

Nuclear Medicine Technologist Scope of Practice and Performance Standards

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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 medicine
5 technologist.

6
7 The spectrum of responsibilities for a nuclear medicine technologist varies widely across the
8 United States. Practice components presented in this document provide a basis for establishing
9 the areas of knowledge and performance for the nuclear medicine technologist. The nuclear
10 medicine technologist must be in compliance with all federal, state, and institutional guidelines,
11 including proper documentation of initial and continued competency in those practices and
12 activities.

13
14 Continuing education is a necessary component in maintaining the skills required to perform all
15 duties and tasks of the nuclear medicine technologist in this ever-evolving field.

16 **Limitation of Scope and Disclaimer**

17
18 This document is intended to set forth the standards in important areas of the nuclear medicine
19 technologist's responsibilities. It may not cover all areas which may present themselves in actual
20 practice. These standards do not supersede the judgment of the individual nuclear medicine
21 technologist and other healthcare professionals serving the patient in light of all of the facts of
22 the individual case. THE SOCIETY OF NUCLEAR MEDICINE AND MOLECULAR
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25 DOCUMENTS.
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27
28 **Overview**

29
30 Nuclear medicine is a medical technology that utilizes sealed and unsealed radioactive materials
31 for diagnostic, treatment, and research purposes. Nuclear medicine instrumentation may be
32 combined with, computed tomography (CT), or other modalities to generate attenuation
33 correction and produce three-dimensional images with or without contrast (adjunctive
34 medications) to enhance the evaluation of physiological processes at a molecular level.
35

36 **Technologist Qualified to Perform Nuclear Medicine Procedures**

37
38 Under the direction of an authorized user, the nuclear medicine technologist is responsible for
39 the safe use of ionizing and nonionizing radiation to for diagnostic, therapeutic, and research
40 purposes. The technologist will review the patient's medical history to understand the patient's
41 illness and pending diagnostic or treatment procedure; instruct the patient before, during, and
42 following the procedure; evaluate the satisfactory preparation of the patient before beginning a
43 procedure; and recognize emergency patient conditions and initiate lifesaving first aid when
44 appropriate.
45

46
47 Administrative functions may include supervising other technologists, students, and other

48 personnel; participating in procuring supplies and equipment; documenting laboratory
49 operations; participating in radiation safety protocols and taking an active role in radiation
50 reduction programs; participating in departmental inspections conducted by various licensing,
51 regulatory, and accrediting agencies; participating in departmental quality assurance or quality
52 improvement projects; and participating in scheduling patient procedures.

53
54 A certified nuclear medicine technologist is qualified to perform general nuclear medicine
55 procedures, nuclear medicine therapy, nuclear cardiology procedures, and positron emission
56 tomography (PET) procedures at entry level. The certified nuclear medicine technologist is an
57 individual who is registered or certified by the *Nuclear Medicine Technology Certification Board*
58 (NMTCB) or the *American Registry of Radiologic Technologists* (ARRT) in nuclear medicine
59 technology or is a registered technologist with the Canadian Association of Medical Radiation
60 Technologists (CAMRT).

61
62 **Education:**

63 Nuclear Medicine Technologists may complete a one- or two- year certificate program, a two-
64 year associate's degree, or a four-year bachelor's degree. Didactic courses include but are not
65 limited to the physical sciences, biological effects of radiation exposure, radiation protection and
66 procedures, the use of radiopharmaceuticals and adjunct pharmaceuticals, imaging techniques,
67 and computer applications. A structured clinical education component provides experience in the
68 clinical environment. Clinical education is designed to meet the requirements of the certification
69 exams. Graduates of accredited programs are eligible to sit for certification examinations offered
70 by the NMTCB and ARRT.

71
72 The Joint Review Committee on Education Programs in Nuclear Medicine Technology accredits
73 training programs in nuclear medicine technology.

74
75 **Licensure**

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

78
79 **Certification**

80 Certification is available from the NMTCB, ARRT, and CAMRT.

81
82 **Continuing Education**

83 In addition to the general certification requirements, certified technologists also must complete a
84 certain number of continuing education hours to maintain certification. Continuing education is
85 required primarily because of the frequent technological and radiopharmaceutical innovations.

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88 **Code of Ethics**

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

93

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

96

97 Principle 1

98 The nuclear medicine technologist will provide services with compassion and respect for
99 the dignity of the individual and with the intent to provide the highest quality of patient
100 care.

101

102 Principle 2

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

106

107 Principle 3

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

110

111 Principle 4

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

114

115 Principle 5

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

118

119 Principle 6

120 The nuclear medicine technologist will not engage in fraud, deception, or criminal
121 activities.

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123 Principle 7

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

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Definitions

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Adjunctive Medication: Involves the identification, preparation, calculation, documentation, administration, and monitoring of adjunctive medication(s) used during diagnostic, therapeutic, or research procedures. Adjunctive medications are defined as those medications used to evoke a specific physiological or biochemical response. Also included are the preparation and administration of oral and IV contrast used in the performance of imaging studies.

