Educational Outcomes, Goals, and Objectives for Postgraduate Year Two (PGY2) Residencies in Nuclear Pharmacy

Overview of PGY2 Residencies in Nuclear Pharmacy

The PGY2 residency in nuclear pharmacy is designed to transition PGY1 residency graduates from generalist practice to specialized practice focused on the medication-related care of patients who require the use of radiopharmaceuticals for diagnosis, monitoring, or therapeutic radiopharmaceutical regimens. Residency graduates are equipped to participate as integral members of interdisciplinary teams caring for these individuals and with referring clinicians. They are able to manage the operation of a pharmacy facility that procures, prepares, and dispenses radiopharmaceuticals and ancillary medications. This includes checking and testing instrumentation, safe preparation, disposal of waste, decontamination of the preparation area, storage, and ensuring appropriate shielding during administration.

Graduates' expertise equips them to successfully serve health care organizations as the ultimate resource for information about radiopharmaceuticals and ancillary medications and for decision-making affecting the care of those requiring their use. This includes leadership in formulary decision-making for these medications and for the development of guidelines and protocols for their use.

Groomed for practice leadership, nuclear pharmacy residency graduates can be expected to continue their pursuit of expertise in practice; to possess advanced skills to identify the nuclear medicine and nuclear pharmacy/molecular imaging training needs of other health care professionals and to deliver effective training to those health care professionals.

Residents exit the program demonstrating professional maturity and judgment by following a personal philosophy of practice, monitoring their own performance, and exhibiting commitment to the profession.

Explanation of the Contents of This Document:

Each of the document's objectives has been classified according to educational taxonomy (cognitive, affective, or psychomotor) and level of learning. An explanation of the taxonomies is available elsewhere.[1]

The order in which the required educational outcomes are presented in this document does not suggest relative importance of the outcome, amount of time that should be devoted to teaching the outcome, or sequence for teaching.

The educational outcomes, goals, and objectives are divided into those that are required and those that are elective. The required outcomes, including all of the goals and objectives falling under them, must be included in the design of all programs. The elective outcomes are provided for those programs that wish to add to the required outcomes. Programs selecting an elective outcome are not required to include all of the goals and objectives falling under that outcome. In addition to the potential elective outcomes contained in this document, programs are free to create their own elective outcomes with associated goals and objectives. Other sources of elective outcomes may include elective educational outcomes in the list provided for PGY1 pharmacy residencies and educational outcomes for training in other PGY2 areas. Each of the goals falling under the program's selection of program outcomes (required and elective) must be evaluated at least once during the resident's year.

Educational Outcomes (*Outcome*): Educational outcomes are statements of broad categories of the residency graduates' capabilities.

Educational Goals (Goal): Educational goals listed under each educational outcome are broad sweeping statements of abilities.

Educational Objectives (OBJ): Resident achievement of educational goals is determined by assessment of the resident's ability to perform the associated educational objectives below each educational goal.

Instructional Objectives *(IO)*: Instructional objectives are the result of a learning analysis of each of the educational objectives. They are offered as a resource for preceptors encountering difficulty in helping residents achieve a particular educational objective. The instructional objectives falling below the educational objectives suggest knowledge and skills required for successful performance of the educational objective that the resident may not possess upon entering the residency year. Instructional objectives are teaching tools only. They are not required in any way nor are they meant to be evaluated.

[1] Nimmo, CM. Developing training materials and programs: creating educational objectives and assessing their attainment. In: Nimmo CM, Guerrero R, Greene SA, Taylor JT, eds. Staff development for pharmacy practice. Bethesda, MD: ASHP; 2000.

Required Educational Outcomes, Goals, and Objectives for Postgraduate Year Two (PGY2) Residencies in Nuclear Pharmacy

Outcome R1: Manage and improve the medication-use process in nuclear medicine/molecular imaging patient care areas.

Goal R1.1 Check and test instrumentation required for radiation safety procedures and for the preparation, dispensing, and quality control of radiopharmaceuticals.

OBJ R1.1.1 (Application) Perform, with accuracy, a check or test of instrumentation required for radiation safety procedures.

IO Explain NRC and state requirements for calibration of instrumentation used for radiation safety procedures.

IO Explain how to check or test each instrument required for radiation safety procedures.

OBJ R1.1.2 (Application) Perform with accuracy a check or test of instrumentation required for preparation, dispensing, and quality control of radiopharmaceuticals.

IO Explain NRC and state requirements for calibration of instrumentation used for the preparation, dispensing, and quality control of radiopharmaceuticals.

IO Explain how to check or test each instrument required for the preparation, dispensing, and quality control of radiopharmaceuticals.

OBJ R1.1.3 (Application) Appropriately record calibration activities.

IO Explain NRC and state requirements for documentation of calibration of instruments.

Goal R1.2 Prepare and dispense radiopharmaceuticals and ancillary medications following existing standards of practice and the organization's policies and procedures.

OBJ R1.2.1 (Evaluation) Interpret the appropriateness of an order for a radiopharmaceutical or ancillary medication before preparing or permitting its distribution.

OBJ R1.2.2 (Application) Follow the organization's policies and procedures to maintain the accuracy of the medical record of a patient receiving radiopharmaceuticals.

OBJ R1.2.3 (Application) Prepare radiopharmaceuticals following appropriate standards of practice and the organization's policies and procedures.

IO Explain the application of the principles of time, distance, and shielding to achieve protection from radiation sources.

IO Explain the importance of using personal monitoring devices when anticipating possible exposure to radiation.

IO Explain how to estimate radiation exposure of personnel during both normal and unusual working conditions.

IO Explain how to interpret the significance of reports of radiation exposure.

IO Explain the importance of USP Chapter 797 requirements for the preparation, distribution, and storage of radiopharmaceuticals.

IO Explain principles for selecting protective clothing for use when preparing, distributing, and storing radiopharmaceuticals.

- IO *Explain the principles of aseptic technique and their application to preparation of parenteral dosage forms.*
- IO *Explain the importance of proper ventilation and exhaust equipment in radiopharmaceutical preparation, distribution, and storage.*
- IO *Explain how to monitor radioactive effluents in restricted and non-restricted areas.*
- IO *Explain principles for selecting remote handling tools when preparing and handling radiopharmaceuticals.*
- IO *Explain the function of remote units for the synthesis of short half-lived radiopharmaceuticals (i.e., PET).*
- IO *Explain principles for the selection of effective shielding when preparing and handling radiopharmaceuticals.*
- IO *Explain methods for improvising effective shielding when preparing and handling radiopharmaceuticals.*
- IO *Explain how to appraise radiopharmaceuticals and ancillary medications for appropriate concentrations, purity, sterility, acceptable endotoxin levels, compatibilities, stability, amount of radioactivity, specific activity, and storage conditions.*
- IO *Explain techniques used to evaluate biological, chemical, radiochemical, and radionuclide purity.*
- IO *Explain techniques for measuring the amount of radioactivity present in, and specific activity of, a radiopharmaceutical.*
- IO *Explain how to investigate suspected problems with the formulation of a radiopharmaceutical.*
- IO *Explain strategies for preparing extemporaneously compounded radiopharmaceuticals and ancillary medications.*
- IO *Explain the USP/NF standards for compounding of radiopharmaceuticals.*
- IO *Explain the chemistry and radiochemistry involved in radiolabeling procedures.*
- IO *Explain the process of formulating kits from raw materials, including lyophilization processes.*
- IO *Explain techniques used to evaluate other physical and pharmaceutical properties (e.g., particle size and number, aggregation, clumping) of a radiopharmaceutical.*
- IO *Explain good manufacturing processes for preparing radiopharmaceuticals.*
- IO *Explain the techniques required for optimal preparation of radiopharmaceuticals (e.g., appropriate volumes, diluents, activities, incubation time, pH, temperature, order of addition, mixing of components).*
- IO *Explain how to elute radionuclide generators.*
- IO *Explain physical and chemical characteristics of available radionuclide generators.*
- IO *Explain radionuclide generator quality assurance techniques.*
- IO *Explain the basics of cyclotron function or operation.*

IO *Explain federal, state, and local rules and regulations for the preparation, storage, disposal, and transport of radiopharmaceuticals.*

OBJ R1.2.4 Dispose of radiopharmaceuticals following existing standards of practice and the organization's policies and procedures.

