Nuclear Medicine Advanced Associate Curriculum Guide
1st Edition

SNM
Advancing Molecular Imaging and Therapy

AUTHORS

The first edition of the *Nuclear Medicine Advanced Associate Curriculum Guide* was developed by members of the Advanced Practice Task Force of the SNMTS in 2008.

Martha W. Pickett, MHSA, CNMT, FSNMTS (Task Force Chair)
Randy L. Bursaw
Carla Coley, PharmD
Scott Eldridge, RN
Jeremy Flowers
Lynnett A. Fulk, CNMT, FSNMTS
Glen David Heggie, RT(N), EdD, FC
William L. Hubble, MA, CNMT, RT(R)(N)(CT), FSNMTS
Kathy E. Hunt, MS, CNMT
Nancy McDonald, CNMT
Anthony W. Knight, CNMT, NCT
Mary Anne (Mimi) Owen, M.H.E., RT(N)
Lisa Satterfield
Monique C. Simoneauz
Anne Stachowiak, BS, CNMT
Kathy S. Thomas, MHA, CNMT, PET
Harish Vaidya, BSc, CNMT, CT

REVIEWERS

David Gilmore, MS, CNMT, RT(R)(N), FSNMTS
Leonie L. Gordon, MD
Robert E. Henkin, MD
Alexander J. B. McEwan, MD
Stephen A. Stowers, MD

TABLE OF CONTENTS

APPENDICES

Chapter 1

Expanded Competencies for the Nuclear Medicine Advanced Associate

Expanded Competencies for the Nuclear Medicine Advanced Associate

Introduction

The SNMTS (formerly the Society of Nuclear Medicine Technologist Section) published the first draft of expected competencies for the Nuclear Medicine Advanced Practitioner (NMAA) in March 2007.[1] These competencies were based on existing scopes of practice, knowledge base, and clinical skills expected of other lateral middle-level providers, primarily Physician Assistants, Radiologist Assistants, and Nurse Practitioners. Results from the 2005 SNMTS physician survey[2] were also used to guide the development of practice areas for the NMAA.[3-5]

The first document focused on the desired clinical and administrative skill sets. It was assumed that because these programs would be offered at the graduate level, coursework in research methods, ethical and professional issues, and health care systems issues would be included in an institution's curriculum and so were purposefully omitted from the document. Upon further consideration, the Advanced Practice Task Force decided to expand the original competency list and explicitly outline all the knowledge, skills, and attitudes that should be demonstrated by an advanced practice professional. This decision was prompted by an extensive literature search on curriculum development for graduate-level education in the health professions with the intention to more fully align the NMAA competencies with complementary actions and perspectives of other participants in the medical field.

The general concepts included in the competency domains outlined in this document have been embraced by a broad spectrum of health and medical education programs throughout the United States and Europe. They are similar to education models promoted by the Accreditation Council for Graduate Medical Education's "Outcome Project."[6] This project resulted in the establishment of baseline standards and competencies for medical residents to meet the needs of the modern health care system, far surpassing the more traditional roles of dispensing patient care and medical knowledge. Additionally, "Project Professionalism," published by the American Board of Internal Medicine, serves as a guide for altruistic and communication characteristics that are also important for instruction and assessment in medical education.[7] Accordingly, the Advanced Practice Task Force has added competencies in Interpersonal and Communication, Practice-Based Decision Making, and Professionalism. The section on Administrative Competencies has been renamed Systems-Based Practice. Competencies pertaining to patient care as found in the original General Core Competencies have been outlined and expanded on in a new competency domain, Patient Care. The remaining competencies in the General Core plus those in the Cardiology, Oncology and Therapy, and Elective Competencies have been combined into a new domain, Clinical Nuclear Medicine.

It is anticipated that NMAAs will be required to demonstrate a high level of autonomy, technical sophistication, advanced clinical knowledge, and strong critical thinking and decision-making skills. They will be highly capable and motivated professionals, comfortable with the sciences, and seeking increased clinical responsibilities and education at an advanced degree level. The new competencies will more clearly delineate for the profession and the public what can be expected of the practicing NMAA.

NMAAs are projected to work in general nuclear medicine settings as well as in specialty settings such as oncology and cardiology. The scope of practice for the NMAA is anticipated to subsume many of the patient care and managerial functions currently provided by a wide array of ancillary personnel and will also include advanced knowledge and skills of the practicing Nuclear Medicine Technologist. Additionally, the NMAA could assume certain physician tasks under the discretion of the overseeing radiologist or attending physician. Candidates for NMAA programs would be credentialed by the Nuclear Medicine Technology Certification Board (NMTCB) or the American Registry of Radiologic Technologists (ARRT-N) and have clinical practice experience deemed appropriate by institutional admissions committees. The NMTCB and the ARRT have agreed to collaborate for the development of a certification examination for the credentialing of advanced imaging practitioners.

Competency Domains

The core competencies outlined in this document are intended to serve as a guide in the development of the curriculum for NMAA programs, which will be offered at the master's degree level. These competencies primarily reflect the clinical tasks of an NMAA, but NMAAs may take on additional responsibilities at the discretion of the supervising physician. They were compiled in consideration of tasks required to work with general as well as specific patient populations in diagnostic and therapeutic settings.

These core competencies drive the professional curriculum in terms of content and, most importantly, in terms of assessment. The professional curriculum is expected to utilize a competency-based model in which responsibilities and functions are defined by clinical competencies integrated with physician interaction and supervision. Education programs will be outcomes based and must provide learning opportunities in each competency domain. Assessment of student achievement in each of the domains should be undertaken at multiple intervals using multiple assessment methods.

Recognizing that existing legislation or policies may prohibit some NMAAs from performing some of the tasks identified as core competencies at the present time, NMAAs should receive an educational foundation in all tasks but may opt to demonstrate technical competency via simulation or other acceptable

alternatives. NMAAs should expect to follow institutional guidelines when seeking credentials to practice.

The six competency domains are Patient Care, Clinical Nuclear Medicine, Interpersonal and Communication Skills, Practice-Based Decision Making, Professionalism, and Systems-Based Practice. Patient Care competencies are described for general nuclear medicine procedures in all settings. Clinical Nuclear Medicine competencies incorporate general nuclear medicine procedures with specialty competences outlined for cardiology, therapy, and elective competencies for those skills in which some NMAAs may choose to become proficient depending on their practice setting and the evolution of the profession. Interpersonal and Communication Skills focuses on the ability to work effectively with others as a member or leader of a health care team or other professional group, with an emphasis on demonstrating team communication skills and leadership skills. Practice-Based Decision Making is the ability to analyze practice experience and perform practice-based improvement activities using a systematic methodology and may involve activities such as quality improvement programs, patient safety programs, or grand rounds conferences. Professionalism encompasses the adherence to ethical principles such as the provision of care, confidentiality, informed consent, and autonomy as well as accountability to patients, society, and the profession. Systems-Based Practice, formerly known as Administrative Competencies, encompasses many of the quality assurance, accreditation, and coding and billing duties required of those assuming administrative tasks.

The supporting curriculum includes all six competency domains as well as three content sections that should be incorporated into educational programs. These are patient assessment, pathophysiology, and pharmacology. These content areas were first developed and published by the American Society of Radiologic Technology for the Radiologist Assistant Curriculum Guide and are reprinted with their permission in this document.

Patient Care

I. Communicate effectively and demonstrate caring, respectful, and ethical behaviors when interacting with the patient, the family, physicians, and other health care professionals (see Interpersonal and Communication Skills competency domain)

II. Counsel and educate the patient and family
   A. Obtain patient informed consent for required procedures according to state law and institutional policy
   B. Educate the patient on preprocedural preparation and postprocedural care

III. Make informed decisions about diagnostic and therapeutic procedures under the direction of the supervising physician and based on patient information and preferences, up-to-date scientific evidence, and clinical judgment
   A. Gather and evaluate essential information, including correlative studies, about the patient and arrange follow-up as necessary under the direction of the supervising physician
   B. Obtain history and perform physical examination
   C. Evaluate findings for contraindications to testing and for indicators of additional patient pathology
   D. Consult with the physician as needed
   E. Counsel the patient and family as indicated

IV. Determine and implement a plan of care
   A. Use professional judgment to recommend or adapt protocols for procedures to improve diagnostic quality and outcome
   B. Consult with the supervising physician or appropriate health care provider to determine a modified action plan when necessary
   C. Report findings to the supervising physicians and the patient per protocol

V. Order and administer sedating pharmaceuticals under the direction of the supervising physician and monitor the patient who is receiving sedating pharmaceuticals as indicated by patient profile and diagnostic or therapeutic procedure as allowable by institutional, state, and federal statutes

VI. Implement additional requirements for patient care for diagnostic or therapeutic procedures
   A. Perform patient bladder catheterizations
   B. Implement additional routes of radiopharmaceutical administration other than intravenous injection or oral
   C. Monitor vital signs and physiologic parameters
   D. Evaluate the need for contrast media in consultation with the supervising physician

VII. Provide indicated intervention per patient emergency event
   A. Provide supportive medical management
   B. Basic life support
   C. Advanced life support
   D. Facilitate transfer to definitive care environment

Clinical Nuclear Medicine

General Core Competencies

I. Review requests and physician directives for nuclear medicine procedures
   A. Review request for imaging procedures per protocol
   B. Ensure the appropriate diagnostic study has been requested for the clinical presentation in consultation with the referring physician
   C. Evaluate collaborative laboratory test results for indications/contraindications
   D. Order or facilitate adjunctive pharmaceuticals for the imaging procedure under the direction of the supervising physician

II. Competently perform clinical nuclear medicine procedures considered essential in the area of practice
   A. Perform routine nuclear medicine procedures
   B. Perform sentinel node imaging and lymphatic mapping
   C. Prepare the patient and ancillary equipment for radiation therapy planning using positron and multimodality imaging systems