ALARA: Acronym for **A**s **L**ow **A**s **R**easonably **A**chievable. This is a radiation safety principle for minimizing radiation doses and releases of radioactive materials by employing all reasonable methods.

Authorized User: The NRC definition under 10 CFR Part 35.2 of an *Authorized User* can be found here: [://www.nrc.gov/reading-rm/doc-collections/cfr/part035/part035-0002.html](http://www.nrc.gov/reading-rm/doc-collections/cfr/part035/part035-0002.html)

Computed Tomography: A medical imaging technology that uses a computer to acquire a volume of x-ray–based images, generally reconstructed as two-dimensional (2D) or three-dimensional (3D) pictures of inside the body. These images can be rotated and viewed from any angle. Each CT image is effectively a single “slice” of anatomy.

Diagnostic Imaging: Diagnostic imaging uses technologies such as x-ray, CT, MR, ultrasound, traditional nuclear medicine, PET, and single-photon emission computed tomography (SPECT) to provide physicians with a way to look inside the body without surgery. Diagnostic imaging is considered a non-invasive diagnostic technique, as opposed to a biopsy or exploratory surgery. PET, SPECT, and some types of MR imaging also provide information about how certain tissues and organs are functioning.

Diagnostic Nuclear Medicine: The use of very small amounts of radioactive materials (called radiopharmaceuticals or radiotracers) to evaluate molecular, metabolic, physiologic, and pathologic conditions of the body for the purposes of diagnosis and research. Nuclear medicine procedures often identify abnormalities very early in the progression of a disease.

Hybrid Imaging: The combination of two imaging technologies that allows information from two different studies to be presented as a single set of images.

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

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

Magnetic Resonance Imaging: Magnetic resonance (MR) imaging is a diagnostic scan that uses

171 high-strength magnetic fields rather than radiation. MR imaging techniques are used primarily to
172 study anatomy, but a special type of MR scan, functional MR imaging (fMRI), can be used to
173 map blood flow for functional studies.

174

175 **Molecular Imaging:** Molecular imaging is an array of non-invasive, diagnostic imaging
176 technologies that can create images of both physical and functional aspects of the living body at
177 a molecular level. Molecular imaging technologies include, but are not limited to, traditional
178 nuclear medicine, optical imaging, spectroscopy, PET, and SPECT.

179

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

182

183 **Positron Emission Tomography:** Positron emission tomography is a medical imaging
184 technology using radiopharmaceuticals emitting positrons which annihilate into two photons.
185 These photon pairs are detected by the PET scanner, where the location of the original positron
186 atom is extrapolated.

187

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

193

194

195 **THE SCOPE OF PRACTICE**

196
197 The scope of practice in nuclear medicine technology includes, *but is not limited to*, the
198 following areas and responsibilities:

199
200 **Patient Care:** Requires the exercise of judgment to assess and respond to the patient’s needs
201 before, during, and after diagnostic imaging and treatment procedures and in patient medication
202 reconciliation. This includes record keeping in accordance with the Health Insurance Portability
203 and Accountability Act (HIPAA).

204
205 **Instrumentation/Quality Control:**
206 Involves the operation of:

207
208 Nuclear medicine and PET imaging systems:
209 With or without sealed sources of radioactive materials, x-ray tubes, or MR systems for
210 attenuation correction, transmission imaging, or diagnostic CT or MR (when
211 appropriately trained and/or credentialed).

212
213 Non-imaging instrumentation:

- 214 Dose calibrators
- 215 Survey instrumentation for exposure and contamination
- 216 Probe and well instrumentation
- 217 Ancillary patient care equipment as authorized by institutional policies
- 218 Infusion systems
- 219 Radionuclide generators

220
221 Quality control:

222 The evaluation and maintenance of a quality control program for all instrumentation to
223 ensure optimal performance and stability.

224
225 **Diagnostic Procedures:** Requires the utilization of appropriate techniques,
226 radiopharmaceuticals, and adjunctive medications as part of a standard protocol to ensure quality
227 diagnostic images and/or laboratory results. Obtains biological samples to perform testing as
228 required for the optimization of patient care and quality of diagnostic procedures.

229
230 **Therapeutic Procedures:** Requires the utilization of appropriate techniques,
231 radiopharmaceuticals, and adjunctive medications as part of a standard protocol to ensure proper
232 treatment of the disease process. Obtains biological samples to perform testing as required for
233 the optimization of patient care.

234
235 **Adjunctive Medications:** Involves the identification, preparation, calculation, documentation,
236 administration, and monitoring of adjunctive medication(s) used during diagnostic imaging, or
237 therapeutic procedure. Adjunctive medications are defined as those medications used to evoke a
238 specific physiological or biochemical response. Also included are the preparation and
239 administration of oral and IV contrast used in the performance of imaging studies.

240

241 **Radiopharmaceuticals:** Involves the safe handling and storage of radiopharmaceuticals. This
242 includes, but is not limited to, the procurement, identification, dose calculation, and
243 administration of radiopharmaceuticals. It also includes all associated documentation and
244 disposal as appropriate.