IO *Explain the impact of mixed waste (i.e., biological/infectious and radioactive components) on waste disposal procedures.*

IO *Explain federal, state, and local rules and regulations for the preparation, storage, disposal, and transport of radioactive waste materials.*

OBJ R1.2.5 (Application) Manage the decontamination of a contaminated area or person, including referral to other resources when appropriate.

OBJ R1.2.6 (Application) Dispense radiopharmaceuticals and ancillary medications following existing standards of practice and the organization's policies and procedures.

IO *Explain the added importance of absolute patient identification when dispensing therapeutic and diagnostic radiopharmaceuticals or radiolabeled blood cellular components.*

IO *Explain how to ensure the proper amount of radioactivity in the dose withdrawn from an original preparation when withdrawing a dose for a specific patient to be delivered at a scheduled time.*

IO *Explain how to calculate the radioactive decay of a given dose of radiopharmaceutical.*

IO *Explain methods for ensuring proper shielding of radiopharmaceutical dosage forms during dispensing, distribution, and administration to patients.*

OBJ R1.2.7 (Application) Store radiopharmaceuticals following existing standards of practice and the organization's policies and procedures.

Goal R1.3 Manage the operation of a pharmacy facility that procures, prepares and dispenses radiopharmaceuticals, ancillary medications, disposables, radiation safety devices, calibration sources, and instrumentation to support the work of the nuclear pharmacy/molecular imaging pharmacy.

OBJ R1.3.1 (Application) Follow the organization's policies and procedures for procuring radiopharmaceuticals and ancillary medications.

IO *State the suppliers of radiopharmaceuticals and ancillary medications.*

IO *Explain the concept of exclusive distribution and its impact on procuring radiopharmaceuticals.*

IO *Explain the impact of radioactive decay on inventory control of radiopharmaceuticals.*

IO *Explain the concept of radiopharmaceutical manufacturer cutoff time and its impact on ordering patterns.*

IO *Explain the importance of considering the delivery method (i.e., carrier) and scheduled time for delivery and the impact on ordering patterns.*

IO *Explain the importance of considering the time of calibration when determining how much radiopharmaceutical to order.*

IO *Explain the relationship between the total amount of radioactivity required for a given time frame and decisions as to the size and number of generators to be ordered and the timing of the order.*

IO *Explain the importance of understanding the differences in reagent kits and their impact on cost and patient care.*

IO *Explain the impact of consignment of reagent kits and its impact on cost and patient care.*

IO *Explain the importance of observing radioactive material license conditions governing radiopharmaceuticals.*

IO *Explain the impact of scheduled maintenance on the delivery of radiopharmaceuticals.*

OBJ R1.3.2 (Application) Follow the organization's policies and procedures for procuring disposables, radiation safety devices, and instrumentation for use in nuclear pharmacy/molecular imaging.

IO *Explain the types and functions of disposables commonly used in nuclear pharmacy/molecular imaging.*

IO *State the suppliers of disposables commonly used in nuclear pharmacy/molecular imaging.*

IO *Explain the types and functions of radiation safety devices commonly used in nuclear pharmacy/molecular imaging.*

IO *State the suppliers of radiation safety devices commonly used in nuclear pharmacy/molecular imaging.*

IO *Explain the types and functions of instrumentation commonly used in nuclear pharmacy/molecular imaging.*

IO *State the suppliers of instrumentation commonly used in nuclear pharmacy/molecular imaging.*

OBJ R1.3.3 (Application) Schedule delivery of radiopharmaceuticals so that they arrive on time.

IO *Explain the organization's transportation network.*

IO *Explain the regulations governing the qualifications of personnel who transport radiopharmaceuticals.*

OBJ R1.3.4 (Comprehension) Explain the essential components of a training program suitable for personnel charged with the safe transport of radiopharmaceuticals.

IO *Explain DOT regulations specifying the training required of individuals who will transport radiopharmaceuticals.*

OBJ R1.3.5 (Comprehension) Explain the training of, and tasks that may be performed in one's organization by, a nuclear medicine technologist.

OBJ R1.3.6 (Comprehension) Explain the training of, and tasks that may be performed in one's organization by, a nuclear pharmacy technician.

OBJ R1.3.7 (Comprehension) Explain methods for identifying and evaluating overall radiopharmaceutical costs and economic trends.

OBJ R1.3.8 (Application) Follow the organization's policies and procedures for procuring calibration sources.

IO *Explain the types of calibration sources commonly used in nuclear pharmacy/molecular imaging.*

IO *State the suppliers of calibration sources commonly used in nuclear pharmacy/molecular imaging.*

IO *Explain the importance of observing radioactive material license conditions governing calibration sources.*

OBJ R1.3.9 (Application) Apply NRC and state regulations governing the receipt of radioactive materials.

OBJ R1.3.10 (Evaluation) Evaluate one's facility for compliance with standards for designing and equipping a facility that prepares and dispenses radiopharmaceuticals.

IO *State sources of standards for designing and equipping facilities that prepare and dispense radiopharmaceuticals.*

OBJ R1.3.11 (Evaluation) Compare the facility's policies and procedures with standards of practice and legal and regulatory requirements for the preparation and distribution of radiopharmaceuticals.

IO *State sources of standards of practice for the preparation and distribution of radiopharmceuticals*

OBJ R1.3.12 (Application) Maintain the established system for obtaining and assuring the security of medications and facility supplies.

IO *Explain systems for assuring the security of radiopharmaceuticals.*

OBJ R1.3.13 (Comprehension) Explain the requirements of a record-keeping system for complying with federal, state, and local rules and regulations for the preparation, storage, disposal, and transport of radiopharmaceuticals and radioactive waste materials.

Outcome R2: Optimize the outcomes of the care of patients who require radiopharmaceuticals by providing evidence-based, patient-centered pharmacotherapy as an integral part of a nuclear medicine/molecular imaging interdisciplinary team.

Establish collaborative professional relationships with health care team members and referring clinician

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Prioritize delivery of pharmaceutical care to patients

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Collect and analyze patient information

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Establish collaborative pharmacist-patient and pharmacist-caregiver relationships

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Conduct diagnostic or monitoring procedures, if needed

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Design evidence-based therapeutic radiopharmaceutical regimen

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Design evidence-based monitoring plan

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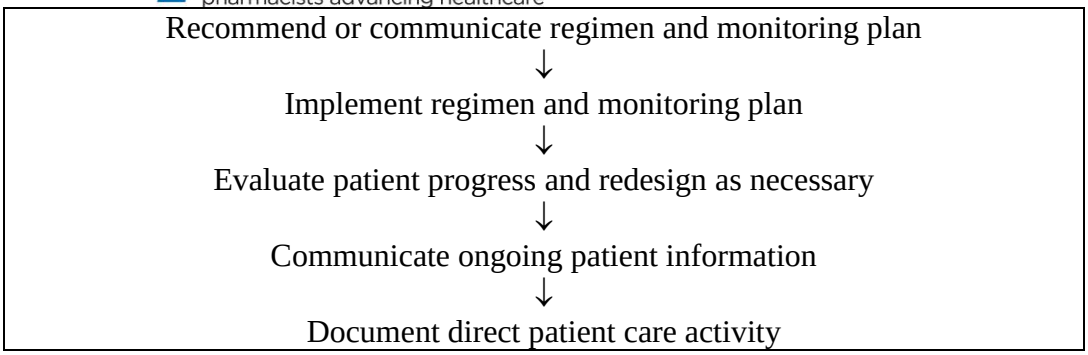

Goal R2.1 Establish collaborative professional relationships with members of the nuclear medicine/molecular imaging interdisciplinary team and referring clinicians.