III. Prescribe and administer pharmacologic and nonpharmacologic interventions under the direction of the supervising physician and as indicated by patient profile and diagnostic procedure as allowable by state and federal statutes
   A. Perform preprocedure requirements and interventions as may be required
   B. Perform intraprocedure requirements as may be required
   C. Perform postprocedure requirements as may be required

IV. Order complementary diagnostic procedures as indicated by patient testing results under the direction of the supervising physician

V. Analyze results of the procedure and prepare a preliminary description of findings for the supervising physician
   A. Assess image quality and other associated data
   B. Make a preliminary assessment
   C. Document initial observations of imaging procedures according to protocol
   D. Communicate initial observations as per the supervising physicians' discretion
   E. Report findings to referring physicians and the patient per protocol

Radionuclide Therapy Core Competencies

I. Review request for radionuclide therapy procedures under the direction of the supervising physician, analyzing the indications, contraindications, and complications for therapeutic interventions
   A. Interpret epidemiologic data, research, and trends related to incidence and prevalence of cancer
   B. Identify risk factors for cancer
   C. Understand dosimetry and dosimetric consequences
   D. Understand the physiologic and radiobiological mechanisms by which differing radioisotope therapies are effective
   E. Conduct imaging protocols and evaluate images and laboratory values for presence of disease and metastasis
   F. Evaluate clinical criteria for radionuclide therapy, including expected biodistribution of radiotherapeutic pharmaceuticals

II. Counsel and educate the patient and family regarding the proposed therapeutic intervention
   A. Obtain translator/interpreter services as necessary
   B. Fully understand the radiation protection regulations and procedures applicable to the administering department and relay the regulations to the patient/caregivers and family if applicable
   C. Explain in detail the processes, guidelines, and timelines for the radioisotope therapy regimen according to institution policy and guidelines
   D. Obtain patient informed consent for required procedures according to state law and institutional policy
   E. Educate the patient on preprocedural and postprocedural care

III. Calculate appropriate therapeutic dosage based on dosimetry, patient well-being, diagnostic imaging, and laboratory results under the direction of the supervising physician
   A. Calculate radionuclide therapy dose for benign thyroid disease, basing dose selection on accepted standards
   B. Calculate radionuclide therapy dose for malignant thyroid disease, basing dose selection on accepted standards
   C. Calculate radionuclide therapy dose for palliative bone therapy, basing dose selection on accepted standards
   D. Calculate radionuclide therapy dose for non-Hodgkin's lymphoma, basing dose selection on accepted standards
   E. Calculate radionuclide therapy dose for polycythemia, basing dose selection on accepted standards
   F. Calculate radionuclide therapy dose for malignant effusion, basing dose selection on accepted standards
   G. Calculate radionuclide therapy dose for selective internal radiation therapy, basing dose selection on accepted standards

IV. Order or facilitate adjunctive pharmaceuticals for radiotherapy according to protocol

V. Administer the therapeutic dose, adhering to the applicable regulations and site protocols

VI. Report procedure to the supervising physician according to protocol
   A. Overview of protocol compliance
   B. Patient identification
   C. Informed consent
   D. Referral prescription
   E. Patient preparation
   F. Relevant clinical history
   G. Radiopharmaceutical dose and route of administration
   H. Patient status before, during, and following therapy
   I. Brief statement outlining patient radiation safety instructions
   J. Recommendations for follow-up diagnostic or therapeutic procedures as indicated
   K. Recommend appropriate follow-up as needed

VII. In conjunction with the referring and supervising physician, monitor the patient and provide posttherapy intervention as needed for adverse side effects
   A. Monitor the patient as indicated by protocol
   B. Provide supportive care for symptoms
   C. Maintain ongoing patient contact throughout the treatment regimen
   D. Reevaluate patient status upon completion of therapy treatment(s) to determine patient's candidacy for additional therapy

Elective Competencies

I. Administer radiopharmaceuticals for radionuclide cisternography, cerebrospinal fluid shunt evaluations, cerebrospinal fluid leaks, or intraperitoneal procedures using aseptic technique and radiation safety standards at the discretion of the supervising physician
   A. Explain complete procedure to the patient/family
   B. Ensure scheduled imaging timeline compliance
   C. Prepare injection site, adhering to predetermined aseptic/sterile technique
   D. Conduct a Joint Commission–recommended "time out" procedure
   E. Monitor room, contents, and personnel as per institutional Radiation Safety Guidelines

II. Participate in image-guided biopsy at the discretion of the supervising physician
   A. Prepare sterile field and biopsy area using aseptic/sterile technique
   B. Obtain informed consent for biopsy
   C. Evaluate for complications prohibiting safe biopsy
   D. Identify appropriate instruments and use according to recommended standards of practice
   E. Prepare biopsy tissue specimens for pathologic examination according to guidelines for specific tissue type, include appropriate transport media slide preparation and documentation
   F. Close and dress the wound according to recommended standards of practice
   G. Order appropriate follow-up imaging studies appropriate to biopsy site and procedure
   H. Conduct a Joint Commission–recommended “time out” procedure
   I. Appropriately intervene for complications
   J. Advise the patient of needed follow-up care

III. Manage pain and sedation for the patient receiving diagnostic testing or therapeutic treatment
   A. Prescribe pharmacologic and nonpharmacologic interventions as allowable by state and federal statues
   B. Monitor patient response to sedation and provide intervention according to accepted standards of practice

Cardiology Competencies

I. Successfully complete Advanced Cardiac Life Support credentialing
   A. Assess normal electrocardiogram to determine patient safety for stress testing
   B. Assess abnormal electrocardiographic conduction in preparation for stress testing

II. Develop procedural policies and standards for pre–cardiac arrest emergencies that might occur within the department as directed by institutional policy and practice standards
   A. Identify the signs and symptoms of symptomatic bradycardia and symptomatic tachycardia
   B. Follow a step-by-step course of action for the patient who develops asymptomatic bradycardia or tachycardia while in office (before, during, or after stress test)
   C. Follow a step-by-step course of action for the patient who develops signs and symptoms of bradycardia or tachycardia while in office (before, during, or after stress test)
   D. Identify the proper medications and dosages for stable cardiac rhythms

E. List contraindications and precautions of common cardiac medications
F. Follow a step-by-step approach to handling an ST elevated myocardial infarction
G. Follow a step-by-step approach to handling a stroke situation
H. Follow a step-by-step approach to handling other patient incidents
I. Identify and delegate personnel to perform various tasks in preparation for cardiac emergencies
J. Incorporate the appropriate federal, state, and institutional guidelines into departmental policies and procedures

III. Develop procedural policies and standards for cardiac arrest emergencies that occur within the department as directed by institutional policy and practice standards and provide indicated intervention for a cardiac emergency event
A. Establish intravenous access
B. Identify and administer the appropriate medications for commonly occurring cardiac arrhythmias under the direction of the supervising physician
C. Perform cardiac compression or defibrillate patient if required
D. Facilitate the ordering of laboratory tests or other tests as needed for a cardiac arrest event under the direction of the supervising physician
E. Facilitate admission of the patient to the hospital if necessary

IV. Provide indicated intervention for noncardiac emergency events

V. Manage crash cart for compliance
A. Follow the appropriate guidelines in implementing regulation for managing the department's crash cart
B. Inventory crash cart components according to institutional policy
C. Properly dispose of expired drugs
D. Replace expired drugs
E. Perform quality assurance testing on defibrillator and document results

VI. Take comprehensive patient history and evaluate for patient pathology
A. Interview the patient and document on department form a complete past and current cardiac history
B. Establish "nothing by mouth" compliance
C. Evaluate ambulatory ability
D. Review noncardiac history for prevalence to study requested
E. Perform physical assessment

VII. Evaluate patient laboratory biochemical markers relevant to cardiac pathology
   A. Review most recent laboratory test results relevant to cardiovascular diseases
   B. Order relevant blood tests if necessary (including pregnancy testing)

VIII. Evaluate patient medications for contraindications to stress testing
   A. Understand contraindications to each type of stress test and evaluate for each
   B. Review patient medications for contraindications to exercise stress testing
   C. Conduct preoperative evaluation for orthopedic or other surgery

IX. Obtain patient informed consent as required for nuclear cardiology procedures according to state law and hospital policy
   A. Understand the ethical and legal underpinnings of informed consent
   B. Determine the capability of the patient to give informed consent
   C. Explain the procedure to the patient, including all components of a valid informed consent
   D. Obtain the patient's or guardian's signature

X. Conduct treadmill testing per all protocol options under the direction of the supervising physician
   A. Prepare the patient for exercise protocol
   B. Determine type of exercise stress test
   C. Monitor electrocardiographic tracings and blood pressure for specific pathology and cardiac events during stress testing
   D. Use the appropriate termination protocols
   E. Calculate the Duke Treadmill Score

XI. Prescribe and administer interventional drugs for pharmacologic stress under the direction of the supervising physician
   A. Explain the indications and contraindications for each pharmacologic stress agent
   B. Identify the physiologic action of each pharmacologic agent as it relates to stress testing
   C. Calculate total dose, volume, and dose rate for each of the most common pharmacologic stress agents
   D. Set up drug administration pump
   E. Prepare pharmacologic agents for administration utilizing sterile technique
   F. Administer pharmacologic agents
   G. Monitor patient response to pharmacologic agents and treat the patient appropriately in the event of an adverse effect