245

246 **Radiation Safety:** Involves practicing techniques that will minimize radiation exposure to the
247 patient, health care personnel, and general public, through consistently using protective devices,
248 shields, dose reduction, and monitors consistent with ALARA principles and establishing
249 protocols for managing spills and unplanned releases of radiation.

250

251 **THE CLINICAL PERFORMANCE STANDARDS**

252
253 The clinical performance standards for the nuclear medicine technologist include, *but are not*
254 *limited to*, the following areas and responsibilities:
255

256 **I. Patient Care**

257 A. A nuclear medicine technologist prepares the patient by:

- 258 1. Verifying patient identification, date of last menstrual period,
259 pregnancy/breastfeeding status (and alerting the authorized user if there are
260 concerns about possible pregnancy), and written orders for the procedure.
- 261 2. Assuring study appropriateness based on indication and patient symptoms.
262 Consulting with the authorized user and/or referring physician whenever the
263 request is called into question.
- 264 3. Obtaining a pertinent medical history, including medications and allergies, and
265 confirming the patient’s candidacy for the procedure.
- 266 4. Ensuring that any pre-procedural preparation has been completed (e.g., fasting,
267 diet, hydration, glucose levels, voiding, bowel cleansing, and suspension of
268 interfering medications).
- 269 5. Ensuring that informed consent has been obtained, as prescribed by the
270 institution, whenever necessary.
- 271 6. Properly explaining the procedure to the patient and/or family and, where
272 appropriate, to the parent and/or legal guardian, and when necessary, obtaining
273 the assistance of an interpreter or translator. This includes, but is not limited to,
274 patient involvement, length of study, radiation safety issues, and post-procedure
275 instructions.
- 276 7. Collecting specimens and performing pertinent laboratory procedures.
277 Performing in vitro diagnostic testing laboratory analyses as required by
278 established protocols. Additionally, performing in vitro diagnostic testing
279 laboratory procedures to measure the biodistribution of radiopharmaceuticals.

280
281 B. A nuclear medicine technologist provides patient care by:

- 282 1. Verifying the patient ID according to institutional policy and verifying the
283 appropriateness of the test being ordered.
- 284 2. Assuring comfort and care to the patient prior to, during, and after a procedure.
285 This includes, but is not limited to, the monitoring of intravenous lines (i.e.,
286 central lines, peripherally inserted central catheters [PICC]), oxygen supplies, and
287 drains. This also includes the operation of blood pressure cuffs, electrocardiogram
288 (ECG) machines, pulse oximeters, glucometers, intravenous pumps, and oxygen
289 delivery regulators as authorized by institutional policies.
- 290 3. Inserting and monitoring peripheral intravenous catheters.
- 291 4. Monitoring patients who are under minimal sedation in accordance with the
292 American Society of Anesthesiologists [ASA] guidelines for conscious sedation
293 and per institutional guidelines.
- 294 5. Establishing and maintaining proper communication with patients (i.e., proper
295 introduction, appropriate explanation of procedure, etc.).

- 296 6. Maintaining a professional demeanor at all times to assure the preservation of
297 patients' rights, resulting in the provision of the highest-quality patient care
298 possible.
- 299 7. Following recognized infection control practices to provide a safe and sanitary
300 working environment for patients and the general public.
- 301 8. Recognizing and responding to an emergency situation at a level commensurate
302 with one's training and competency, including cardiopulmonary resuscitation
303 (CPR); the use of automatic external defibrillators (AED), if applicable; advanced
304 cardiac life support (ACLS); and advanced pediatric life support (PALS).
- 305 9. Recognizing, responding to, reporting, and documenting adverse events.
- 306
- 307 C. A nuclear medicine technologist performs administrative procedures by:
- 308 1. Maintaining an adequate volume of medical/surgical supplies, pharmaceuticals,
309 radiopharmaceuticals, storage media, and other items required to perform
310 procedures in a timely manner.
- 311 2. Scheduling patient procedures appropriate to the indication and in the proper
312 sequence.
- 313 3. Maintaining appropriate records of administered radioactivity, quality control
314 procedures, patient reports, and other required records applying state and federal
315 guidelines and institutional policies.
- 316 4. Developing and revising, when necessary, policies and procedures in accordance
317 with applicable regulations.
- 318 5. Actively participating in total quality management/continuous quality
319 improvement programs (i.e., age-specific competencies, patient education, and
320 patient restraint and immobilization).
- 321 6. Complying with licensing standards and institutional policies. The nuclear
322 medicine technologist involved with research must also follow Institutional
323 Research Board protocols, comply with Institutional Animal Care and Use
324 Committee, and Food and Drug Administration standards.
- 325

326 II. Instrumentation/Quality Control

- 327 A. A nuclear medicine technologist evaluates equipment performance, initiates
328 corrective action when necessary, and maintains required records for the quality
329 control program of gamma camera imaging systems, PET systems, and hybrid
330 imaging systems, CT, and/or MR in accordance with federal and state regulations and
331 institutional policy. Responsibilities include but are not limited to:
- 332 1. Identifying system-specific quality control requirements by following
333 recommended initial acceptance quality control procedures and daily, weekly,
334 monthly, quarterly, and annual quality control procedures to evaluate allowable
335 parameter ranges for uniformity, photon detection/discrimination, spatial
336 resolution, scatter correction, count loss, measurement of random interactions,
337 sensitivity, dead-time loss, and random count correction accuracy as
338 recommended by the manufacturer, and required by institutional and accreditation
339 policies.