OBJ R2.1.1 (Synthesis) Establish a cooperative, collaborative, and communicative working relationship with members of the nuclear medicine/molecular imaging interdisciplinary team.

IO *Explain the training and expected areas of expertise of the members of the nuclear medicine/molecular imaging interdisciplinary team with which one works.*

IO *For each of the professions with which one interacts on the nuclear medicine/molecular imaging interdisciplinary team, explain the profession's view of its role and responsibilities and their expectations of the pharmacist's role in collaborations on patient-centered care.*

IO *Explain the professional dynamics of the different services that contribute to the care of patients who require radiopharmaceuticals.*

OBJ R2.1.2 (Synthesis) Establish a cooperative, collaborative, and communicative working relationship with the referring clinician.

IO *Explain the kinds of information that referring clinicians need from the nuclear medicine/molecular imaging pharmacy specialist.*

IO *Explain the kinds of information that the nuclear medicine/molecular imaging pharmacy specialist needs from referring clinicians.*

Goal R2.2 For a caseload of nuclear medicine/molecular imaging patients, prioritize the delivery of pharmaceutical care.

OBJ R2.2.1 (Evaluation) Devise a plan for determining the priority for care of patients who require radiopharmaceuticals if given limited time and resources (e.g., space, cameras, radiopharmaceutical half life).

IO *Explain factors to consider when determining priority for care among nuclear medicine/molecular imaging patients.*

Goal R2.3 Collect and analyze patient information.

OBJ R2.3.1 (Analysis) Collect and organize all patient-specific information needed by the nuclear pharmacy/molecular imaging specialist to make appropriate evidence-based, patient-centered recommendations for patients who may require radiopharmaceuticals as part of the nuclear medicine/molecular imaging interdisciplinary team. (See Appendix)

IO *Identify the types of patient-specific information the nuclear pharmacy/molecular imaging specialist requires to anticipate, prevent,*

detect, and/or resolve medication-related problems and to make appropriate evidence-based, patient-centered recommendations for patients who may require radiopharmaceuticals.

IO *Explain signs and symptoms, epidemiology, risk factors, pathogenesis, natural history of disease, pathophysiology, clinical course, etiology, and treatment of diseases commonly encountered in nuclear medicine/molecular imaging.*

IO *Explain the mechanism of localization, mechanism of action, pharmacokinetics, pharmacodynamics (if any), pharmacogenomics, pharmacoeconomics, usual regimen (dose, schedule, form, route, and method of administration), and indications, of all currently used radiopharmaceuticals and adjunct pharmaceuticals.*

IO *Explain the mechanism of localization, mechanism of action, pharmacokinetics, pharmacodynamics (if any), pharmacogenomics, pharmacoeconomics, usual regimen (dose, schedule, form, route, and method of administration), and indications of all currently used contrast agents.*

IO *Explain issues and methodologies associated with pediatric dose adjustment of radiopharmaceuticals.*

IO *Explain issues associated with the administration of radiopharmaceuticals to pregnant or lactating women.*

IO *Explain issues associated with radiopharmaceutical clearance during dialysis.*

OBJ R2.3.2 (Analysis) Determine the presence of problems in the current medication therapy of a patient who may require radiopharmaceuticals.

IO *Explain the contraindications, interactions, and adverse reactions of all currently used radiopharmaceuticals and adjunct pharmaceuticals.*

IO *Explain the contraindications, interactions, and adverse reactions of all currently used contrast agents.*

OBJ R2.3.3 (Analysis) Using an organized collection of patient-specific information, summarize the health care needs of a patient who may require radiopharmaceuticals.

Goal R2.4 Establish collaborative pharmacist-patient and pharmacist-caregiver relationships.

OBJ R2.4.1 (Synthesis) Formulate a strategy that effectively establishes a patient-centered pharmacist-patient or a pharmacist-caregiver relationship.

IO *Explain unique characteristics of nuclear medicine/molecular imaging patients that may influence pharmacist-patient and pharmacist-caregiver relationships.*

IO *Explain the importance of including in the strategy an explanation to the patient and/or caregiver of the role of radiopharmaceuticals in the patient's care.*

IO *Explain the importance of including in the strategy an explanation to the patient and/or caregiver of the role of the nuclear pharmacy/molecular imaging specialist's role in his/her care.*

IO *Explain the view of diverse cultures and religions on the conceptualization of illness, treatment, death, and dying.*

Goal R2.5 When appropriate, evaluate the suitability of, implement, and interpret the results of diagnostic or monitoring procedures for radiopharmaceuticals.

OBJ R2.5.1 (Evaluation) Determine the suitability of a radiopharmaceutical diagnostic or monitoring procedure.

IO *Explain circumstances that necessitate the use of a diagnostic study.*

IO *Compare and contrast the benefits of various diagnostic study modalities (e.g., MRI, CT, ultrasound, SPECT).*

OBJ R2.5.2 (Synthesis) Given a patient who requires a diagnostic radiopharmaceutical, individualize the diagnostic regimen.

IO *Explain sources of guidelines for the use of diagnostic radiopharmaceuticals.*

IO *Explain factors to consider when individualizing the regimen for a diagnostic radiopharmaceutical.*

OBJ R2.5.3 (Application) When appropriate, implement the diagnostic radiopharmaceutical regimen.

IO *When appropriate, exercise skill in phlebotomy.*

IO *When appropriate, exercise skill in venous line placement.*

OBJ R2.5.4 (Evaluation) Accurately evaluate the results of a diagnostic pharmaceutical regimen.

IO *Explain the characteristics of normal diagnostic radiopharmaceutical studies.*

IO *Explain the therapeutic implications of the outcomes of various common diagnostic studies.*

IO *Explain how pathophysiology may influence the distribution of radiopharmaceuticals.*

IO *Explain factors other than pathophysiology that may influence the distribution of radiopharmaceuticals (e.g., radiopharmaceutical formulation problems, drug interactions, interventional procedures).*

IO *Explain common artifacts and their origin in radiopharmaceutical imaging.*

IO *Explain the effect of artifacts (e.g., imaging, data processing) on the interpretation of images.*

IO *Explain the relationship between anatomy and physiology and the images obtained in nuclear medicine/molecular imaging.*

Goal R2.6 Design evidence-based therapeutic radiopharmaceutical regimens.

OBJ R2.6.1 (Synthesis) Specify therapeutic goals for a patient requiring radiopharmaceuticals, incorporating the principles of evidence-based medicine that integrate patient-specific data, disease and medication-specific information, ethics, and quality-of-life considerations.

IO *Identify the sources of disease management and medication-use guidelines, consensus statements, and evidence-based meta-analyses currently used in nuclear pharmacy/molecular imaging practice.*

IO *Explain quality-of-life issues that may influence the setting of therapeutic goals for patients requiring therapeutic radiopharmaceuticals.*

IO *Explain ethical issues specific to setting therapeutic goals for patients requiring therapeutic radiopharmaceuticals.*

OBJ R2.6.2 (Synthesis) Design a patient-centered therapeutic radiopharmaceutical regimen that meets the evidence-based therapeutic goals established for a patient requiring therapeutic radiopharmaceuticals; integrates patient-specific information, disease and drug information, ethical issues and quality-of-life issues; and considers pharmacoeconomic principles.