XII. Analyze results of the stress test and imaging portion of the examination and prepare a preliminary description of findings for the supervising physician
   A. Create a preliminary description of findings detailing the results of the stress portion of the test
   B. Examine rotating raw data from both stress and resting image acquisitions and evaluate image quality
   C. Review data for incidental finding outside of the heart
   D. Compare and contrast stress versus resting processed images for perfusion defects
   E. Determine if the heart-to-lung ratio and transient ischemic dilation are abnormal
   F. Evaluate the wall motion of stress and resting images for ejection fraction and kinetic abnormalities
   G. Review and evaluate bull's eye polar maps and summed stress scores
   H. Create a preliminary description of findings detailing the results of the imaging portion of the test

XIII. Facilitate or recommend patient-specific cardiac-related procedures based on nuclear cardiology examination results (outcomes management) according to the supervising physician
   A. Order or facilitate scheduling of complementary diagnostic procedures as indicated
   B. Identify the clinical pathways as outlined by the American Medical Association/American College of Cardiology for cardiac disease

Interpersonal and Communication Skills

I. Demonstrate team communication and leadership skills to work effectively with others as a member or leader of a health care team or other professional group
   A. Demonstrate leadership skills by leading a group project to successful completion
   B. Communicate with the referring physician to assure appropriate examination selection, including actions to be taken if the requested procedure appears to be inappropriate
   C. Collaborate with other health care team members to improve service delivery

II. Protect and preserve personal and confidential information of others to which access is provided
   A. Adhere to privacy and regulatory standards and requirements regarding the accountability and protection of patient information
   B. Identify potential abuses of confidential patient information

C. Describe the challenges associated with maintaining the confidentiality of patient information stored in computer systems and transmitted via networks

III. Use effective listening skills and elicit and provide information using effective nonverbal, explanatory, questioning, and writing skills
   A. Listen to the "patient's story," extract important details from the history taking, and provide information to their patients in an understandable way
   B. Demonstrate effective interviewing skills for patient assessment
   C. Demonstrate effective communication skills with and provide psychosocial support to specific groups of people, such as the terminally ill, physically or emotionally impaired, culturally diverse patients, families, and colleagues
   D. Demonstrate effective age- and gender-specific communications
   E. Be receptive to the clinical significance of patients' personal beliefs and values for adaptation of an examination protocol or departmental policies

IV. Demonstrate emotional resilience and stability, adaptability, flexibility, and tolerance of ambiguity and anxiety
   A. Maintain composure in all situations
   B. Refrain from negative conversations
   C. Demonstrate self-awareness of personality traits

V. Follow appropriate protocol in resolution of conflict, exhibiting proper restraint when presented with potentially volatile situations

VI. Maintain comprehensive, timely, and legible records for medical, legal, quality improvement, and financial purposes

VII. Maintain appropriate protocol, courtesy, tact, and confidentiality in business communication, both written and oral

VIII. Demonstrate an appropriate level of communication skills when orally presenting professional or scholarly work

IX. Demonstrate technical writing ability in a variety of venues, including scholarly writing and business communications
   A. Write an abstract according to published standards
   B. Prepare a poster for presentation at a professional conference
   C. Write scholarly articles
   D. Develop patient procedure protocols
   E. Develop department policies
   F. Write business correspondence such as business letters, memos, or internal reports

G. Prepare reports, such as a needs assessment or progress report
H. Develop action plans for quality improvement projects
I. Develop patient education materials

X. Apply concepts of teaching and learning theories in design, implementation, and evaluation in the education of the patient, the family, colleagues, and community

Practice-Based Decision Making

I. Track and analyze processes, procedures, and outcomes using appropriate statistical and/or qualitative techniques
   A. Use the evidence-based medicine process of asking, acquiring, appraising, applying, and assessing to improve clinical practice
   B. Analyze practice organization and management and perform practice-based improvement activities
   C. Develop a personal program of self-study and professional growth

II. Use benchmarking analysis and adjust processes, procedures, and operations for comparison with published standards of care
   A. Follow a systematic process for identifying and implementing best or better practices
   B. Follow professional standards of practice and work within the NMAA scope of practice to improve patient care and safety and protect the public

III. Critically evaluate current literature and extant research to assess the effectiveness of diagnostic and therapeutic procedures
   A. Identify credible sources of information
   B. Determine applicability of information, clarifying the patient's questions and misunderstandings about procedures, conditions, or treatment options based on what they may have read
   C. Use findings from literature and benchmarks to design and initiate appropriate research to investigate a given clinical situation in order to arrive at an optimal solution
   D. Apply knowledge of research design and statistical methods to appraise the literature

IV. Use feedback and observations to verify that changes were implemented to optimize patient care delivery and outcomes were effective

V. Use information technology to effectively access, collect, analyze, and disseminate data
   A. Use current information technology and other sources to efficiently

locate and retrieve relevant information from credible sources
B. Follow ethical principles in using information that may be sensitive
C. Be aware of appropriate regulations or legislation involving information sharing, storing, and protecting or deleting sensitive information

VI. Provide discipline-specific education to the patients, students, colleagues, and the public
A. Use opportunities to teach and learn as facets of professional practice
B. Develop learning relationships with clients, patients, students, and colleagues
C. Assess what needs to be learned and demonstrate effective teaching techniques in settings that may be spontaneous or by design
D. Select appropriate resources and activities to support teaching
E. Use evaluation and feedback to measure and enhance teaching effectiveness
F. Facilitate the transfer of learning

Professionalism

I. Demonstrate a calm, compassionate, and helpful demeanor toward those in need

II. Treat others with dignity and respect, demonstrating sensitivity and responsiveness to culture, age, gender, and disability
A. Discuss how diversity issues, health literacy, or disparity issues might impact patient care and adherence to treatment

III. Consistently strive for excellence in professional activities
A. Be meticulous and careful in conducting professional tasks
B. Work systematically and complete assignments in a timely manner
C. Take responsibility for continuity of care
D. Recognize how NMAA patient care and professional practices might affect other health care professionals and the health care organization
E. Demonstrate ability to reflect on methods of improving professional behavior

IV. Act with integrity and understand personal limitations
A. Refrain from performing tasks beyond personal capabilities or outside of professional scope of practice
B. Accept responsibility for mistakes and report mistakes as appropriate

C. Accept criticism and make an effort to improve
D. Reflect on difficult encounters and analyze how values, skills, and knowledge are affecting care of patients with challenging and/or terminal illnesses
E. Recognize and appropriately respond to impairment of self or colleagues

V. Demonstrate the professional attitudes that must be considered by the NMAA
A. Uphold the goals of the profession by supporting professional organizations, keeping professional confidences, maintaining competency, and exhibiting a professional image
B. Exhibit exemplary professional appearance and personal hygiene
C. Adhere to the scope of practice and standards of practice, including the role of state and federal regulations
D. Demonstrate conscientiousness and organization in addressing all professional obligations

VI. Foster professional relationships with members of the health care team
A. Mentor students, technologists, and other members of the health care team
B. Enhance the professional relationship by keeping the patient as the main focus
C. Manage conflict among health professionals in a constructive manner

VII. Demonstrate accountability to the health care organization and society by adhering to ethical business principles
A. Outline the nature of the special fiduciary relationship between the practitioner and the patient

VIII. Demonstrate a commitment to medicolegal and ethical principles
A. Apply the ethical principles of autonomy, nonmalfeasance, beneficence, justice, paternalism, fidelity, veracity, altruism, integrity, respect, and compassion
B. Practice patient-centered care that encompasses confidentiality, respect, and autonomy via appropriate informed consent and shared decision making

Systems-Based Practice

I. Describe the structure, governance, financing, and operation of the health care system and its facilities and how this influences patient care, research, and educational activities at a local, state, regional, and national level

A. Understand the structure and function of health care delivery systems and medical practices
B. Describe the various third-party payer systems, covered health benefits, formularies, preauthorization, appeals, disease management, and quality improvement
C. Define and describe a patient population

II. Practice cost-effective health care and resource allocation that do not compromise quality of care
A. Review and adjust coding practices and procedures to assure optimal and legal reimbursement
B. Analyze departmental budget and cost/revenue for optimal efficiency
C. Provide documented analysis and data for resource acquisition
D. Follow filing and documentation practices for practitioner reimbursement as directed by Centers for Medicare & Medicaid Services policies and procedures as well as state and federal law

III. Ensure compliance with all local, state, regional, and federal requirements for laboratory operations and personnel training and credentialing
A. Comply with current federal, regional, and local regulations governing the laboratory
B. Conduct procedures and provide documentation for laboratory accreditation
C. Implement Joint Commission standards

IV. Partner with health care managers and health care providers to assess, coordinate, and improve health care
A. Structure department staffing for quality care delivery and employee satisfaction
B. Conduct process for departmental strategic planning per institutional mission
C. Advocate for quality patient care and assist the patient in dealing with system complexities

V. Understand the reciprocal impact of personal professional practice, health care teams, and the health care organization on the community and society
A. Identify ways in which an NMAA may interact with health care professionals, health administrators, and community groups to positively impact the health and well-being of one's community
B. Gather information (eg, demographics and sociocultural beliefs) about the community in which one works and practices that affect health and disease

C. Participate in interdisciplinary team discussions, demonstrating the ability to accept, consider, and respect the opinions of the other team members while contributing an appropriate level of expertise to patient care

VI. Describe the major legal mechanisms for oversight and regulation of medical practice, including those related to licensure and discipline, negligence, malpractice, risk management, physician-patient relationships, confidentiality, and patients' rights
   A. Compare civil and criminal law
   B. Explain civil procedures
   C. Follow the prescribed standard of care for NMAA
   D. Distinguish between the different types of consent
   E. Understand and comply with patients' directives in regard to medical care
   F. Comply with employer and employee legal obligations

References

1. Owen MA, Pickett MW, Christian PE, et al. Nuclear medicine practitioner competencies. *J Nucl Med Technol*. 2007;35:39-41.

2. Pickett MW, Keech FK, Owen MA, et al. Position paper on the development of a middle level provider in nuclear medicine: the nuclear medicine practitioner. *J Nucl Med Technol*. 2006;34:236-243.

