- 803 8. Recording data in the required format (e.g., dpm instead of cpm).
- 804 9. Evaluating the results of wipe tests and area surveys to determine if action is
805 required.
- 806 10. Notifying the radiation safety officer when actions are required.
- 807
- 808 D. A nuclear medicine technologist performs decontamination procedures by:
- 809 1. Wearing personal protective equipment as necessary.
- 810 2. Restricting access to the affected area and confining a spill.
- 811 3. Removing contamination and monitoring the area and personnel, and repeating
812 the decontamination procedure until activity levels are acceptable.
- 813 4. Closing off all areas of fixed contamination that are above acceptable levels,
814 shielding the area, and posting appropriate signs.
- 815 5. Identifying, storing, or disposing of contaminated material.
- 816 6. Maintaining appropriate decontamination records.
- 817 7. Notifying the appropriate authority (e.g., radiation safety officer) in the event of
818 possible overexposure or other violations of federal and state regulations and
819 institutional policies.
- 820
- 821 E. A nuclear medicine technologist disposes of radioactive waste by:
- 822 1. Maintaining appropriate records.
- 823 2. Disposing according to license specifications.
- 824 3. Maintaining radioactive storage areas.
- 825 4. Maintaining current Hazmat training records per NRC and Organization of
826 Agreement States (OAS) regulations.
- 827 F. A nuclear medicine technologist participates in programs designed to instruct other
828 personnel about radiation hazards and principles of radiation safety by:
- 829 1. Using the following teaching concepts:
- 830 a. Types of ionizing radiation.
- 831 b. Biological effects of ionizing radiation.

- 832 c. Limits of dose, exposure, and radiation effect.
833 d. Concepts of low-level radiation and health.
834 e. Concept of risk versus benefit.
835 f. ALARA
- 836 2. Providing appropriate radiation safety measure instructions.
837 3. Providing proper emergency procedures instruction.
838 4. Modeling proper radiation safety techniques and shielding in the course of daily
839 duties.
- 840
- 841 G. A nuclear medicine technologist assists in performing radiation safety procedures
842 associated with radionuclide therapy by:
- 843 1. Following the guidelines for administration of therapeutic radiopharmaceuticals
844 and the release of patients administered therapeutic radiopharmaceuticals.
845 2. Following the guidelines for the release of patients administered radioactive
846 materials.
847 3. Following the proper procedures for patients requiring hospitalization after
848 administration of therapeutic radiopharmaceuticals.
849 4. Providing appropriate instruction on radiation safety procedures for patients, care
850 givers, and staff.
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