IO *State those therapeutic radiopharmaceuticals that require a diagnostic study prior to their use.*

IO *Explain regulatory constraints of dosage (amount of administered radioactivity) of radiopharmaceuticals on determining treatment setting (inpatient or outpatient).*

IO *Explain the biological effects (dosimetry) of therapeutic radiopharmaceuticals on the success of therapy.*

IO *Explain the effects of therapeutic radiopharmaceuticals on tissues other than the target site (target specificity) in determining dosage.*

IO *Explain implications of the effects of therapeutic radiopharmaceuticals on other treatments the patient is receiving.*

IO *Explain the function of agents used to promote the biological elimination of radiopharmaceuticals and agents used as radioprotectors.*

Goal R2.7 Design evidence-based monitoring plans for patients requiring therapeutic radiopharmaceuticals.

OBJ R2.7.1 (Synthesis) Design a patient-centered, evidenced-based monitoring plan for a therapeutic radiopharmaceutical regimen that effectively evaluates achievement of the therapeutic goals set for the patient.

IO *State customary monitoring parameters for toxicity and efficacy of therapeutic radiopharmaceuticals.*

Goal R2.8 Recommend or communicate regimens and monitoring plans for patients requiring therapeutic radiopharmaceuticals.

OBJ R2.8.1 (Application) Recommend a patient-centered, evidence-based therapeutic radiopharmaceutical regimen and corresponding monitoring plan to other members of the interdisciplinary team in a way that is systematic, logical, accurate, timely, and secures consensus from the team.

OBJ R2.8.2 (Application) Discuss the proposed patient-centered, evidence-based therapeutic radiopharmaceutical regimen and corresponding monitoring plan with the patient or caregiver in a way that is systematic, logical, accurate, timely, sensitive, and secures consensus from the patient or caregiver.

IO *Explain the impact of fears of radioactivity and its effects on patient acceptance of therapeutic radiopharmaceuticals.*

IO *Explain the importance of clear explanation of the adverse effects of radiopharmaceuticals.*

IO *Explain the importance of explaining to the patient limitations that must be placed on patient activities post administration of the specific radiopharmaceutical.*

IO *Explain the importance of explaining to the patient the expected limits of the outcomes of the therapy.*

Goal R2.9 Implement therapeutic radiopharmaceutical regimens and monitoring plans.

OBJ R2.9.1 (Application) When appropriate, initiate the patient-centered, evidence-based therapeutic radiopharmaceutical regimen and monitoring plan according to the organization's policies and procedures.

IO *Explain the organization's policies and procedures for ordering inpatient and outpatient medications.*

IO *Explain the organization's policies and procedures for ordering tests.*

OBJ R2.9.2 (Complex Overt Response) When appropriate, exercise skill in the administration or supervision of the administration of therapeutic radiopharmaceuticals.

OBJ R2.9.3 (Application) When necessary, contribute to the work of the team that secures reimbursement for medications used in a regimen for a patient requiring therapeutic radiopharmaceuticals.

IO *Explain the general framework of patient assistance programs available for radiopharmaceuticals.*

IO *Explain the pharmacist's role (versus other interdisciplinary team members) in securing payer coverage or patient assistance.*

IO *Explain organizational policies and procedures for securing compassionate use medications needed for an individual patient.*

OBJ R2.9.4 (Synthesis) Use effective patient education techniques to provide radiopharmaceutical-related counseling to a patient or the patient's caregiver(s).

IO *Identify resources for prepared materials designed for the education of patients requiring radiopharmaceuticals.*

IO *Explain the types of information that patients receiving radiopharmaceuticals and their caregivers need to know about the patients' medications and nuclear medicine/molecular imaging procedures they will undergo.*

IO *Explain the types of information about radiation safety that patients receiving radiopharmaceuticals and their caregivers need to know.*

Goal R2.10 Evaluate the progress of patients receiving a therapeutic radiopharmaceutical and redesign regimens and monitoring plans.

OBJ R2.10.1 (Evaluation) Accurately assess progress toward the therapeutic goal(s) of a patient receiving a therapeutic radiopharmaceutical.

IO *Explain factors to consider when determining when a patient receiving a therapeutic radiopharmaceutical can be released to the ambulatory care setting.*

OBJ R2.10.2 (Synthesis) If applicable, redesign the regimen and monitoring plan of a patient receiving a therapeutic radiopharmaceutical based on evaluation of monitoring data and therapeutic outcomes.

Goal R2.11 Communicate ongoing patient information to facilitate continuity of care.

OBJ R2.11.1 (Synthesis) Formulate a strategy for continuity of pharmaceutical care across all applicable treatment settings.

IO *Explain potential problems that may place patients requiring therapeutic radiopharmaceuticals at risk in various treatment settings (e.g., hospital, clinic, home) or upon change in level of care.*

IO *Explain methods for coordinating information between pharmacy and other health care workers serving the needs of patients requiring therapeutic radiopharmaceuticals that will facilitate the provision of pharmaceutical care.*

OBJ R2.11.2 (Application) When given a patient requiring therapeutic radiopharmaceuticals who is transitioning from one health care setting to another, communicate pertinent pharmacotherapeutic information to the receiving health care professionals.

Goal R2.12 Document direct patient care activities appropriately.

OBJ R2.12.1 (Analysis) Appropriately select direct patient care activities for nuclear medicine/molecular imaging patients for documentation.

IO *Explain the organization's policies and procedures for identifying activities that must be documented.*

OBJ R2.12.2 (Application) Use effective communication practices when documenting a direct patient-care activity for a patient receiving radiopharmaceuticals.

IO *Explain the organization's policies and procedures for documenting direct patient care activities.*

Outcome R3: Serve as an authoritative resource on the optimal use of radiopharmaceuticals, contrast agents, and ancillary medications.

Goal R3.1 Demonstrate understanding of basic nuclear pharmacy principles.

OBJ R3.1.1 (Comprehension) Explain the fundamentals of nuclear physics that apply to the work of nuclear pharmacy/molecular imaging.

OBJ R3.1.2 (Comprehension) Explain the fundamentals of health physics/radiation protection that apply to the work of nuclear pharmacy/molecular imaging.

OBJ R3.1.3 (Comprehension) Explain the fundamentals of radiation detection that apply to the work of nuclear pharmacy/molecular imaging.

OBJ R3.1.4 (Comprehension) Explain the fundamentals of radiotracer methodologies that apply to the work of nuclear pharmacy/molecular imaging.

OBJ R3.1.5 (Comprehension) Explain the fundamentals of radiation biology that apply to the work of nuclear pharmacy/molecular imaging.

OBJ R3.1.6 (Comprehension) Explain the fundamentals of radiation dosimetry that apply to the work of nuclear pharmacy/molecular imaging.

OBJ R3.1.7 (Comprehension) Explain the fundamentals of contrast agents that apply to the work of medical imaging.

OBJ R3.1.8 (Comprehension) Explain the fundamentals of radiopharmaceutical chemistry that apply to the work of nuclear pharmacy/molecular imaging.

OBJ R3.1.9 (Comprehension) Explain the fundamentals of radiopharmacology that apply to the work of nuclear pharmacy/molecular imaging.

Goal R3.2 Contribute to the organization's process for reporting medication errors involving radiopharmaceuticals and contrast agents.