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2. Recognizing image artifacts requiring imaging system correction and performing corrections and quality assurance as directed by institutional and manufacturer recommendations.
 3. Performing and evaluating sinogram acquisition or other routine quality control procedures per manufacturer recommendations to evaluate detector integrity.
 4. Performing imaging system quality assurance:
 - a. Obtaining uniformity images on imaging detectors.
 - i. Selecting a radionuclide source of appropriate type, size, quantity, and energy.
 - ii. Selecting an appropriate pulse height analyzer (PHA), photopeak, and window.
 - iii. Obtaining uniformity images using standardized imaging parameters.
 - iv. Evaluating the images qualitatively and/or quantitatively in comparison to the manufacturer's specifications and the performance requirements based on the studies for which the unit is used.
 - v. Identifying the source of any significant nonuniformity (e.g., checking collimator and PHA peak setting).
 - vi. Initiating corrective action when necessary based on the physicist recommendations.
 - b. Performing a detector linearity evaluation on imaging detectors.
 - i. Selecting a radionuclide, selecting a linearity phantom, and obtaining images.
 - ii. Identifying any nonlinear distortion in the image.
 - iii. Determining the source of nonlinearity (e.g., detector–source geometry).
 - iv. Initiating corrective action when necessary based on the physicist recommendations.
 - c. Performing spatial resolution checks on imaging detectors.
 - i. Selecting an appropriate radionuclide.
 - ii. Choosing a phantom that is compatible with the specified resolution of the camera.
 - iii. Analyzing the resulting images for degradation of resolution and determining the causes.
 - iv. Initiating corrective action when necessary based on the physicist recommendations.
 - d. Conducting sensitivity checks on imaging detectors yearly in conjunction with a physicist.
 - i. Selecting a source with an appropriate level of activity and half-life.
 - ii. Ensuring identical geometry, source placement, and measurement parameters for repetitive checks.
 - iii. Evaluating results.
 - iv. Initiating corrective action when necessary based on the physicist

- 385 recommendations.
- 386 e. Performing single-photon emission computed tomography (SPECT)
- 387 quality control procedures.
- 388 i. Obtaining a high-count uniformity calibration flood.
- 389 ii. Obtaining a center-of-rotation calibration.
- 390 iii. Obtaining a multihead detector alignment calibration.
- 391 iv. Evaluating reconstruction results of an acquired cylindrical SPECT
- 392 phantom with contrast and spatial resolution inserts:
- 393 a. Uniformity and noise are evaluated qualitatively by
- 394 inspection of reconstructed tomographic sections. Optimal
- 395 density ranges should be comparable to those used for
- 396 clinical images.
- 397 b. Contrast is number of “cold” spheres that can be discerned.
- 398 c. Spatial resolution is judged by identifying the smallest
- 399 “cold” rod.
- 400
- 401 f. Performing CT system quality assurance.
- 402 i. Daily: Follow manufacturer’s described warm-up procedure and
- 403 automatic monitoring, at various tube voltage (kVp) or current
- 404 (mAs) settings, of the tube output and detector response.
- 405 ii. Monthly: Perform a phantom evaluation to determine tomographic
- 406 uniformity accuracy of the CT number for water, image noise, and
- 407 slice thickness.
- 408 b. Acquiring consistent 2D and/or 3D PET images, using appropriate
- 409 reconstruction techniques, to display images for interpretation.
- 410 c. Acquiring consistent CT images, depending on scanner capability, with
- 411 appropriate reconstruction and displaying them.
- 412 d. Setting CT/AC protocols, including mAs, kVp, pitch, and helical
- 413 scanning.
- 414 e. Verifying the accuracy of ECG and respiratory gating if available and
- 415 used routinely.
- 416 5. Performing radionuclide generator quality assurance, daily and before the
- 417 use of the generator, to include dose calibrator/generator calibration and
- 418 parent/daughter breakthrough.
- 419 6. Performing infusion device quality control per manufacturer recommendations.
- 420 7. Operating imaging systems, storage media, and radiation detection and counting
- 421 devices, including but not limited to imaging detectors, dose calibrators, survey
- 422 instruments, scintillation probes, well counters, and data processing and image
- 423 production devices:
- 424 a. Maintaining and operating auxiliary equipment used in procedures.
- 425 b. Actively participating in total quality management/continuous quality
- 426 improvement programs by:
- 427 i. Identifying indicators to be analyzed.
- 428 ii. Gathering and presenting data in appropriate formats, analyzing data,
- 429 and recommending changes.