3. Competencies for the physician assistant profession. *J Am Acad Physician Assistants.* 2005;18:16-18.

4. National Commission on Certification of Physician Assistants. Physician assistant knowledge and skill areas. Available at: http://www.nccpa.net/EX_knowledge.aspx?r=pance. Accessed August 24, 2005.

5. American Association of Colleges of Nursing. Curriculum standards. Acute care nursing practitioner. Available at: http://www.aacn.nche.edu/Education/curriculum.htm. Accessed August 21, 2005.

6. Accreditation Council for Graduate Medical Education. Outcome Project. Available at: http://www.acgme.org/outcome/comp/compFull.asp. Accessed August 8, 2007.

7. American Board of Internal Medicine. Project Professionalism. Available at: http://www.abim.org/pdf/profess.pdf. Accessed August 5, 2007.

Other Resources

1. Nuclear Medicine Certification Board. Cardiology examination: detailed content outline. Available at: http://www.nmtcb.org/Content1.shtml. Accessed August 24, 2005.

2. Carey CF, Lee, HH, Woeltje KF, eds. *Washington Manual of Therapeutics.* Lippincott, Williams, and Wilkins, 29th ed.1998:91-98.

3. Oncology nursing exam prep guide. Available at: http://www.cna-nurses.ca/cna/documents/pdf/publications/CERT_Oncology_e.pdf. Accessed August 30, 2005.

4. Oncology Nursing Society. Position on oncology services in the ambulatory setting. Available at: http://www.ons.org/publications/positions/AmbulatoryPractice.shtml. Accessed August 30, 2005.

5. Nuclear Medicine Certification Board. Positron imaging examination: exam content specifications. Available at: http://www.nmtcb.org/PET%20Content%20Outline.htm. Accessed September 1, 2005.

6. American Society of Radiological Technologists, Society of Nuclear Medicine. 2004. PET/CT curriculum. Available at: http://www.crcpd.org/PET-CT_Fusion_Imaging/PETCT%20Curriculum%20Accepted%20021704.pd.pdf. Accessed September 13, 2005.

7. Merriam SB, Simpson EL. *A Guide to Research for Educators and Trainers of Adults.* Malabar, FL: Krieger Publishing Company; 1995.

8. Meltzoff J. *Critical Thinking About Research: Psychology and Related Fields.* Washington, DC: American Psychological Association; 1999.

9. U.S. Department of Health and Human Services. Agency for Healthcare Research and Quality. AACE/AAES medical/surgical guidelines for clinical practice: management of thyroid carcinoma. Available at: http://www.guideline.gov/summary/summary.aspx?ss=15&doc_id=2848&nbr=2074&string=. Accessed May 25, 2006.

10. University of Rochester, Department of Imaging Science. Competencies and goals for radiology residents. Available at: http://www.urmc.rochester.edu/smd/Rad/ResidentGoals.pdf. Accessed May 25, 2006.

11. Iskandrian AE, Verani MS. *Nuclear Cardiac Imaging, Principles and Applications.* Oxford University Press, 2003.

12. English, CR, English L,. Giering H, Manspeaker J, Murphy,Wise P. *Introduction to Nuclear Cardiology*. DuPont Pharma, 1993.

13. American Heart Assocation. 2007. ACC/AHA Guidelines for Exercise Testing: Executive Summary. Available at http://circ.ahajournals.org. Accessed November 1, 2007,

14. Astellas. 2007. Technically Speaking. http://www.pharmstresstech.com/tech_tips.html. Accessed October 2, 2007.

15. American Society of Radiologic Technologists. 2006. *Radiologist Assistant Curriculum.* American Society of Radiologic Technologists, 15000 Central Ave. SE, Albuquerque, NM 87123-3917.

16. Christian P, Waterstram-Rich K, eds. *Nuclear Medicine and PET/CT Technology and Techniques*. Mosby Elsevier. 2007.

17. Society of Nuclear Medicine. 2003. Society of Nuclear Medicine Procedure Guideline for Palliative Treatment of Painful Bone Metastases, version 3.0. Available at http://interactive.snm.org/index.cfm?PageID=772&RPID=969. Accessed December 4, 2007.

18. Society of Nuclear Medicine. 2005. Society of Nuclear Medicine Procedure Guideline for Therapy for Thyroid Disease with I-131 (Sodium Iodide), version 2.0. Available at http://interactive.snm.org/index.cfm?PageID=772&RPID=969. Accessed December 4, 2007.

19. Hematology Disease Site Group. 2007. Iodine-131 Tositumomab in Lymphoma: A Clinical Practice Guideline. Available at http://www.cancercare.on.ca/pdf/pebc6-19s.pdf. Accessed December 4, 2007.

20. Package insert. 2007. Ibritumomab Tiuxetan (Systemic). Available at http://www.drugs.com/mmx/ibritumomab.html. Accessed December 2007.

21. The Joint Commission. 2007. Available at http://www.jointcommission.org/. Accessed December 3, 2007.

22. Tank PW. 1999. Lymphatics Tables**.** Department of Anatomy, University of Arkansas for Medical Sciences. Available at http://anatomy.uams.edu/anatomyhtml/lymph.html. Accessed December 7, 2007

23. Uren RF, Howman-Giles, Thompson JF. 2003. Patterns of lymphatic drainage from the skin in patients with melanoma. J Nucl Med. 2003; 44(4):570-582.

24. Murphy K, Waterstram-Rich K, Wells P. 2003. *Curriculum Guide for Educational Programs in Nuclear Med. T*. Society of Nuclear Medicine, 1850 Samuel Morse Drive, Reston, VA 20190.

Chapter 2

Patient Care

Overview for the Patient Care Curriculum

The role of the Nuclear Medicine Advanced Practitioner (NMAA) is to provide a quality patient care experience at an advanced level in diagnostic and therapeutic environments. The NMAA works under the direction of the supervising physician, making an initial assessment, performing routine and advanced procedures, and ensuring appropriate follow-up as needed. The NMAA synthesizes theoretical, scientific, and contemporary clinical knowledge for the personalized assessment and management of patients to provide efficient and effective patient care. The outcome is improved service delivery for the supervising physician, the referring physician, and the patient in terms of reduced costs or time, improved efficiency, and an enhanced patient experience.

NMAAs are committed to creating a patient-centered experience and should be familiar with the clinical pathway the patient can expect to follow. Although working under the direction of the supervising physician, they demonstrate a high level of clinical decision making and autonomy. As part of their comprehensive responsibilities in patient care, NMAAs conduct physical examinations, collect relevant clinical information, address patient's concerns and answer questions, and facilitate appropriate follow-up care.

The NMAA will build on existing knowledge and skills of a nuclear medicine technologist and is expected to maintain Advanced Cardiac Life Support certification and demonstrate a comprehensive knowledge of anatomy, physiology, pathology, and pathophysiology that would have been included in the undergraduate nuclear medicine technology program. In addition to instruction in advanced patient care skills, NMAA students could also be expected to take graduate-level courses in pathophysiology and clinical pharmacology.

Patient Care Curriculum Content

I. Communicate effectively and demonstrate caring, respectful, and ethical behaviors when interacting with the patient, the family, physicians, and other health care professionals (see Interpersonal and Communication Skills competency domain)

II. Counsel and educate the patient and family
- A. Obtain patient informed consent for required procedures according to state law and institutional policy
  1. Ethical and legal underpinnings of informed consent
     - a. Autonomy, veracity, and confidentiality
     - b. Who may give consent
       - i. Competency issues
       - ii. Minors and mentally impaired adults
     - c. Types of consent
       - i. Express
       - ii. Implied by law
       - iii. Informed consent
     - d. Components of valid informed consent
       - i. Procedure that will be done
         1) Diagnosis
         2) Nature or purpose of the treatment or procedure
       - ii. The name and qualifications of the person doing the procedure
       - iii. The consequences or expected outcome
       - iv. The risks involved, except for the very remote
         1) Exceptions: risk of death or sterility if applicable
       - v. The alternatives to this procedure must be discussed
         1) Includes alternative of doing nothing
         2) Must then disclose the patient's prognosis
     - e. Responsibilities of physician and health care providers
     - f. When consent becomes invalid
       - i. The procedure exceeds the consent given
       - ii. Inadequate information is given to the patient
       - iii. The nurse or technologist answers medically related questions
       - iv. The patient is given the consent form and told that it is just “routine papers”
       - v. Force of circumstances
       - vi. Change of circumstances
  2. Capability of the patient to give informed consent
  3. Explanation of the procedure to the patient, including all components of a valid informed consent
     - a. Risks
     - b. Benefits

c. Alternatives
d. Precautions used to reduce risks

4. Assessment of the patient's understanding of the risks, benefits, and alternatives and follow-up
5. Responding to questions or directing questions to the appropriate health care professional

B. Educate the patient on preprocedural preparation and postprocedural care
1. Dietary requirements
2. Modification of medication
a. Restrictions
b. Resumptions
3. Follow-up appointments
4. Next step in patient treatment algorithms
5. Physical activity limitations

III. Make informed decisions about diagnostic and therapeutic procedures under the direction of the supervising physician and based on patient information and preferences, up-to-date scientific evidence, and clinical judgment

A. Gather and evaluate essential information, including correlative studies, about the patient and arrange follow-up as necessary under the direction of the supervising physician
1. Pertinent patient laboratory biochemical markers relevant to pathology
a. Chemistry
b. Hematology
c. Microbiology
d. Histology/cytology
2. Pertinent previous diagnostic imaging studies
a. X-ray
b. Ultrasonography
c. Computed tomography
d. Nuclear procedures
e. Magnetic resonance imaging
f. Angiography
g. Mammography