OBJ R3.2.1 (Application) Contribute to the organization's system for reporting medication errors and adverse drug reactions.

IO Explain NRC and state requirements for reporting misadministration of radiopharmaceuticals.

OBJ R3.2.2 (Analysis) When applicable, contribute to a root cause analysis (RCA) of a medication error.

Goal R3.3 Contribute to the development and implementation of selected policies and procedures for nuclear pharmacy/molecular imaging.

OBJ R3.3.1 (Evaluation) When applicable, contribute to the conduct of a medication use evaluation (MUE) for a contrast agent, adjunct pharmaceutical, or radiopharmaceutical.

OBJ R3.3.2 (Synthesis) Write a new, or revise an existing, departmental policy and/or procedure for nuclear pharmacy/molecular imaging so that it is congruent with the organization's goals, needs, and mission.

OBJ R3.3.3 (Comprehension) Understand the role of the nuclear pharmacy specialist on regulatory-related organizational committees.

IO Explain the nuclear pharmacy specialist's role on the organization's Radiation Safety Committee.

IO Explain the nuclear pharmacy specialist's role on the organization's Radioactive Drug Research Committee.

Goal R3.4 Establish oneself as an organizational expert for information and resources related to radiopharmaceuticals and ancillary medications.

OBJ R3.4.1 (Synthesis) Implement a successful strategy for earning credibility within the organization to be an authoritative resource on the care of patients requiring radiopharmaceuticals.

IO Identify barriers for the nuclear pharmacy/molecular imaging specialist to earning credibility with members of the interdisciplinary team.

IO Identify barriers for the nuclear pharmacy/molecular imaging specialist to earning credibility within the organization.

Goal R3.5 Contribute to the maintenance of the organization's formulary for radiopharmaceuticals and ancillary medications.

OBJ R3.5.1 (Evaluation) Make a recommendation for an addition or deletion to the organization's formulary for a radiopharmaceutical or ancillary medication based on literature and/or comparative reviews.

IO State the elements of a comparative review.

IO State sources to consult in the preparation of a comparative review.

IO Explain the importance of including consideration of efficacy, safety, and cost in the preparation of reviews.

OBJ R3.5.2 (Evaluation) Make a recommendation for a drug class decision related to a nuclear medicine/molecular imaging procedure based on comparative reviews.

OBJ R3.5.3 (Evaluation) When presented with a real or hypothetical drug shortage, identify appropriate alternative medications.

IO State resources for identifying medications in short supply.

IO Explain the organization's system for communicating information regarding drug shortages.

IO Explain a strategy for making optimal choices for alternative medications.

Goal R3.6 Employ advanced literature analysis skills in the analysis and effective communication of evidence-based information regarding nuclear pharmacy/molecular imaging.

OBJ R3.6.1 (Synthesis) Create an efficient and effective advanced search strategy to obtain information.

IO Explain the full range of biomedical information resources that are currently available.

IO State sources of nuclear medicine/pharmacy biomedical literature.

IO Explain content and applicability of specialized sources of biomedical information.

OBJ R3.6.2 (Analysis) Accurately identify the study design employed for a piece of biomedical literature.

IO Explain the key features of experimental designs and the strengths and weaknesses of each.

IO Explain the limitations of studies testing sensitivity, specificity, etc.

OBJ R3.6.3 (Evaluation) Determine if the study design and methodology are appropriate to accomplish the objectives of a piece of biomedical literature.

IO Explain the effects on study outcomes of various methods of drug assay and quality assurance procedures (e.g., imaging modalities, high-performance liquid chromatography, radiometric methods).

OBJ R3.6.4 (Evaluation) Accurately interpret statistical information presented in a piece of biomedical literature.

IO Explain the application and interpretation of advanced statistical methods.

IO Determine instances in which a study conclusion is erroneously supported by data display.

OBJ R3.6.5 (Analysis) Identify potential sources of bias in a piece of biomedical literature.

OBJ R3.6.6 (Evaluation) Determine the internal and external validity of a piece of biomedical literature.

OBJ R3.6.7 (Evaluation) Determine if a study's results have applicability for hypothesizing future research or for directing patient care decisions.

IO Explain how level of evidence is determined.

OBJ R3.6.8 (Evaluation) When presented with conflicting biomedical literature, determine the validity and applicability for a specific information need.

IO Compare and contrast the reputations of biomedical journals.

IO Compare and contrast the peer-review procedures of biomedical journals.

IO Explain how to appraise biomedical information for the expertise and reputation of the author(s).

OBJ R3.6.9 (Evaluation) When presented with limited evidence-based biomedical literature, synthesize a reasonable response for the specific information need.

OBJ R3.6.10 (Evaluation) Appraise information provided by a pharmaceutical manufacturer.

OBJ R3.6.11 (Synthesis) Prepare an expert response to a complex information need.

IO Explain a standardized process for documenting, storing, and retrieving information responses.

Goal R3.7 Select core biomedical literature resources appropriate for nuclear pharmacy/molecular imaging practice.

OBJ R3.7.1 (Application) Use a knowledge of standard nuclear medicine/molecular imaging-related resources to select core primary, secondary, and tertiary biomedical literature resources appropriate for nuclear pharmacy/molecular imaging practice.

Goal R3.8 Contribute to the review, modification, and implementation of` medication-related guidelines/protocols for the care of individuals who require the use of radiopharmaceuticals.

OBJ R3.8.1 (Analysis) Identify the need for a medication-related guideline/protocol for the care of individuals requiring the use of radiopharmaceuticals.

OBJ R3.8.2 (Synthesis) Contribute to the development or modification of a medication-related guideline/protocol for the care of individuals who require the use of radiopharmaceuticals based on best evidence and the characteristics of the local environment and patients.

OBJ R3.8.3 (Synthesis) Formulate a strategy that will successfully implement a medication-related guideline/protocol for the care of individuals who require the use of radiopharmaceuticals.

IO Explain the importance of including pharmacy, nuclear medicine technologists, nursing, and medical services in the design of an implementation strategy.

Goal R3.9 Contribute to publishing periodic newsletters or bulletins for health care providers on timely medication-related matters and medication policies.

OBJ R3.9.1 (Synthesis) Write an article for a newsletter or bulletin addressing either a medication or a medication policy affecting patients who require radiopharmaceuticals.

Goal R3.10 Understand the role of the nuclear pharmacy specialist in public health initiatives.

OBJ R3.10.1 (Comprehension) Explain the nuclear pharmacy specialist's role in the development of emergency protocols for public health disasters (e.g., natural disaster, bioterrorism, epidemic).

Outcome R4: Demonstrate excellence in the provision of training and educational activities on nuclear medicine and nuclear pharmacy/molecular imaging for health care professionals and health care professionals in training.

Goal R4.1 Provide effective education and/or training on nuclear medicine or nuclear pharmacy/molecular imaging to health care professionals and health care professionals in training.

OBJ R4.1.1 (Synthesis) Design an educational/training activity using effective educational techniques.

IO *Identify emerging issues in nuclear medicine and nuclear pharmacy/molecular imaging that would be suitable for interdisciplinary educational sessions (e.g., inservices, grand rounds).*

IO *Explain the differences in effective educational strategies when teaching colleagues versus residents versus students versus health professionals in other disciplines.*

IO *Explain the concept of learning styles and its influence on the design of instruction.*

IO *Explain the principles for design of instruction to meet and individual learner's needs.*

IO *Explain how to write appropriately worded educational objectives.*

IO *Explain the match between instructional delivery systems (e.g., demonstration, written materials, video) and the specific types of learning each facilitates.*

IO *Explain how to design instruction that employs strategies, methods, and techniques congruent with the objectives for education or training.*

IO *Explain effective teaching approaches for the various types of learning (e.g., imparting information, teaching psychomotor skills, inculcation of new attitudes).*

OBJ R4.1.2 (Synthesis) Design an assessment strategy that appropriately measures the specified objectives for an education or training activity and fits the learning situation.