- 430 8. Operating scintillation probes, well counters, and other laboratory equipment:
 431 a. Calibrating a spectrometer with a long-half-life radionuclide source.
 432 b. Determining energy resolution.
 433 c. Conducting sensitivity measurements at appropriate energies with a
 434 standard, long-lived source such as Cs-137 or I-129.
 435 d. Checking background and determining the cause for levels greater than
 436 established normal levels.
 437 e. Conducting a chi-square test.
 438 f. Maintaining required records for quality control programs in accordance
 439 with federal and state regulations and institutional policies.
 440 g. Performing glucometer quality assurance using high and low standards.
 441 9. Operating survey meters:
 442 a. Ensuring that calibration has been completed within the last 12 months.
 443 b. Performing a battery check to verify the meter is operational.
 444 c. Performing a check-source test and comparing with previous results.
 445 d. Maintaining required records for the quality control program.
 446 10. Operating dose calibrator:
 447 a. Verifying constancy every day that isotopes are administered to patients,
 448 including weekends and on-call hours, and checking channels of the
 449 isotopes used that day using a check source with a long half-life.
 450 b. Verifying linearity quarterly over the entire range of radionuclide activity
 451 to be administered to patients, comparing calculated activities to
 452 measured activities, and determining correction factors when necessary.
 453 c. Determining accuracy annually by comparing a set of known activities to
 454 measured activities using isotopes of varying energy emissions such as
 455 Co-57, Ba-133, and Cs-137.
 456 d. Upon installation, testing for significant geometric variation in activity
 457 measured as a function of sample volume or configuration and
 458 determining correction factors when necessary.
 459 e. Maintaining required records for the quality control program in
 460 accordance with federal and state regulations and institutional policies.
 461 11. Operating image processors/computer monitors:
 462 a. Verifying the calibration of the instrument.
 463 b. Maintaining required records for the quality control program.
 464

III. Diagnostic Procedures

- 466 A. A nuclear medicine technologist performs imaging procedures by:
 467 1. Determining appropriate imaging parameters.
 468 a. Preparing (see Section V.C.), evaluating, and properly administering the
 469 prescribed amount of various radiopharmaceuticals and/or
 470 pharmaceuticals and contrast.
 471 b. Selecting the appropriate imaging or data collection parameters.
 472 2. Administering radiopharmaceuticals and/or pharmaceuticals through various
 473 routes after appropriate access has been verified and obtained in accordance with

- 474 established protocols and verifying that the radiopharmaceutical meets quality
475 specifications prior to administration (i.e., expiry time, pH, half-life, etc.).
- 476 3. Administering adjunctive medications or radiopharmaceuticals:
- 477 a. Verifying patient ID according to institutional policy.
- 478 b. Determining route of administration according to established protocol.
- 479 c. Establishing and/or verifying venipuncture access using aseptic technique.
- 480 d. Using and maintaining established venous access routes (e.g., heparin
481 infusion or infusion pump).
- 482 e. Reconciling patient medications according to institutional policy to ensure
483 that the patient's current medications will not interact with the
484 radiopharmaceutical and/or adjunctive medication used for the ordered
485 exam.
- 486 f. Preparing (see Section IV.C.) and administering adjunctive pharmacologic
487 agents, including oral and IV contrast agents, per the appropriate route.
- 488 g. Documenting medications and/or radiopharmaceutical administrations in
489 the patient medical record in accordance with federal and state
490 regulations and institutional policies.
- 491 h. Observing the patient carefully after any pharmaceutical administration
492 for any side effects, and handling such side effects appropriately as
493 described in established policies or as directed by medical staff.
- 494 4. Positioning the patient and obtaining images:
- 495 a. Waiting an appropriate time following the administration of a
496 radiopharmaceutical or pharmaceutical to begin the imaging procedure
497 protocol, and acquiring additional views as necessary to optimize
498 information content.
- 499 b. Exercising professional judgment in positioning a patient to best
500 demonstrate pathology and to adapt to the patient's limitations.
- 501 c. Positioning the patient using supportive materials and immobilizers, as
502 necessary.
- 503 d. Indicating appropriate anatomic landmarks for each view of the
504 procedure.
- 505 e. Reviewing images to ensure that the required information has been
506 acquired and that the images have been processed properly and are of the
507 highest quality.
- 508 5. Assisting in exercise and pharmacologic cardiac testing procedures:
- 509 a. Preparing patients to include the correct placement of ECG electrodes.
- 510 b. Determining if the appropriate test has been ordered based on the ECG
511 rhythm, medical history, and current medications.
- 512 c. Recognizing and responding to ECG changes.
- 513 d. Recognizing the parameters that indicate termination of a cardiac stress
514 study.
- 515 e. Recognizing ECG patterns that are appropriate for image gating.
- 516 6. Performing data collection, processing, and analysis:
- 517 a. Performing data collection, processing, and analysis in accordance with
518 institutional protocols.