B. Perform history and physical examinations (see Appendix I for History and Physicals)
1. Review of systems
2. History of present illness
a. Onset
b. Provocation
c. Quality
d. Radiation
e. Severity

f. Time
g. Previous diagnosis
h. Previous treatment

3. Past medical history
   a. Medications
   b. Allergies
   c. Surgeries
   d. Medical conditions
4. Family history
5. Focused physical examination
   a. Neurologic
   b. General
   c. Psychosocial
   d. Cardiovascular
   e. Pulmonary
   f. Gastrointestinal
   g. Musculoskeletal
   h. Reproductive
   i. Genitourinary
   j. Pain
   k. Vital signs

C. Evaluate findings for contraindications to testing and for indicators of additional patient pathology
D. Consult with physician as needed
E. Counsel the patient and family as indicated

IV. Determine and implement a plan of care
   A. Use professional judgment to recommend or adapt protocols for procedures to improve diagnostic quality and outcome
   B. Consult with the supervising physician or appropriate health care provider to determine a modified action plan when necessary
   C. Report findings to the supervising physicians and the patient per protocol

V. Order and administer sedating pharmaceuticals under the direction of the supervising physician and monitor the patient who is receiving sedating pharmaceuticals as indicated by patient profile and diagnostic or therapeutic procedure as allowable by institutional, state, and federal statutes
   A. Indications
   B. Contraindications
   C. Comorbidities
   D. Legal issues

VI. Implement additional requirements for patient care for diagnostic or therapeutic procedures

A. Perform patient bladder catheterizations
B. Establish additional routes of radiopharmaceutical administration other than intravenous injection or oral
    1. Feeding tube
        a. Insertion
            i. Nasogastric
            ii. Orogastric
        b. Administration
            i. Nasogastric
            ii. Orogastric
            iii. Percutaneous endoscopic gastrostomy
            iv. Gastrostomy
    2. Rectal
        a. Insertion
        b. Administration
            i. Radiopharmaceuticals
            ii. Pharmaceuticals
            iii. Contrast media
    3. Administration into existing catheters or surgical routes
        a. Peritoneal catheters
        b. Ventriculoperitoneal shunts
        c. Central lines
        d. Intra-arterial lines
C. Monitor vital signs and physiologic parameters
    1. Blood pressure
    2. Pulse
    3. Pulse oxygen level
    4. Temperature
    5. O_2 saturation
    6. Endotidal CO_2
    7. Capnography
    8. Electrocardiogram
    9. Cardiac output
    10. Drainage catheters
D. Evaluate the need for contrast media in consultation with the supervising physician
    1. Indications/contraindications
    2. Manage adverse events

VII. Provide indicated intervention per patient emergency event
A. Provide supportive medical management
    1. Adverse response
    2. Allergic response
B. Provide basic life support
C. Provide advanced life support
D. Facilitate transfer to definitive care environment

Chapter 3

Clinical Nuclear Medicine

Overview for the Clinical Nuclear Medicine Curriculum

Clinical leadership exemplifies one of the most important roles of the Nuclear Medicine Advanced Practitioner (NMAA) and is integrated throughout the advanced practice curriculum. Those who practice clinical leadership learn to optimize everyone's role and value in the service, not just their own. An enhanced clinical skill set is an important component of the NMAA practice model. However, advanced practice involves more than performing highly technical procedures; it also requires a high level of clinical decision making. The successful NMAA internalizes individual and professional qualities that motivate him or her to initiate improvements in service delivery. Improving service delivery implies that each NMAA's discrete role will be different, depending on the needs of the local practice. Some may choose to practice in a general nuclear medicine department, while others may work in specialty areas such as cardiology, pediatrics, or oncology/therapy.

NMAAs work under the direction of a supervising physician and follow protocols for most of their clinical work. They must clearly understand the types of decisions they can make and those they should not make. As the profession matures, it will become necessary to establish clinical benchmarks and make evidence-based practice decisions. Consequently, NMAAs will find they will need to distribute and share information to ensure that the patient is cared for in an expeditious, efficient, and ethical manner.

It is important to recognize that adding clinical knowledge is not simply a matter of adding more technical skills and/or adding advanced technical skills. The NMAA will be expected to provide clinical nuclear medicine technology services and will build on those skill sets to improve service delivery and provide an exceptional patient experience. The NMAA will review requests for imaging or radiotherapy procedures to ensure the appropriate study has been requested for the clinical presentation. This will entail an evaluation of collaborative laboratory results for indications and contraindications and may require the NMAA to order or facilitate adjunctive pharmaceuticals for the imaging procedure under the direction of the supervising physician. The NMAA may prescribe and administer pharmacologic and nonpharmacologic interventions or order complementary diagnostic procedures as allowable by state and federal statutes. The NMAA may also prepare a preliminary description of findings for the supervising physician. NMAA students should expect to spend extensive time in the clinical setting and the classroom to master these skills.

Clinical Nuclear Medicine Curriculum Content

Core Imaging

I. Review requests and physician directives for nuclear medicine procedures
   A. Review request for imaging procedures per protocol
   B. Ensure the appropriate diagnostic study has been requested for the clinical presentation in consultation with the referring physician
   C. Evaluate collaborative laboratory test results for indications/contraindications
      1. Cardiac
         a. Creatine kinase
         b. Creatine kinase MB
         c. Troponin
         d. Lipid panel
         e. Prior electrocardiogram
         f. Prior cardiac procedures (catheterization, bypass, etc)
      2. Hepatic
         a. Liver function tests
         b. Chemistry panel
      3. Pulmonary
         a. D-dimer
         b. B-type natriuretic peptide
         c. Prothrombin time
         d. Partial thromboplastin time
         e. International normalized ratio
      4. Oncology
         a. Tumor markers (eg, Ca-125, α-fetoprotein, serum carcinoembryonic antigen, serum thyroglobulin)
         b. Blood glucose
      5. Renal study
         a. Chemistry panel
         b. Urinalysis
      6. Thyroid
         a. Free T3
         b. Free T4
         c. Thyroid-stimulating hormone
         d. Thyroglobulin
         e. Thyroglobulin antibodies
      7. Parathyroid
         a. Parathyroid hormone
         b. Calcium
   D. Order or facilitate adjunctive pharmaceuticals for the imaging procedure under the direction of the supervising physician
      1. Morphine
         a. Supersaturated Potassium Iodide

2. Cimetidine
3. Cardiac stress agents
4. Gastrointestinal agents
    a. Cimetidine
    b. Ranitidine
    c. Pentagastrin
    d. Glucagon
    e. Cholecystokinin or analogue

II. Competently perform clinical nuclear medicine procedures considered essential in the area of practice

A. Competently perform nuclear medicine imaging or therapeutic procedures

1. For each nuclear medicine procedure, identify the following:
    a. Indications
    b. Contraindications
    c. Complications
    d. Limitations
2. For each nuclear medicine procedure, select the following:
    a. Appropriate radiopharmaceutical and dose
    b. Imaging technique
    c. Data analysis
    d. Image presentation
3. Review image quality
4. Determine the need for additional images
5. Correlate with other imaging studies such as x-rays, computed tomography (CT), magnetic resonance imaging (MRI), or ultrasonography
6. Demonstrate competency in the following categories
    a. Musculoskeletal studies
        i. Bone scanning for benign disease
        ii. Bone scanning for malignant disease
        iii. Bone densitometry
    b. Myocardial perfusion imaging procedures performed with radioactive perfusion agents in association with treadmill and pharmacologic stress (planar and tomographic, including gated tomographic imaging): see Nuclear Cardiology section below
    c. Radionuclide ventriculography performed with electrocardiographic gating for evaluation of ventricular performance
        i. First-pass studies
        ii. Equilibrium studies
        iii. Calculation of ventricular performance parameters (eg, ejection fraction and regional wall motion assessment)
    d. Endocrinologic studies

i. Thyroid uptake and imaging
ii. Parathyroid imaging
iii. Adrenal imaging
iv. Octreotide and other receptor-based imaging studies

e. Gastrointestinal studies
i. Liver: reticuloendothelial function
ii. Liver: biliary function
iii. Salivary glands
iv. Esophagus
v. Stomach
vi. Gastrointestinal bleeding
vii. Meckel diverticulum
viii. ^{14}C breath testing

f. Hematologic studies
i. Red cell and plasma volume
ii. Splenic sequestration
iii. Hemangioma studies
iv. Labeled granulocytes for infection
v. Thrombus imaging
vi. Bone marrow imaging

g. Oncology studies
i. With agents using
1) Gallium
2) Thallium
3) Sestamibi
4) Antibodies
5) Peptides
6) Fluorodeoxyglucose (FDG)
7) Other agents as they become available

ii. Procedures of all common malignancies
1) Brain
2) Head and neck
3) Thyroid
4) Breast
5) Lung
6) Liver
7) Colon
8) Kidney
9) Bladder
10) Prostate
11) Lymphoma
12) Leukemia
13) Melanoma
14) Musculoskeletal tumors
15) Lymphoscintigraphy, including sentinel node mapping: see below

h. Neurologic studies
    i. Procedures
        1) Cerebral perfusion with single photon emission computed tomography (SPECT)
        2) Cerebral perfusion with positron emission tomography (PET)
        3) Cerebral metabolism with FDG
        4) Cisternography
    ii. Pathologies
        1) Stroke
        2) Dementia
        3) Epilepsy
        4) Brain death
        5) Cerebrospinal fluid dynamics
i. Pulmonary studies
    i. Perfusion and ventilation performed with radiolabeled macroaggregates and radioactive gas or aerosols used in the diagnosis of pulmonary embolus
    ii. Quantitative assessment of perfusion and ventilation
j. Genitourinary tract imaging
    i. Renal perfusion and function procedures
    ii. Clearance methods
    iii. Renal scintigraphy with pharmacologic interventions
    iv. Renal transplant evaluation
    v. Vesicoureteral reflux
k. PET imaging of the heart
    i. Myocardial perfusion
    ii. Myocardial viability
l. PET imaging of the brain
    i. Dementia
    ii. Epilepsy
    iii. Brain tumors
m. PET imaging in oncology
    i. Lung
    ii. Head and neck
    iii. Esophagus
    iv. Colon
    v. Thyroid
    vi. Breast
    vii. Melanoma
    viii. Lymphoma
    ix. Other tumors as the indications become established
n. Registration and image fusion of SPECT and PET images with CT and MRI studies
o. Anatomic imaging of brain, head and neck, thorax, abdomen, and pelvis with CT to be able to understand the

correlation between anatomic and functional imaging
p. Experience in radiation oncology and medical oncology

