Components of Professional Competence of Nuclear Medicine Physicians*

The nuclear medicine physician requires broad knowledge and experience in medicine. The nuclear medicine physician must be prepared intellectually to extend the scope of nuclear medicine beyond current methodology as the specialty advances.

Upon referral of a patient for consultation, a nuclear medicine physician must be prepared to:

a. Obtain pertinent information from the patient and other sources.
b. Perform a physical examination related to the consultation.
c. Select and carry out appropriate procedures in a manner that is safe to both patient and staff.
d. Interpret the results, arrive at a reasonable diagnosis on the basis of correlation of all clinical and laboratory information available, and issue a timely report.
e. Recommend further study or treatment when appropriate.
f. If requested, assume full responsibility for patient management if nuclear medicine therapy is indicated.
g. Demonstrate oral and written communications skills adequate for full exchange of information with patients and referring physicians.
h. Perform quality assurance programs, quality control measures, and their applications to nuclear medicine practice.

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

I. Physical science
   a. Elementary aspects of the structure of matter.
   b. Modes of radioactive decay.
   c. Emissions accompanying radioactive decay, and their biological implications.
   d. Interactions of radiation with matter.
   e. Basic physics of other imaging procedures including x-ray computed tomography, nuclear magnetic resonance, and ultrasonography.

II. Instrumentation
   a. Principles of radiation detection and detectors.
   b. Nuclear medicine instrumentation, with special emphasis on gamma scintillation cameras, but also including scanners, tomographic imaging devices, "positron imaging instruments," whole body counters, gamma well counters, liquid scintillation counters, monitoring devices, and dose calibrators.
   c. Collimation of radiation detectors with special emphasis on the characteristics of not only parallel hole, diverging and converging, and slant-hole collimators, but also pinhole and coded-aperture 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, with special emphasis on sensitivity, resolution, contrast, latitude, and film processing.
   f. Principles and application of other imaging modalities as a correlate to nuclear medicine procedures.

III. Mathematics, statistics, and computer sciences
   a. Fundamental concepts of mathematics including algebra, geometry, and calculus.
   b. Probability distributions and parametric and nonparametric statistics.
   c. The principles of medical decision making and comparative effectiveness of tests and therapeutic procedures.
   d. Basic aspects of computer structure, function, and programming.
   e. Computer applications with emphasis on digital image acquisition, analysis, processing and enhancement, tomographic reconstruction, display, and recordings of findings.

f. Mathematical models of physiologic systems.

IV. Radiation biology and protection
   a. The 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 environment.
   c. Immunology, molecular biology, and genetics.
   d. Calculation of the radiation dose from internally administered radionuclides.
   e. The diagnosis, evaluation, and treatment of radiation overexposure in any form.
   f. Governmental regulations regarding limits of radiation exposure, handling of radioactive patients, and disposal of radioactive wastes.
   g. Management of radiation accidents, including monitoring, decontamination, and subsequent control.

V. Radiopharmaceuticals
   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.
   c. Biochemistry, physiology, and pharmacokinetics of radiopharmaceuticals.
   d. An understanding of the role of regulatory bodies applicable to the practice of and research in nuclear medicine.

VI. Diagnostic use of radionuclides
   a. General: Clinical indications and limitations for the appropriate usage; normal and altered anatomy, physiology, biochemistry, and metabolism of the various organs or processes to be examined; technical performance of the procedure, including proper patient preparation and patient management before, during, and after the procedure.
   b. In vivo imaging and/or function studies, including the brain, cerebrospinal fluid, thyroid, salivary glands, lung, heart and vessels, esophagus, stomach, biliary, liver, spleen, kidney, pancreas, tumors and abscesses, bladder, bones, joints, and the bone marrow.
   c. The use of imaging devices and external detectors for body organ imaging, and for time-dependent and differential function studies.
   d. The use of physiologic gating techniques for functional studies.
   e. Patient monitoring during interventional tests such as exercise and pharmacological administrations with special emphasis on electrocardiographic interpretation and cardiopulmonary resuscitation.
   f. Cellular kinetics, absorption and excretion analyses, and balance studies using radiotracers.
   g. Body composition tests, including compartmental analysis.
   h. Whole-body counting and total-body scanning.
   i. Relationship between nuclear medicine procedures and other pertinent imaging modalities such as diagnostic radiographic techniques, ultrasound, x-ray computed tomography, nuclear magnetic resonance, and digital radiography.

VII. In vitro studies
   a. Methodology and quality control of radioligand assay.
   b. Binding capacity studies.
   c. Principles of activation analysis and autoradiography.

VIII. Therapeutic uses of radionuclides
   a. Patient selection; including the diagnostic procedures necessary to establish the need for radionuclide therapy, indications and contraindications for the use of radionuclide therapeutic procedures and their efficacy in relation to other therapeutic approaches.
   b. Dose administration in patient management: including dose to the target area, to the surrounding tissues and/or other organ systems, and total-body exposure; the range of doses in each specific application; the special problems of patient care

caused by radionuclide therapeutic procedure, potential early and late adverse reactions, the timing and parameters of anticipated clinical response, and the follow-up care and evaluation as needed.

c. Specific applications: radioiodine in hyperthyroidism and thyroid carcinoma; radiophosphorus (soluble) in polycythemia vera and other myeloproliferative disorders, and metastatic bone disease; colloidal radiophosphorus and other radiocolloids for intracavitary therapy of malignant effusions; radiolabeled antibody therapy.

M. Donald Blaufox, MD
Frank H. DeLand, MD
Robert M. Donati, MD
David L. Gilday, MD
John R. Hansell, MD
Nilo E. Herrera, MD
B. Leonard Holman, MD
Merle K. Loken, MD
I. Ross McDougall, MB, ChB, PhD
Wil B. Nelp, MD
Dennis D. Patton, MD
Barry A. Siegel, MD

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