- 519 b. Exercising independent judgment in selecting appropriate images for
520 processing.
- 521 c. Obtaining quantitative measurements such as SUV, coronary flow reserve,
522 kinetic modeling, regional brain analysis, biliary and cardiac ejection
523 fractions, and renal function, as appropriate for the procedure performed.
- 524 d. Defining regions of interest (ROIs) with reproducible results and
525 correctly applying background subtraction.
- 526 e. Performing computer data manipulations as required.
- 527 f. Labeling processed images (e.g., anatomical positioning, ROIs, date, and
528 time).
- 529 g. Archiving and retrieving data from storage media.
- 530
- 531 B. A nuclear medicine technologist may perform non-imaging in vitro and/or radioassay
532 studies by:
- 533 1. Operating laboratory equipment, including well counters, probes, and other
534 detection devices to measure the biodistribution of radiopharmaceuticals.
- 535 2. Preparing doses:
- 536 a. Quantitating doses.
- 537 i. Calculating and confirming the activity to be used.
- 538 ii. Calculating the volume necessary to deliver activity for the
539 prescribed dose.
- 540 b. Preparing standard solutions or dosage for phantom use as needed using
541 appropriate volumetric or gravimetric techniques to dilute the standard
542 per institutional protocol.
- 543 3. Collecting appropriate biological specimens for procedures using standard
544 precaution techniques as required by protocol:
- 545 i. Collecting blood samples:
- 546 a. Selecting proper supplies (e.g., needles, syringes,
547 evacuated tubes, or anticoagulants).
- 548 b. Identifying the patient and labeling patient
549 demographics on collection containers.
- 550 c. Performing venipuncture at appropriate intervals using
551 aseptic technique.
- 552 d. Adding hemolyzing compounds or anticoagulants to
553 samples according to protocol.
- 554 e. Centrifuging blood and separating blood components,
555 according to protocol.
- 556 f. Storing aliquots of serum, plasma, or whole blood
557 according to protocol.
- 558 ii. Collecting urine samples by:
- 559 a. Instructing the patient and/or nursing staff regarding the
560 correct method and time of urine collection.
- 561 b. Aliquoting the urine sample and measuring total urine
562 volume.
- 563 c. Measuring the specific gravity of urine, if required.

- 564 d. Recognizing and documenting all technical
565 circumstances that would produce invalid results.
566
- 567 4. Gathering, validating, and documenting data:
568 a. Subtracting room background or patient background from appropriate
569 samples.
570 b. Applying appropriate formulas, including conversion and dilution factors.
571 c. Calculating results according to the procedure used.
572 d. Plotting a graph, if necessary, and determining half time by extrapolating
573 to zero time.
574 e. Reporting both calculated values for a patient and normal range of specific
575 procedures used.
576 f. Evaluating results for potential error.
577 5. Managing biohazardous, chemical, and radioactive waste in accordance with
578 applicable state and federal regulations and institutional policy.
579
580

581 **IV. Adjunctive Medications**

582 A nuclear medicine technologist displays:

- 583 A. A thorough understanding and knowledge of indications, contraindications, warnings,
584 precautions, proper use, drug interactions, and adverse reactions for each adjunct
585 medication to be used.
586
- 587 B. The ability to procure and maintain pharmaceutical products and adjunct supplies by:
588 1. Anticipating and procuring a sufficient supply of pharmaceuticals for an
589 appropriate period in accordance with anticipated need.
590 2. Storing pharmaceuticals and supplies in a manner consistent with labeled product
591 safeguards and established facility policies.
592
- 593 C. The ability to properly prepare and administer pharmaceuticals under the direction of
594 an authorized user in accordance with all federal and state regulations and
595 institutional policies by:
596 1. Employing aseptic technique for manipulation of sterile products and
597 preparations.
598 2. Selecting and preparing pharmaceuticals in accordance with the manufacturer's
599 specifications and institutional policy.
600 3. Confirming the quality of a pharmaceutical in accordance with accepted
601 techniques and official standards.
602 4. Documenting the administered dose, date, and time of all pharmaceuticals in a
603 permanent medical record.
604 5. Observing the patient for possible complications (e.g., adverse reactions) of
605 adjunctive medication administration, and handling such complications
606 appropriately in conjunction with other available staff.
607
608