B. Perform sentinel node imaging and lymphatic mapping
1. Anatomy and physiology of lymphatic system
a. Breast
i. Contains greater concentration than any other part of the body
ii. Lymph node or gland location and drainage patterns
b. Melanoma
i. Head and neck levels and drainage patterns
ii. Torso/trunk (2) above umbilicus
iii. Pelvis (below umbilicus)
iv. Extremities: arms and legs
c. Solid organ (eg, biopsy-proven colorectal cancer)
2. Injection technique
a. Intradermal
i. Local systemic route
ii. Melanoma
b. Peritumoral
i. Melanoma
ii. Breast
c. Subcutaneous
d. Periareolar
i. Breast
e. Perirectal
i. Solid organ
3. Radiopharmaceutical
a. Agent
b. Dose
c. Route of administration (see injection technique)
d. Volume limitation
e. Particle size
f. Needle size
4. Pharmaceutical intervention: anesthetic
5. Patient positioning and immobilization devices
a. Positioning
i. Therapy planning table
ii. Positioning devices (eg, wedges)
b. Immobilization
i. Casts/masks
ii. Vacuum bags

C. Prepare the patient and ancillary equipment for radiation therapy planning using positron and multimodality imaging systems
1. Equipment
a. Masks
b. Therapy planning table

c. Positioning appliances
d. Other ancillary equipment

2. Laser positioning and reference marking

III. Prescribe and administer pharmacologic and nonpharmacologic interventions under the direction of the supervising physician and as indicated by patient profile and diagnostic procedure as allowable by state and federal statutes

A. Perform preprocedure requirements and interventions as may be required

1. Dietary status
   a. Nothing by mouth per department protocol
      i. Hepatobiliary
      ii. Gastric emptying
      iii. Thyroid uptake/scan
      iv. Gastric reflux
      v. C-14 urea breath test
   b. Prearranged meals
      i. Fatty
      ii. Low iodine
      iii. Low carbohydrate
      iv. High protein
2. Hydration per department protocol
   a. Renal imaging
   b. PET
3. Medication discontinued per department protocol
   a. Thyroid uptake/scan
      i. T3
      ii. T4
      iii. Propylthiouracil/methimazole
      iv. Iodinated contrast
   b. Adrenal medullary imaging
      i. Opioids
      ii. Tricyclic antidepressants
      iii. Sympathicomimetics
      iv. Antihypertensive/cardiovascular agents
      v. Angiotensin-converting enzyme inhibitors
      vi. Antipsychotics
   c. C-14 urea breath test
      i. Antibiotics
      ii. Bismuth
      iii. Sulfates
   d. Captopril renal scan
      i. Diuretics
      ii. Angiotensin-converting enzyme inhibitors
      iii. Calcium antagonists

iv. Angoitensin II receptor blockers
4. Activity limitation as clinically indicated
   a. PET: reduce physical activity
   b. PET: eliminate speech
5. Laboratory evaluations as per department protocol (see competency #1)

B. Perform intraprocedure requirements as may be required
1. Medications as per department protocol
   a. Morphine intervention for hepatobiliary imaging
      i. Dose
      ii. Dose limits
      iii. Administration technique
   b. Cholecystokinin intervention for hepatobiliary imaging
      i. Dose
      ii. Administration technique
   c. Furosemide for renal imaging
      i. Dose
      ii. Administration technique
2. Activity limitations as clinically indicated (see A above)
3. Dietary status as per department protocol (see A above)
4. Laboratory evaluation as per department protocol
5. Vital signs: see Patient Care competency domain

C. Perform postprocedure requirements as may be required
1. Activity limitations as clinically indicated
2. Medications as directed by referring physician or supervising physician
   a. Administration of additional medications as directed by referring physician or supervising physician
   b. Ensure that the patient does not take metformin-containing medications 48 hours after administration of iodinated contrast material
   c. Ensure children are rehydrated after diuretic study
3. Dietary limitations
   a. Nothing by mouth 1 hour postdose – thyroid uptake
   b. Hydration – facilitate urination
4. Laboratory evaluation – as clinically indicated

IV. Order complementary diagnostic procedures as indicated by patient testing results under the direction of the supervising physician

V. Analyze results of the procedure and prepare a preliminary description of findings for the supervising physician

A. Assess image quality and other associated data
1. Adequacy
2. Artifact
3. Incidental findings

B. Make a preliminary assessment
    1. Incidental findings
    2. Review correlative data
    3. Summarize findings with a concise statement addressing the referring physician's question for ordering the study
C. Document initial observations of imaging procedures according to protocol
    1. Patient identification
    2. Informed consent as necessary
    3. Referral prescription
    4. Patient preparation
    5. Relevant clinical history
    6. Radiopharmaceutical dose and route of administration
    7. Patient status before, during, and following procedure/therapy
    8. Statement outlining patient radiation safety instructions as necessary
    9. Recommendations for follow-up diagnostic or therapeutic procedures as indicated
    10. Recommendations for follow-up as needed
D. Communicate initial observations as per supervising physician's discretion
E. Report findings to referring physicians and the patient per protocol
    1. Recommend appropriate diagnostic or therapeutic procedures as indicated
    2. Recommend appropriate follow-up as needed

Radionuclide Therapy Competencies

I. Review request for radionuclide therapy procedures under the direction of the supervising physician, analyzing the indications, contraindications, and complications for therapeutic interventions
A. Interpret epidemiologic data, research, and trends related to incidence and prevalence of cancer
    1. Malignant versus benign tumors
    2. Proto-oncogenes
    3. Statistical interpretation
    4. Lifestyle/environmental risks
    5. Clinical treatments
        a. Curative/palliative
            i. Surgical
            ii. Medical
            iii. Medication
    6. Clinical studies
    7. Life expectancy
B. Identify risk factors for cancer

1. Previous cancer/treatment
2. Genetic risk
3. Environmental risk

C. Understand dosimetry and dosimetric consequences
   1. Interactions and energy deposition by ionizing radiation in matter
   2. Concepts, quantities, and units in radiologic physics
   3. Principles and methods of radiation dosimetry

D. Understand the physiologic and radiobiological mechanisms by which differing radioisotope therapies are effective
   1. Effects of ionizing radiations on living cells and organisms
   2. Physical, chemical, and physiologic bases of radiation cytotoxicity, mutagenicity, and carcinogenesis

E. Conduct imaging protocols and evaluate images and laboratory values for presence of disease and metastasis
   1. Coordinate imaging protocols per protocol, reference patient care
   2. Tumor markers
   3. Evaluation for metastatic disease, reference patient care and core imaging
   4. Order or facilitate necessary laboratory and imaging studies per protocol and physician directive

F. Evaluate clinical criteria for radionuclide therapy, including expected biodistribution of radiotherapeutic pharmaceutical
   1. Bone marrow suppression and secondary to added chemotherapy within 6-week window
   2. Unintended thyroid ablation
   3. Pulmonary fibrosis secondary to pulmonary metastasis
   4. Exclude patients with pain from other causes that is mimicking bone pain
   5. Evaluate impending spinal cord compression or impending long bone fractures
   6. Evaluate renal function to lower dosage or delay therapy
   7. Exclude pregnant patients
   8. Exclude patients for 2-3 days receiving other phosphonate-based therapy

II. Counsel and educate the patient and family regarding the proposed therapeutic intervention

A. Obtain translator/interpreter services as necessary

B. Fully understand the radiation protection regulations and procedures applicable to the administering department and relay the regulations to the patient/caregivers and family if applicable
   1. Written directive
      a. Patient identification
      b. Dose verification

2. Patient release requirements
    a. Total effective dose equivalent (TEDE) to others not likely to exceed 5 mSv (0.5 rem)
    b. Written instructions if TEDE to others could exceed 1 mSv (0.1 rem)
3. Recordkeeping requirements
    a. Basis for release
        i. TEDE versus activity or dose rate
4. Emergency preparedness
    a. Contact information for the patient
    b. Major spill cleanup
    c. Medical emergencies or death
        i. Notify Radiation Safety Officer
        ii. Notify medical personnel

C. Explain in detail the processes, guidelines, and timelines for the radioisotope therapy regimen according to institutional policy and guidelines
1. I-131 therapy
    a. Preparation
    b. Treatment
    c. Follow-up
2. P-32 therapy
    a. Preparation
    b. Treatment
    c. Follow-up
3. Ibritumomab tiuxetan
    a. Preparation
    b. Treatment
    c. Follow-up
4. Tositumomab
    a. Preparation
    b. Treatment
    c. Follow-up
5. ^{89}Sr chloride
    a. Preparation
    b. Treatment
    c. Follow-up
6. ^{153}Sm
    a. Preparation
    b. Treatment
    c. Follow-up
7. ^{90}Y
    a. Preparation
    b. Treatment
    c. Follow-up