IO *Explain appropriate assessment techniques for assessing the learning outcomes of educational or training programs.*

OBJ R4.1.3 (Application) Use skill in the four preceptor roles employed in practice-based teaching (direct instruction, modeling, coaching, and facilitation)[2].

IO *Explain the stages of learning that are associated with each of the preceptor roles.*

OBJ R4.1.4 (Application) Speak effectively to a large group.

IO *Explain techniques that can be used to enhance audience interest.*

IO *Explain techniques that can be used to enhance audience understanding of one's topic.*

IO *Explain speaker habits that distract the audience.*

OBJ R4.1.5 (Application) Speak effectively in a small group.

Outcome R5: Demonstrate leadership and practice management skills.

Goal R5.1 Exhibit the ongoing development of essential personal skills of a nuclear pharmacy/molecular imaging practice leader.

OBJ R5.1.1 (Characterization) Practice self-managed continuing professional development with the goal of improving the quality of one's own performance through self-assessment and change.

[2] Nimmo, CM. Developing training materials and programs: creating educational objectives and assessing their attainment. In: Nimmo CM, Guerrero R, Greene SA, Taylor JT, eds. Staff development for pharmacy practice. Bethesda, MD: ASHP; 2000.

IO *State criteria for judging one's performance of tasks that are critical in one's own practice.*

IO *Explain the role of participation in nuclear medicine/molecular imaging and pharmacy professional organization meetings in the ongoing development of expertise in nuclear pharmacy/molecular imaging.*

IO *Explain the importance of staying current with pertinent nuclear medicine and general pharmacy literature.*

OBJ R5.1.2 (Characterization) Demonstrate commitment to the professional practice of nuclear pharmacy/molecular imaging through active participation in the activities of nuclear pharmacy/nuclear medicine local, state, and/or national professional organizations.

IO *Assess the relevance of membership or participation in various professional organizations associated with nuclear pharmacy/molecular imaging practice.*

IO *Explain the importance of contributing to the work of pharmacy professional organizations in advancing the visibility of the pharmacist's role in the medication-related care of nuclear medicine patients.*

OBJ R5.1.3 (Characterization) Display integrity in professional relationships and actions.

IO *Explain the impact of exclusive distribution agreements on patient care and the resulting effect on relationships with the radiopharmaceutical industry.*

IO *Explain the impact of radiopharmaceutical consignment practices on patient care and the resulting effect on relationships with the radiopharmaceutical industry.*

IO *Explain how ownership of nuclear pharmacies by the radiopharmaceutical industry may confound relationships with the radiopharmaceutical industry.*

Goal R5.2 Contribute to the leadership and management activities within the practice area.

OBJ R5.2.1 (Comprehension) Explain sources of credentialing for nuclear pharmacy/molecular imaging specialists.

IO *Explain the importance of credentialing and how that influences practice.*

IO *State the practice setting's policy for applying to be credentialed as a nuclear pharmacy/molecular imaging specialist.*

OBJ R5.2.2 (Synthesis) Use group participation skills when leading or working as a member of a formal or informal work group.

IO *Explain methods for achieving consensus.*

IO *Explain how to create an agenda for a meeting.*

IO *Explain methods for assuring participation by all members of a group.*

IO *Explain methods for effective group leadership.*

IO *Explain behaviors that contribute to the successfulness of a group.*

IO *Explain behaviors that interfere with successful group performance.*

Goal R5.3 Promote the advancement of nuclear pharmacy/molecular imaging practice.

OBJ R5.3.3 (Comprehension) Explain the nature of mentoring in pharmacy, its potential connection with achievement, and the importance of being willing to serve as a mentor to appropriate individuals.

OBJ R5.3.4 (Comprehension) Explain the general processes of establishing and maintaining a nuclear pharmacy/molecular imaging residency program.

Outcome R6: Function effectively in nuclear medicine/molecular imaging settings participating in preclinical or clinical investigations.

Goal R6.1 When applicable, contribute to the design and formulation of an investigational radiopharmaceutical or ancillary medication.

OBJ R6.1.1 (Synthesis) When applicable, contribute to the design of an investigational radiopharmaceutical or ancillary medication.

- *IO Explain factors to consider when determining when an expressed need might practically be met by creation of a new radiopharmaceutical or ancillary medication.*
- *IO Explain how to identify structure-distribution and structure-activity relationships for candidate molecular entities.*
- *IO Explain the importance of considering toxicity of a proposed radiopharmaceutical or ancillary medication.*
- *IO Explain factors to consider when determining an appropriate radionuclide for labeling of the proposed molecular entity.*

OBJ R6.1.2 (Synthesis) When applicable, contribute to the development of an investigational radiopharmaceutical or ancillary medication.

- *IO Explain the steps in developing an investigational radiopharmaceutical or ancillary medication.*
- *IO Explain principles for writing a radiolabeling procedure for the molecular entity to be developed.*
- *IO Explain the importance of testing to ensure accurate development of the specified product.*

Goal R6.2 Contribute to the design and implementation of studies of radiopharmaceuticals and ancillary medications.

OBJ R6.2.1 (Synthesis) Contribute to the writing of a research protocol for an investigational radiopharmaceutical or ancillary medication.

OBJ R6.2.2 (Application) Contribute to the conduct of a study of an investigational radiopharmaceutical or ancillary medication according to the organization's policies and procedures.

- *IO Explain the role of the organization's radiation safety committee, radioactive drug research committee, human subjects review committee, and their subcommittees, if any.*
- *IO Explain the role of committees (e.g., clinical investigation, human use, and radiation control) in the approval process of research projects, and in the submission of an IND-type protocol, involving the use of radiopharmaceuticals.*
- *IO Explain statements used on consent forms to convey to the research subject the risks associated with the radiopharmaceutical.*

IO *Explain the role of the Institutional Animal Care and Use Committee (IACUC) in the oversight of studies involving animals.*

Outcome R7: Contribute to the body of nuclear pharmacy/molecular imaging knowledge.

Goal R7.1 Conduct a nuclear pharmacy/molecular imaging-related project using effective research and project management skills.

OBJ R7.1.1 (Synthesis) Identify a topic of significance for a nuclear pharmacy/molecular imaging-related project.

IO *Explain the types of resident projects (e.g., teaching, prospective, retrospective, clinical trials) that will meet residency program project requirements and timeframe.*

IO *Explain how one determines if a potential project topic is of significance in one's particular practice setting.*

IO *Explain how to conduct an efficient and effective literature search for the background analysis.*

IO *Explain how to generate a research question(s) to be answered by an investigation.*

OBJ R7.1.2 (Synthesis) Formulate a feasible design for a nuclear pharmacy/molecular imaging-related project.

IO *Explain the elements of a project proposal.*

IO *Explain how to identify those health care personnel who will be affected by the conduct of the project and strategies for gaining their cooperation.*

IO *Explain how to determine a timeline with suitable milestones that will result in project completion by an agreed upon date.*

IO *Explain various methods for constructing data collection tools.*

OBJ R7.1.3 (Synthesis) Secure any necessary approvals, including IRB, for a nuclear pharmacy/molecular imaging-related project.