609 **V. Radiopharmaceuticals**

- 610 A. A nuclear medicine technologist displays a:
- 611 1. Thorough knowledge of indications, contraindications, warnings, precautions,
612 proper use, drug interactions, and adverse reactions for each radiopharmaceutical
613 to be used.
- 614 2. Thorough knowledge of molecular-level physiological functions that relate to, but
615 not limited to, glucose metabolism, blood flow, brain oxygen utilization,
616 perfusion, and receptor–ligand binding rates.
- 617 3. Thorough knowledge of the physiological processes that relate to organ system
618 function and anatomy and radiopharmaceutical demonstration of normal and
619 pathologic states.
- 620
- 621 B. A nuclear medicine technologist maintains radiopharmaceutical products and adjunct
622 supplies by:
- 623 1. Anticipating and procuring a sufficient supply of radiopharmaceuticals for an
624 appropriate period in accordance with anticipated need and license possession
625 limits.
- 626 2. Maintaining security while storing pharmaceuticals, radiopharmaceuticals, and
627 supplies in a manner consistent with the manufacturer’s labeled product
628 safeguards, radiation safety considerations, and established institutional policies.
- 629 3. Performing and documenting radiation survey and wipe tests upon receipt of
630 radioactive materials in accordance with federal and state regulations and
631 institutional policies.
- 632 4. Recording receipt of radioactive materials in a permanent record in accordance
633 with federal and state regulations and institutional policies.
- 634 5. Following Department of Transportation (DOT) regulations and radiation safety
635 guidelines in the transport, receipt, and shipment of radioactivity in accordance
636 with federal and state regulations and institutional policies.
- 637
- 638 C. A nuclear medicine technologist properly prepares and administers
639 radiopharmaceuticals under the direction of an authorized user in accordance with
640 all federal and state regulations and institutional policies by:
- 641 1. Preparing all sterile radiopharmaceuticals and adjunct pharmaceuticals in
642 appropriate environments in compliance with USP<797> standards.
- 643 2. Following appropriate personnel cleansing and garbing protocols when
644 entering “clean” areas in accordance with USP<797> standards.
- 645 3. Employing aseptic technique, consistent with USP <797> standards, when
646 mixing and manipulating sterile products.
- 647 4. Following appropriate USP<797> standards for beyond-use date (time-of-
648 use) and vial puncture standards.
- 649 5. Assembling and maintaining radionuclide generators.
- 650 6. Eluting radionuclide generators according to the manufacturer’s
651 specification in a “clean” environment that complies with USP<797>
652 standards.
- 653 7. Verifying the radionuclidic purity of generator eluates.

- 654 8. Selecting and preparing radiopharmaceuticals in accordance with the
655 manufacturer's specifications.
- 656 9. Measuring the radioactivity of the radiopharmaceutical using a dose
657 calibrator.
- 658 10. Confirming the quality of a radiopharmaceutical in accordance with
659 accepted techniques and official standards (e.g., radiochemical purity and
660 physical appearance).
- 661 11. Handling and preparing blood or blood products for labeling and/or
662 labeled blood cells in accordance with established regulations and
663 protocols and in an environment in compliance with USP<797> standards,
664 and ensuring that when blood products are handled and compounded they
665 are separated from other radiopharmaceuticals.
- 666 12. Recording use and/or disposition of all radioactive materials in a
667 permanent record:
- 668 a. Properly storing pharmaceuticals, radiopharmaceutical kits, and
669 radiopharmaceuticals as stated in USP<797> standards.
- 670 b. Recording results of radionuclide generator eluates' quality
671 assurance tests to include dose calibrator/generator calibration and
672 radionuclidic purity of eluates.
- 673
- 674
- 675 C. A nuclear medicine technologist is responsible for the identification and labeling of
676 all radiopharmaceutical preparations by:
- 677 1. Labeling vials and syringes in accordance with federal and state regulations and
678 institutional policies.
- 679 2. Recording radiopharmaceutical and medication information on a patient's
680 administration form and permanent preparation records in accordance with federal
681 and state regulations and institutional policies.
- 682 3. Labeling and segregating radioactive waste and recording the information in a
683 permanent record in accordance with federal and state regulations and
684 institutional policies.
- 685
- 686 D. A nuclear medicine technologist prepares individual dosages under the direction of an
687 authorized user by:
- 688 1. Applying radioactive decay calculations to determine the required volume or unit
689 form necessary to deliver the prescribed radioactive dose.
- 690 2. Selecting and preparing prescribed dosages and entering the information on a
691 patient's administration form and other permanent records.
- 692 3. Appropriately labeling the dose for administration.
- 693 4. Checking the dose activity prior to administration in a dose calibrator and
694 comparing this measurement against the shipment documentation.
- 695 5. Recording use and/or disposition of radioactive materials in a permanent record
696 by properly storing pharmaceuticals and radiopharmaceuticals as stated in federal
697 and state regulations and institutional policies
- 698

699 **VI. Radionuclide Therapy**

700 A. A nuclear medicine technologist properly prepares and administers therapeutic
701 radionuclides, radiopharmaceuticals, and pharmaceutical agents by oral and/or
702 intravenous routes when these agents are part of a standard procedure that is required
703 for treatment under the direction of an authorized user in accordance with federal,
704 state, and institutional policies by:

- 705 1. Ensuring that the correct radiopharmaceutical and dosage is prepared.
- 706 2. Following the quality management program in effect at the facility in
707 regard to patient identification and verification and the use of therapeutic
708 radionuclides.
- 709 3. Observing prescribed radiation safety and USP procedures during the
710 preparation and administration of such treatment.
- 711 4. Assisting the authorized user in supplying proper patient care instructions
712 to hospital staff, patient, and/or caregivers.
- 713 5. Conducting and documenting radiation surveys of designated patient
714 areas, when indicated.
- 715 6. Instructing the patient, family, and staff in radiation safety precautions
716 after the administration of therapeutic radiopharmaceuticals.
- 717 7. Coordinating/scheduling pre-/post treatment blood draws and/or imaging.
- 718 8. Maintaining all appropriate records.