D. Obtain patient informed consent for required procedures according

to state law and institutional policy

1. Educate the patient on the risks, benefits, and alternatives to the procedure
    a. Thyroid disease
        i. Benign thyroid disease
            1) Risks
                a) More than one I-131 treatment may be necessary
                b) Risk of hypothyroidism is high, resulting in lifelong daily ingestion of thyroid medication
                c) Long-term follow-up necessary
                d) Ophthalmopathy may improve or worsen or develop after I-131 treatment (Graves' disease)
                e) Radiation thyroiditis/thyroid storm (rare)
            2) Benefits
                a) Reduction/cell death of overactive thyroid tissue
                b) Reduces/eliminates dependent medications
                c) Reduces/eliminates associated symptoms
                d) Prevents cardiac damage
            3) Alternatives to treatment
                a) Surgery
                b) Pharmaceutical therapy
                c) No therapy
        ii. Malignant thyroid disease
            1) Risks
                a) Normal as well as cancerous thyroid tissue will be destroyed; other normal tissues may also be affected
                b) More than one I-131 treatment may be necessary
                c) Early side effects
                    i) Mucositis
                    ii) Nausea/vomiting
                    iii) Pain/tenderness in salivary glands
                    iv) Loss of saliva or taste
                    v) Metallic-like alterations in taste
                    vi) Neck pain/swelling (rare)
                    vii) Temporary decreased white blood cell count (increased susceptibility to infection) (very rare)
                d) Late side effects
                    i) Temporary infertility
                    ii) Permanent damage to salivary glands
                        1. Loss of saliva
                        2. Excessive dental caries
                        3. Reduced taste
                    iii) Dry eyes
                    iv) Epiphora from scarring of lacrimal ducts

v) Development of other malignancies (rare)
1. Stomach
2. Bladder
3. Colon
4. Salivary glands
5. Leukemia (dose related and most significant late sequelae)

e) Lifelong daily ingestion of thyroid medication will be required
f) Long-term follow-up necessary

2) Benefits
a) Destruction of malignant and normal thyroid tissue

3) Alternatives to treatment
a) External beam therapy
b) Surgery

b. Palliative bone therapy (P-32, Sm-153, Sr-89)
i. Risks
1) Potential for pain flare at 7 to 10 days post treatment
2) Reduction in leukocytes and platelet counts, resulting in bleeding/infection and potentially death
3) Chance of total pain relief rare
4) Not a curative treatment

ii. Benefits
1) Reduces bone pain
2) Improves mobility/quality of life
3) Reduces dependence on narcotic and non-narcotic analgesics
4) Improves performance status and possibly survival
5) Reduces cotreatment costs

iii. Alternatives to treatment
1) External beam therapy
2) Chemotherapy

c. Non-Hodgkin's lymphoma (I-131 tositumomab, Y-90 ibritumomab tiuxetan)
i. Risks
1) Hematologic events
a) Neutropenia
b) Thrombocytopenia
c) Anemia
d) Ecchymosis

2) Digestive symptoms
a) Nausea
b) Vomiting
c) Diarrhea
d) Anorexia
e) Abdominal enlargement

f) Constipation
3) Musculoskeletal system
a) Arthralgia
b) Myalgia
4) Nervous system
a) Dizziness
b) Insomnia
5) Respiratory system
a) Dyspnea
b) Increased cough
c) Rhinitis
d) Bronchospasm
6) Skin/appendages
a) Pruritus
b) Rash
7) Whole body
a) Fever
b) Infection
c) Chills
d) Abdominal pain
e) Pain
f) Headache
g) Throat irritation
h) Back pain
i) Flushing
8) Cardiovascular
a) Hypotension
9) Anaphylactic shock (acute)
a) Death
10) Nonresponse to treatment protocol
11) Human antimurine antibody
12) Hypothyroidism (tositumomab)
a) Lifelong daily ingestion of thyroid medication may be required

ii. Benefits
1) Target treatment to CD20 antigen expressed on normal and abnormal B cells, resulting in cell destruction/death (possible partial or complete remission)
2) Durable response to therapy; results comparable to chemotherapy and external beam therapy
3) Short outpatient treatment protocol (14 days)
4) Improved quality of life during/following treatment protocol

iii. Alternatives to treatment
1) Chemotherapy

2) External beam therapy
3) Watch/wait – no therapy

d. Polycythemia
   i. Risks
      1) Hematologic event (transient reduction in platelet and leukocyte counts) resulting in possible bleeding/infection
   ii. Benefits
      1) Reduces total red blood cell volume
      2) Repeat treatments possible
      3) Reduces platelet counts to prevent clotting
   iii. Alternatives to treatment
      1) Chemotherapy
      2) Pharmacologic therapy
e. Malignant effusion
   i. Risks
      1) Hematologic events (transient reduction in platelet and leukocyte counts; rare)
      2) Suboptimal treatment outcome due to loculation in thoracic or peritoneal cavity
      3) Tissue necrosis
      4) Not a curative treatment
   ii. Benefits
      1) Reduce malignant cells in the thoracic or peritoneal cavity
      2) Delayed fluid buildup in thoracic or peritoneal cavity
      3) Repeat procedures possible
   iii. Alternatives to treatment
      1) Chemotherapy (treatment of choice)
f. Selective internal radiation therapy
   i. Risks
      1) Chronic pain
      2) Ulceration/bleeding
      3) Lung edema/fibrosis when lung shunting exceeds 20%
      4) Local radiotherapeutic treatment may include destruction of normal liver tissue
      5) Not a curative treatment
   ii. Benefits
      1) Local radiotherapeutic treatment to embolized liver tumors produces cell death to malignant tumor
      2) Procedure may be repeated
      3) Short treatment protocol performed over 7 to 14 days (diagnostic + therapeutic)
   iii. Alternatives to treatment
      1) Surgery

2) Chemotherapy
3) Hepatic arterial embolization with or without chemotherapy
4) Liver transplantation (probably not an alternative)

g. Radiosynoviorthesis
   i. Risks
      1) Pain
      2) Joint inflammation
      3) Infection
      4) Not a curative procedure
   ii. Benefits
      1) Reduction in painful joint swelling including postoperative prosthesis
      2) Procedure may be repeated
   iii. Alternatives to treatment
      1) Pharmacologic therapy
      2) Surgery

2. Assess the patient's understanding of risks, benefits, and alternatives as well as follow-up
   a. Address and document the patient's questions and concerns
      i. Consider cultural diversity and ethical issues
      ii. When approved by patient, include family members/friends to improve communication/understanding
      iii. Identify the need for an interpreter as necessary
         1) Language
         2) Hearing impaired
      iv. Document as per institutional protocol
         1) Discussion topics
            a) Risks
            b) Benefits
            c) Alternatives to treatment
         2) Patient's questions, issues, or concerns
         3) Barriers to communication
            a) Emotional
            b) Psychological
            c) Physical (motor deficit)
            d) Cultural/spiritual
            e) Age specific
               i) Neonate
               ii) Pediatric
               iii) Adolescent
               iv) Geriatric
3. Ensure the patient will comply fully with the necessary therapy constrictions and guidelines
4. Determine a candidate's suitability for radioisotope therapy in

collaboration with the treating physician
5. Final discussion outcome
    a. Consent to treat
    b. Refusal of treatment

E. Educate the patient on preprocedural and post procedural care
1. Dietary requirements
    a. Low-iodine diet 10-14 days pretreatment – I-131 treatment – thyroid cancer
    b. Nothing by mouth
        i. I-131 treatment (benign and malignant treatment protocols)
        ii. Selective internal radiation therapy
2. Modification of medications
    a. Restrictions
        i. Thyroid
            1) Thyroid hormones (unless recombinant human thyroid-stimulating hormone is used)
            2) Iodinated contrast
            3) Medications that may limit/restrict the ability of thyroid tissue to absorb radioactive iodine
        ii. Bone palliation
            1) Oral/systemic myelosuppressive chemotherapy
            2) Bisphosphonates
    b. Resumptions – per procedural protocol and referring physician's/radiologist's directives
3. Follow-up appointments – per procedural protocol and referring physician's/radiologist's directives to include the following:
    a. Diagnostic imaging
    b. Laboratory follow-up
    c. Referring physician follow-up
    d. Treating physician follow-up
4. Next step in patient treatment algorithms – in consultation with treating physician, per referring physician's directives
5. Counsel the patient on the post administration requirement to reduce exposure rates to the public and document compliance
    a. Oral and written instructions given to patient
        i. Two copies of written instructions
            1) Chart copy signed by patient
                a) Receipt of document noted in final patient report
            2) Patient copy reviewed with patient and/or family member
                a) I-131
                    i) Maintain appropriate distance from others
                    ii) Separate sleeping arrangements
                    iii) Minimize time spent in public places
                    iv) Precautions to reduce the spread of

contamination, including urine and other body fluids
v) Effective contraceptive methods
vi) Length of time for each precaution

b) Beta-emitting radiopharmaceuticals (Sr-89, Sm-153, P-32)
i) Hand-washing technique
ii) Precautions to reduce the spread of contamination, including urine and other body fluids
iii) Use of condoms for sexual relations
iv) Effective contraceptive methods

III. Calculate appropriate therapeutic dosage based on dosimetry, patient well-being, diagnostic imaging, and laboratory results under the direction of the supervising physician

A. Calculate radionuclide therapy dose for benign thyroid disease, basing dose selection on accepted standards
1. Recent radioiodine uptake or qualitative thyroid scan
2. Thyroid hormone levels
3. Delivered activity
4. Fixed-dose regimen based on disease

B. Calculate radionuclide therapy dose for malignant thyroid disease, basing dose selection on accepted standards
1. Postoperative ablation
2. Treatment of presumed thyroid cancer in the neck or mediastinal lymph nodes
3. Treatment of distant metastases
4. Dosimetrically determined thyroid calculations; customize dose levels from body clearance times
5. External beam therapy plus I-131 for bone disease