IO *Explain how to identify stakeholders who must approve a particular project.*

IO *Explain the components that make up a budget for a project.*

IO *Explain strategies for seeking funding for a project.*

IO *Explain the implications of the Belmont Report*[3] *for ethical decision-making in pharmacy.*

IO *Explain the role of the IRB in the approval process.*

IO *Explain effective researcher conduct when seeking IRB approval.*

OBJ R7.1.4 (Synthesis) Implement a nuclear pharmacy/molecular imaging-related project as specified in its design.

IO *Explain strategies for keeping one's work on a project at a pace that matches with the projected timeline.*

[3] The Belmont Report.: Ethical Principles for the Protection of Human Subjects of Research. Report from the the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (resource on the World Wide Web). URL: http.//ohsr.od.nih.gov/guidelines/guidelines.html. Office of Human Subjects Research, National Institutes of Health. 1979 April 18, Available from Internet. Accessed 2007April 2.

IO *Given a particular residency project, explain methods for organizing and maintaining project materials and documentation of the project's ongoing implementation.*

IO *Explain methods for data analysis.*

IO *Explain issues surrounding confidentiality of patient information accessed for a project.*

OBJ R7.1.5 (Synthesis) Effectively present the results of a nuclear pharmacy/molecular imaging-related project.

OBJ R7.1.6 (Synthesis) Use correct grammar, punctuation, spelling, style, and formatting conventions to prepare a written summary of a nuclear pharmacy/molecular imaging-related project.

Goal R7.2 Engage in the publication process.

OBJ R7.2.1 (Comprehension) Explain the benefits, to the practitioner and the profession, of contributing to the pharmacy literature.

OBJ R7.2.2 (Synthesis) Write a research article, review, or case report that is suitable for publication.

IO *Use a standard style for biomedical journals in the preparation of research articles, reviews, or case reports submitted for publication.*

IO *Given a specific article, identify appropriate journals to which that article might be submitted for publication.*

IO *Given an identified topic related to pharmacy practice, appraise the potential to publish an article on that topic.*

IO *Explain the rules governing who may declare authorship of a given work.*

Elective Educational Outcomes, Goals, and Objectives for Postgraduate Year Two (PGY2) Residencies in Nuclear Pharmacy

Outcome E1: Demonstrate skills required to function in an academic setting.

Goal E1.1 Understand faculty roles and responsibilities.

OBJ E1.1.1 (Comprehension) Explain variations in the expectations of different colleges/schools of pharmacy for teaching, practice, research, and service.

- *IO Discuss how the different missions of public versus private colleges/schools of pharmacy can impact the role of faculty members.*
- *IO Discuss maintaining a balance between teaching, practice, research and service.*
- *IO Discuss the relationships between scholarly activity and teaching, practice, research and service.*

OBJ E1.1.2 (Analysis) Explain the role and influence of faculty in the academic environment.

- *IO Explain the responsibilities of faculty in governance structure (e.g. the faculty senate, committee service).*
- IO *Describe the responsibilities of faculty (e.g. curriculum development and committee service) related to teaching, practice, research, and service roles.*

OBJ E1.1.3 (Comprehension) Describe the academic environment.

- *IO Describe how the decisions by university and college administration impact the faculty.*
- *IO Discuss outside forces (e.g. change in the profession, funding source, accreditation requirements) that impact administrator and faculty roles.*

OBJ E1.1.4 (Comprehension) Describe the types and ranks of faculty appointments.

- *IO Explain the various types of appointments (e.g. non-tenure, tenure-track, and tenured faculty).*
- *IO Differentiate among the various ranks of faculty (e.g. instructor, assistant professor, associate professor, full professor).*
- *IO Discuss the role and implications of part-time and adjunct faculty as schools continue to expand and faculty shortages occur.*

OBJ E1.1.5 (Comprehension) Discuss the promotion and/or tenure process for each type of appointment.

- *IO Identify the types of activities that are considered in the promotion process.*
- *IO Identify the types of activities that are considered for tenure.*

OBJ E1.1.6 (Application) Identify resources available to help develop academic skills.

- *IO Explain the role of academic-related professional organizations (e.g. AACP) in faculty professional development.*
- *IO Identify resources to help develop teaching skills and a teaching philosophy.*

OBJ E1.1.7 (Comprehension) Explain the characteristics of a typical affiliation agreement between a college of pharmacy and a practice site (e.g., health system, hospital, clinic, retail pharmacy).

IO Explain how the political environments of either a college or a practice site may affect the other.

Goal E1.2 Exercise teaching skills essential to pharmacy faculty.

OBJ E1.2.1 (Synthesis) Develop an instructional design for a class session, module, or course.

IO Construct a student-centered syllabus.

IO Construct educational objectives for a class session, module, or course that is appropriate to the audience.

IO Identify appropriate instructional strategies for the class session, module, or course to achieve the objectives.

IO Consider assessment tools that measure student achievement of the educational objectives.

OBJ E1.2.2 (Synthesis) Prepare and deliver didactic instruction on a topic relevant to the specialized area of pharmacy residency training.

IO Identify educational technology that could be used for a class session, module, or course (e.g., streaming media, course management software, audience response systems).

IO Create instructional materials appropriate for the topic and audience.

IO Identify strategies to deal with difficult learners.

IO Given feedback from teaching evaluations (e.g. student and or peer), devise a plan to incorporate improvements in future instruction.

OBJ E1.2.3 (Application) Develop and deliver cases for workshops and/or exercises for laboratory experiences.

IO Identify the appropriate level of case-based teachings for small group instruction.

IO Identify appropriate exercises for laboratory experiences.

IO Provide appropriate and timely feedback to improve performance.

OBJ E1.2.4 (Application) Serve as a preceptor or co-preceptor utilizing the four roles employed in practice-based teaching (direct instruction, modeling, coaching and facilitation).

IO Assess the learner's skill level to determine the appropriate preceptor strategy for providing practice-based teaching.

IO Given performance-based criteria, identify ways to provide constructive feedback to learners.

IO Develop strategies to promote professional behavior.

IO Identify strategies to deal with difficult learners in the practice setting.

IO Given a diverse learner population, identify strategies to interact with all groups with equity and respect.

OBJ E1.2.5 (Analysis) Develop a teaching experience for a practice setting (e.g., introductory or advanced pharmacy experience).

IO Create educational goals and objectives to be achieved.

IO *Develop activities that will allow achievement of identified educational goals and objectives.*

IO *Identify how and when feedback should be provided.*

IO *Identify other preceptors for the experience, if appropriate.*

IO *Determine training that might be needed for the preceptors to deliver student education.*

IO *Identify potential challenges of precepting and providing patient care services simultaneously.*

OBJ E1.2.6 (Synthesis) Design an assessment strategy that appropriately measures the specified educational objectives for the class session, module, course, or rotation.

IO *Identify appropriate techniques for assessing learning outcomes in various educational settings [e.g., written examinations, oral examinations, practical examinations, Objective Structured Clinical Examination (OSCE)].*

IO *Develop examination questions to assess the knowledge, skills, attitudes and behaviors that are appropriate to the learner's level and topic.*

IO *Discuss the various methods for administering examination questions (e.g., computerized testing, paper testing).*

OBJ E1.2.7 (Evaluation) Create a teaching portfolio.

IO *Define the concept of a teaching portfolio and describe its primary purpose*

IO *Outline the steps in building a teaching portfolio.*

IO *Develop a personal teaching philosophy to guide one's teaching efforts and facilitate student learning.*

OBJ E1.2.8 (Evaluation) Compare and contrast methods to prevent and respond to academic and profession dishonesty.