719
720 **VII. Radiation Safety**

721
722 A. A nuclear medicine technologist performs all procedures utilizing ionizing radiation
723 safely and effectively in accordance with federal and state regulations and
724 institutional policies including, but not limited to:

- 725 1. Maintaining security of radioactive materials.
- 726 2. Notifying the appropriate authority when changes occur in the radiation safety
727 program.
- 728 3. Assisting in the preparation of license amendments when necessary.
- 729 4. Keeping up to date on regulatory changes and complying with all applicable
730 regulations.
- 731 5. Maintaining required records.
- 732 6. Posting appropriate radiation signage in designated areas.
- 733 7. Following federal and state regulations regarding receipt, storage, disposal, and
734 usage of all radioactive materials.
- 735 8. Recommending the purchase of radiation protection equipment to meet federal
736 and state regulations and institutional policies.
- 737 9. Packaging and monitoring radioactive material for transport according to federal
738 and state regulations, and keeping accurate records of transfer.

739
740 B. A nuclear medicine technologist follows appropriate radiation protection procedures
741 by:

- 742 1. Using personnel monitoring devices (film badges, optically stimulated
743 luminescence [OSL] thermoluminescent dosimeters, etc.).

- 744 a. Reviewing personnel exposure records in regard to maximum permissible
745 dose limits.
- 746 b. Taking appropriate measures to reduce exposure.
- 747 c. Notifying proper authorities of excessive exposure upon
748 discovery/occurrence.
- 749 2. Selecting and using proper syringe shields and other shielding configurations to
750 reduce radiation exposure to patients, personnel, and the general public.
- 751 3. Using proper shielding and disposal procedures in compliance with federal and
752 state regulations to maximize patient, technologist, and public protection.
- 753 4. Working in a safe but timely manner in order to decrease radiation exposure in
754 consideration of ALARA guidelines.
- 755 5. Reviewing personal monitoring device readings to determine if radiation exposure
756 can be further reduced.
- 757 6. Working in a manner that minimizes potential contamination of patients,
758 technologists, the public and work areas.
- 759
- 760 C. A nuclear medicine technologist monitors for radioactive contamination by:
- 761 1. Ensuring that instruments are calibrated at regular intervals or after repairs,
762 according to federal and state regulations.
- 763 2. Setting the frequency and locations for surveys and following schedules.
- 764 3. Using appropriate survey meters for each type and level of activity.
- 765 4. Following federal and state regulations regarding personnel surveys and reporting
766 to the designated authorized user or radiation safety officer.
- 767 5. Performing constancy checks on survey meters.
- 768 6. Performing wipe tests where applicable.
- 769 7. Performing leak tests on sealed sources, when so authorized.
- 770 8. Recording data in the required format (e.g., dpm instead of cpm).
- 771 9. Evaluating the results of wipe tests and area surveys to determine if action is
772 required.
- 773 10. Notifying the radiation safety officer when actions are required by federal and
774 state regulations and institutional policies.
- 775
- 776 D. A nuclear medicine technologist performs decontamination procedures in accordance
777 with federal and state regulations and institutional policies by:
- 778 1. Wearing personal protective equipment as necessary.
- 779 2. Restricting access to the affected area and confining a spill.
- 780 3. Removing contamination and monitoring the area and personnel, and repeating
781 the decontamination procedure until activity levels are acceptable.
- 782 4. Closing off all areas of fixed contamination that are above acceptable levels,
783 shielding the area, and posting appropriate signs.
- 784 5. Identifying, storing, or disposing of contaminated material in accordance with
785 federal and state regulations and institutional policies.
- 786 6. Maintaining appropriate decontamination records.

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7. Notifying the appropriate authority (e.g., radiation safety officer) in the event of possible overexposure or other violations of federal and state regulations and institutional policies.
- E. A nuclear medicine technologist disposes of radioactive waste in accordance with federal and state regulations and institutional policies by:
1. Maintaining appropriate records.
 2. Disposing according to license specifications.
 3. Maintaining long- and short-term storage areas.
- F. A nuclear medicine technologist participates in programs designed to instruct other personnel about radiation hazards and principles of radiation safety by:
1. Using the following teaching concepts:
 - a. Types of ionizing radiation.
 - b. Biological effects of ionizing radiation.
 - c. Limits of dose, exposure, and radiation effect.
 - d. Concepts of low-level radiation and health.
 - e. Concept of risk versus benefit.
 2. Providing appropriate radiation safety measure instructions.
 3. Providing proper emergency procedures instruction.
 4. Modeling proper radiation safety techniques and shielding in the course of daily duties.
- G. A nuclear medicine technologist assists in performing radiation safety procedures associated with radionuclide therapy according to federal and state regulations and institutional policies by:
1. Following the guidelines for administration of therapeutic radiopharmaceuticals and the release of patients administered therapeutic radiopharmaceuticals.
 2. Following the guidelines for the release of patients administered radioactive materials.
 3. Following the proper procedures for patients requiring hospitalization after administration of therapeutic radiopharmaceuticals
 4. Providing appropriate instruction on radiation safety procedures for patients, care givers, and staff.

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