Components of Professional Competence of Nuclear Medicine Physicians American Board of Nuclear Medicine

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The nuclear medicine physician must have broad knowledge and experience in medicine. As the specialty advances, the nuclear medicine physician must be prepared to participate by extending the scope of nuclear medicine practice beyond that available at the time of training. Upon referral of a patient for consultation, a nuclear medicine physician must be prepared to:

a. Obtain a pertinent history.
b. Perform a physical examination appropriate to the consultation.
c. Select and carry out diagnostic and therapeutic procedures in a manner that is safe both to the patient and the staff.
d. Interpret the results, arrive at a reasonable diagnosis on the basis of correlation of all available clinical and laboratory information, and issue a timely report.
e. Recommend further study or treatment as appropriate.
f. Assume responsibility for patient management if nuclear medicine therapy is indicated.
g. Communicate effectively with patients and referring physicians.
h. Develop and supervise programs for quality assurance and quality control.
i. Provide expert consultation regarding the most appropriate and cost effective examinations.

The practice of nuclear medicine requires special knowledge in the following areas:

I. Physical Science
a. The structure of matter.
b. Modes of radioactive decay and the accompanying emissions.
c. Emissions accompanying radioactive decay and their biological implications.
d. Interaction of radiation with matter and its biological implications.
e. Basic principles of imaging procedures, including x-ray computed tomography, magnetic resonance imaging, magnetic resonance spectroscopy, ultrasonography and Doppler ultrasound.

II. Instrumentation
a. Principles of radiation detection and detectors.
b. Imaging instrumentation such as the gamma scintillation camera, scanners, single photon emission computed tomography (SPECT), positron emission tomography (PET), single- and dual-photon absorptiometry and nonimaging instrumentation such as the whole-body counter, gamma well counter, scintillation probe, liquid scintillation counter, radiation monitoring devices and dose calibrator.
c. Collimation for the various types of radiation detectors with special emphasis on the characteristics of parallel-hole, diverging, converging, slant-hole, pinhole, fan-beam, and cone-beam collimators and their response to point, line and plane sources.
d. Electronic instruments such as pulse amplifiers, pulse-height analyzers, scalers and count rate meters.
e. Image production and display technology, including photographic principles, sensitivity, resolution, contrast, latitude and film processing.

III. Mathematics and Statistics
a. Fundamental concepts of mathematics, including algebra, geometry and calculus.
b. Fundamental concepts of statistics, including probability distributions, parametric and nonparametric statistics.
c. Principles of medical decision making, including Bayes' theorem, comparative accuracy of diagnostic tests and effectiveness of therapeutic procedures and principles of clinical study design and analysis.
d. Mathematical models of physiologic systems.
e. Principles of data transport and storage, picture archiving and communication systems.

IV. Computer Science
a. Basic aspects of computer structure, function and programming.

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For reprints contact: The American Board of Nuclear Medicine, 900 Veteran Avenue, Los Angeles, CA 90024.

b. Principles of computer applications with emphasis on digital imaging acquisition, image filters, analysis, processing and enhancement, tomographic reconstruction, display and recording of findings.

V. Radiation Biology and Protection

a. Biological effects of radiation exposure, with emphasis on the effects of low-level exposure.
b. Administrative and technical means of reducing unnecessary radiation exposure to patients, personnel and the environment.
c. Calculation of radiation dose from internally administered radionuclides.
d. Diagnosis, evaluation, clinical management and treatment of patients experiencing radiation overexposure in any form.
e. Management of radiation accidents, including monitoring, decontamination and subsequent control.
f. Governmental regulations regarding limits of radiation exposure, handling of radioactive patients and disposal of radioactive wastes.

VI. Radiopharmaceutical Production, Biochemistry and Clinical Physiology

a. Production of radionuclides by reactors, cyclotrons, other particle accelerators and the use of radionuclide generators.
b. Formulation of radiopharmaceuticals considering chemical properties and quality control including sterility and pyrogenicity testing.
c. Biochemistry, physiology, pharmacokinetics of radiopharmaceuticals and mechanisms of localization in normal and abnormal physiologic states.
d. Role of regulatory bodies applicable to the use of radiopharmaceuticals in nuclear medicine practice and research.

VII. In Vivo Diagnostic Use of Radiopharmaceuticals

a. In vivo imaging and/or body function measurements, including the central nervous system, endocrine system, salivary glands, bone marrow and hematologic system, respiratory system, cardiovascular system, gastrointestinal tract, hepatobiliary system and spleen, the musculoskeletal system and the genitourinary system.
b. Use of imaging devices and detectors for body organ, time-dependent and differential function studies and quantification of function.
c. Cellular kinetics, absorption, excretion and dilution analyses and balance studies using radiotracers.
d. Body composition tests, including compartmental analysis.
e. Relationship between and correlation of nuclear medicine procedures and other pertinent imaging modalities such as diagnostic radiographic techniques, ultrasound, x-ray computed tomography, magnetic resonance imaging and magnetic resonance spectroscopy.
f. Patient monitoring with special emphasis on electrocardiographic interpretation, and cardiopulmonary resuscitation during interventional tests such as exercise and pharmacological stress.
g. Pharmacology of drugs used in nuclear medicine.
h. Preparation and use of labeled antibodies, peptides and cells and related areas of immunology.

VIII. In Vitro Studies Including Nonradioactive Isotopic Tracers

a. Methodology, quality control and biological basis of radioligand assay.
b. Principles of activation analysis and autoradiography.

IX. Therapeutic Uses of Radionuclides

a. Patient selection, including the diagnostic procedures necessary to establish the need for radionuclide therapy, the indications and contraindications for the use of radionuclide therapeutic procedures and their effectiveness in relation to other therapeutic approaches.
b. Understanding and calculation of absorbed radiation dose, including calculation of absorbed radiation dose to the target area, to the surrounding tissue, other organ systems and total body.
c. Patient care during radionuclide therapy, including understanding of potential early and late adverse reactions, additive toxicity when combined with other therapy, the timing and parameters of anticipated response and follow-up care and evaluation.
d. Potential adverse effects of radiation (e.g., oncogenesis and genetic effects). Effect on family members, the public. Maximum body dose on discharge from the hospital.
e. Application to children, e.g., cancer incidence, tissue sensitivity.
f. Specific applications: e.g., radioiodine in hyperthyroidism and thyroid carcinoma; radiophosphorus (soluble) in polycythemia ruba vera and other myeloproliferative disorders, radiocolloids for therapy, radionuclides for metastatic bone disease and radiolabeled antibody therapy.