IO *Evaluate physical and attitudinal methods to prevent academic dishonesty.*

IO *Discuss methods of responding to incidents of academic dishonesty.*

IO *Discuss the role of academic honor committees in cases of academic dishonesty.*

IO *Identify examples and methods to address unprofessional behavior in learners.*

OBJ E1.2.9 (Comprehension) Explain the relevance of copyright laws to developing teaching materials.

IO *Discuss copyright regulations as related to reproducing materials for teaching purposes.*

IO *Discuss copyright regulations as related to linking and citing on-line materials.*

Outcome E2: Conduct outcomes research.

Goal E2.1 Contribute to clinical and economic outcomes analyses.

OBJ E2.1.1 (Evaluation) Contribute to clinical outcomes analyses.

IO *Explain the purpose of a prospective and of a retrospective clinical outcomes analysis.*

IO *Explain study designs appropriate for a prospective and of a retrospective clinical outcomes analysis.*
IO *Explain the technique and application of modeling.*
IO *Explain the types of data that must be collected in a prospective and in a retrospective clinical outcomes analysis.*
IO *Explain possible reliable sources of data for a clinical outcomes analysis.*
IO *Explain methods for analyzing data in a prospective and in a retrospective clinical outcomes analysis.*
IO *Explain how results of a clinical outcomes analysis may be applied to practice decisions.*

OBJ E2.1.2 (Evaluation) Contribute to an economic outcomes analysis.
IO *Explain the principles and methodology of basic pharmacoeconomic analyses.*
IO *Explain the purpose of a retrospective and of a prospective economic outcomes analysis.*
IO *Explain study designs appropriate for a retrospective and for a prospective economic outcomes analysis.*
IO *Explain the types of data that must be collected in a retrospective and in a prospective economic outcomes analysis.*
IO *Explain the content and utilization of reports and audits produced by the pharmacy department.*
IO *Explain possible reliable sources of data for a retrospective and of a prospective economic outcomes analysis.*
IO *Explain methods for analyzing data in a retrospective and in a prospective economic outcomes analysis.*
IO *Explain the impact of limitations of retrospective data on the interpretation of results.*

Outcome E3: Demonstrate additional skills for contributing to the body of nuclear pharmacy/molecular imaging knowledge.

Goal E3.1 Engage in the publication process.

OBJ E3.1.1 (Application) Follow the submission requirements of an appropriate peer-reviewed publication to submit a manuscript for publication.

Outcome E4: Contribute to the organization's management of emergency situations.

Goal E4.1 Contribute to the management of medical emergencies.

OBJ E4.1.1 (Synthesis) Exercise skill as a team member in the management of a medical emergency according to the organization's policies and procedures.
IO *Explain appropriate medication therapy in medical emergency situations.*
IO *Explain unique considerations when preparing and dispensing medications and calculating doses during a medical emergency.*

OBJ E4.1.2 (Complex Overt Response) When administration is allowed by the organization, exercise skill in the administration of emergency medications.

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The effective date for implementation of these educational outcomes, goals and objectives is commencing with the entering resident class of 2009.

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Appendix

PGY2 Nuclear Pharmacy Residencies

Didactic discussions, reading assignments, case presentations, written assignments, conferences, and direct patient care experience will allow the nuclear pharmacy/molecular imaging resident to understand and appreciate the implications of radiopharmacy, with the following areas of emphasis:

I. Radiation Protection and Safety
- A. Patients and general public
- B. Radiation workers
  1. ALARA principle (time, distance, shielding)
  2. Proper use of radiation badges
- C. Decontamination procedures (minor/major spills)
- D. Quality control on instruments for radiation detection and dose measurement
- E. Security of radioactive material
- F. Area monitoring and personnel survey
- G. Bioassays
- H. Homeland security awareness for patients receiving radiopharmaceuticals
- I. Releasing patients receiving radiopharmaceutical therapy
- J. Pregnancy/breast feeding

II. Fundamental Didactic Training
- A. Nuclear physics
- B. Health physics
- C. Radiation detection
- D. Radiotracer methodologies
- E. Radiation biology
- F. Radiation dosimetry
- G. Radiopharmaceutical chemistry
- H. Radiopharmacology
- I. Radioactive material production methods

III. Regulatory and Accrediting Agencies
- A. Nuclear Regulatory Commission (NRC)
- B. Department of Transportation (DOT)
- C. Food and Drug Administration (FDA)
- D. Occupational Safety and Health (OSHA)
- E. Joint Commission
- F. Environmental Protection Agency (EPA)
- G. American Society of Health-System Pharmacists (ASHP)
- H. State and Federal Laws

IV. Management of a Nuclear Pharmacy
- A. Preparation of radiopharmaceuticals
  - 1. quality control tests on radiopharmaceuticals
  - 2. use of aseptic technique – USP Chapter <797>
- B. Procurement of radiopharmaceuticals, radioactive material, and equipment
- C. Receiving and disposal of radioactive material
- D. Dispensing radiopharmaceuticals and ancillary medications
- E. Dose calculations/decay of radiopharmaceuticals
- F. Administration of radiopharmaceuticals
- G. Supervision/training of personnel

V. Diagnostic Tests in Nuclear Medicine
- A. Organ system imaging
  - 1. heart
    - a. perfusion (rest and stress)
    - b. viability
    - c. metabolic function
    - d. myocardial infarct
    - e. radionuclide angiography
      - 1) first pass
      - 2) multiple gated acquisition scan (MUGA)
      - 3) radionuclide stress ventriculography
    - f. cardiac shunt
  - 2. kidney/genitourinary
    - a. renogram
      - 1) flow and function
      - 2) glomerular filtration rate
      - 3) effective renal plasma flow
      - 4) parenchymal disorders
      - 5) Captopril renography
    - b. voiding cystogram
    - c. testicular study
  - 3. liver
    - a. cholescintigraphy
    - b. biliary atresia
    - c. hemangiomas
  - 4. spleen
    - splenic cell sequestration
  - 5. central nervous system
    - a. brain scan
    - b. cisternography
    - c. ventriculo-peritoneal shunt
  - 6. lung
    - a. pulmonary perfusion

b. pulmonary ventilation

7. skeleton
    a. bone scan
    b. bone scan with blood pool and flow
    c. arthrogram
    d. bone marrow
8. adrenal gland
    adrenal medulla scan
9. thyroid
    a. uptake and scan
    b. dosimetry
    c. neck and chest
10. parathyroid scan
11. gastric and intestinal system
    a. gastric emptying
    b. Meckel's diverticulum
    c. gastrointestinal bleeding
    d. esophageal clearance
    e. esophageal reflux study
    f. milk aspiration
    g. defecation
    h. urea-breath test
    i. salivary glands
12. miscellaneous
    a. thrombus detection
    b. lymphoscintigraphy
    c. inflammatory disease and infection
    d. tumor localization

VI. Diagnostic in Vivo Function Studies
- A. Red blood cell volume/plasma volume
- B. Red blood cell survival

VII. Therapy
- A. Thyroid
    1. Grave's disease
    2. cancer
    3. uni nodular and multinodular goiter
- B. Bone
- C. Radio immunotherapy
    non-Hodgkin's lymphoma (NHL)
- D. Polycythemia vera
- E. Effusion therapy
- F. Radiation synovectomy
- G. Radiation therapy of malignant glioma

VIII. Adjunct Medications

IX. Food and Drug Interactions

X. Associated Nuclear Medicine Laboratory Tests

XI. Imaging Modalities
- A. Positron emission tomography (PET)
  1. radiation protection
  2. patient care considerations
- B. Positron emission tomography/computed tomography (PET/CT)
- C. Single photon emission computed tomography (SPECT)
- D. Single photon emission computed tomography/computed tomography (SPECT/CT)
- E. Radiation therapy