C. Calculate radionuclide therapy dose for palliative bone therapy, basing dose selection on accepted standards
1. Based on whole body bone imaging study
2. Sr-89
a. Dose
b. Route of administration
3. P-32
a. Dose
b. Route of administration
4. Sm-153
a. Dose
b. Route of administration

D. Calculate radionuclide therapy dose for non-Hodgkin's lymphoma, basing dose selection on accepted standards
1. Based on diagnostic whole body biodistribution scan

2. I-131 – dose calculations based on the following:
    a. Platelet counts
    b. Total body residence time
    c. Activity time using body mass to calculate
3. Y-90 – dose calculations based on the following:
    a. Patient's weight
    b. Platelet count

E. Calculate radionuclide therapy dose for polycythemia, basing dose selection on accepted standards
1. Extent of disease
2. Weight
3. Blood counts
4. Typical doses

F. Calculate radionuclide therapy dose for malignant effusion, basing dose selection on accepted standards
1. Based on depth in tissue, activity administered, and uniformity of distribution
2. Intraperitoneal dose range
3. Intrapleural dose range
4. Radiosynoviorthesis – dose based on size of joint, depth of tissue, activity administered, and uniformity of distribution
5. Proximal interphalangeal joints
6. Knee joints – 5-6 mCi is typical

G. Calculate radionuclide therapy dose for selective internal radiation therapy, basing dose selection on accepted standards
1. Tumor volume from CT
2. Liver size
3. Lung shunting

IV. Order or facilitate adjunctive pharmaceuticals for radiotherapy according to protocol
A. Rituximab
B. Supersaturated potassium iodide
C. Thyrotropin alfa

V. Administer the therapeutic dose, adhering to the applicable regulations and site protocols
A. Oral
B. Intravenous
C. Subcutaneous ports

VI. Report procedure to the supervising physician according to protocol
A. Overview of protocol compliance
B. Patient identification
C. Informed consent
D. Referral prescription

E. Patient preparation
F. Relevant clinical history
G. Radiopharmaceutical dose and route of administration
H. Patient status before, during, and following therapy
I. Brief statement outlining patient radiation safety instructions
J. Recommendations for follow-up diagnostic or therapeutic procedures as indicated
K. Recommendations for appropriate follow-up as needed

VII. In conjunction with the referring and supervising physician, monitor the patient and provide post therapy interventions as needed for adverse side effects
A. Monitor the patient as indicated by protocol
1. Bone marrow suppression
2. Laboratory results
3. Quality of life
B. Provide supportive care for symptoms
1. Pain management
2. Nausea
3. Fatigue
4. Gastrointestinal disturbance
C. Maintain ongoing patient contact throughout the treatment regimen
D. Reevaluate patient status upon completion of therapy treatment(s) to determine patient's candidacy for additional therapy
1. Diagnostic imaging follow-up
E. Laboratory testing follow-up

Elective Competencies

These procedures consist of those tasks that are infrequently performed in most practice settings but might be particularly useful to some NMAAs in some settings.

I. Administer radiopharmaceuticals for radionuclide cisternography, cerebrospinal fluid shunt evaluations, cerebrospinal fluid leaks, or intraperitoneal procedures using aseptic technique and radiation safety standards at the discretion of the supervising physician
A. Explain complete procedure to the patient/family
B. Ensure scheduled imaging timeline compliance
C. Prepare injection site, adhering to predetermined aseptic/sterile technique
D. Conduct a Joint Commission–recommended "time out" procedure
E. Monitor room, contents, and personnel as per institutional Radiation Safety Guidelines

II. Participate in image-guided biopsy at the discretion of the supervising physician
   A. Prepare sterile field and biopsy area using aseptic/sterile technique
   B. Obtain informed consent for biopsy
   C. Evaluate for complications prohibiting safe biopsy
      1. Impaired coagulation
      2. Poor window to biopsy site
   D. Identify appropriate instruments and use according to recommended standards of practice
   E. Prepare biopsy tissue specimens for pathologic examination according to guidelines for specific tissue type, include appropriate transport media slide preparation and documentation
   F. Close and dress wound according to recommended standards of practice
   G. Order appropriate follow-up imaging studies appropriate to biopsy site and procedure
   H. Conduct a Joint Commission–recommended “time out” procedure
   I. Appropriately intervene for complications
      1. Pneumothorax
      2. Bleeding
      3. Unintended damage to surrounding structures due to extravasations
   J. Advise the patient of needed follow-up care

III. Manage pain and sedation for the patient receiving diagnostic testing or therapeutic treatment
   A. Prescribe pharmacologic and nonpharmacologic interventions as allowable by state and federal statues
   B. Monitor patient response to sedation and provide intervention according to accepted standards of practice

Chapter 4

Nuclear Cardiology

Overview for the Nuclear Cardiology Curriculum

The knowledge and skills of Nuclear Medicine Advanced Practitioners (NMAAs) will be tested and utilized to their capacity in the nuclear cardiology arena. Communication skills on many levels will be essential as the NMAA obtains informed consent from patients, discusses image acquisition with the technologists and clinical staff, and relays outcomes to physicians. It is likely that the actual duties of NMAAs working in nuclear cardiology will vary depending on whether they are employed in a nuclear medicine department within the hospital or in an outpatient cardiology clinic. Many who work in cardiology clinics may have already assumed expanded role responsibilities, and very often these individuals have advanced credentials as nuclear cardiology technologists.

The NMAA will work under the direction of the supervising physician, taking responsibility for all phases involved in obtaining an appropriate and technically accurate test result in a safe and professional manner for each individual patient. Although nuclear cardiology can be assumed to cover all aspects of cardiac imaging with radiopharmaceuticals, the emphasis of this aspect of the curriculum will be on myocardial perfusion imaging. Knowledge of cardiac physiology and pathology, stress testing techniques and effects, drug interactions, emergency procedures, electrocardiography (ECG) and image assessment, and clinical pathways will be emphasized. The NMAA will build on the clinical skills learned during technologist training such as establishing intravenous lines, ECG lead placement, and image acquisition to obtain advanced proficiencies including but not limited to ECG and image assessment, outcomes management, and advanced life support.

Nuclear Cardiology Curriculum Content

I. Successfully complete and maintain Advanced Cardiac Life Support credentialing
   A. Assess normal ECG to determine patient safety for stress testing
      1. Understand the conduction systems within the heart
      2. Analyze and interpret recordings of the electrical activity of the heart
      3. Identify the leads associated with the various walls of the heart
   B. Assess abnormal ECG conduction in preparation for stress testing
      1. Identify conduction abnormalities, including those originating from the myocardium
      2. Differentiate between abnormalities that arise from the inferior, anterior, posterior, and septal walls
      3. Pathologic conditions
         a. New or old left bundle branch block
         b. New or old ST elevations or ST depressions

II. Develop procedural policies and standards for precardiac emergencies that might occur within the department as directed by institutional policy and practice standards
   A. Identify the signs and symptoms of symptomatic bradycardia and symptomatic tachycardia
      1. Lightheadedness
      2. Dizziness
      3. Fainting
      4. Near syncope
      5. Palpitations
      6. Chest pain
      7. Diaphoresis
      8. Chest pressure
      9. Arrhythmic heart beats
      10. Shortness of breath
      11. Nausea/vomiting
      12. Disturbances in vision
      13. New onset of confusion
      14. Changes in level of consciousness
      15. Hypotension or hypertension (unstable patient)
   B. Follow a step-by-step course of action for the patient who develops asymptomatic bradycardia or tachycardia while in the office (before, during, or after stress test)
      1. Immediately stop the stress test if applicable
      2. Administer appropriate oxygen therapy
      3. Obtain intravenous access if applicable

4. Assess vital signs frequently (ie, blood pressure as required)
5. Activate cardiac assistance team if necessary
6. Call 9-1-1 if applicable

C. Follow a step-by-step course of action for the patient who develops signs and symptoms of bradycardia or tachycardia while in the office (before, during, or after stress test)
   1. Immediately stop the stress test if applicable
   2. Place patient flat on floor
   3. Elevate lower extremities above heart
   4. Administer appropriate oxygen therapy
   5. Obtain intravenous access
   6. Initiate intravenous fluid bolus of normal saline or lactated Ringer's solution
   7. Obtain blood sugar level if appropriate
   8. Activate cardiac assistance team if necessary
   9. Call 9-1-1 if applicable

D. Identify the proper medications and dosages for stable cardiac rhythms
   1. Bradycardia
      a. Atropine
         i. Usual dose
         ii. Maximum dose
         iii. Dose rate
   2. Sinus tachycardia
      a. Normal saline or lactated Ringer's solution
         i. Usual dose
         ii. Maximum dose
         iii. Dose rate
   3. Narrow complex tachycardia of unknown etiology or supraventricular tachycardia
      a. Adenosine (therapeutic)
         i. Usual dose
         ii. Maximum dose
         iii. Dose rate
      b. Calcium channel blockers
         i. Diltiazem
            1) Usual dose
            2) Maximum dose
            3) Dose rate
         ii. Verapamil
            1) Usual dose
            2) Maximum dose
            3) Dose rate
      c. Beta-blockers
         i. Metoprolol
            1) Usual dose

2) Maximum dose
3) Dose rate

ii. Labetalol
1) Usual dose
2) Maximum dose
3) Dose rate

d. Amiodarone
i. Usual dose
ii. Maximum dose
iii. Dose rate

4. Narrow complex tachycardia of unknown etiology or supraventricular tachycardia nonmedicine
a. Valsalva maneuver
b. Ice to face
c. Blow into an occluded straw
d. Carotid massage

5. Atrial fibrillation/atrial flutter
a. Diltiazem
i. Usual dose
ii. Maximum dose
iii. Dose rate

b. Beta-blockers
i. Metoprolol
1) Usual dose
2) Maximum dose
3) Dose rate

ii. Labetalol
1) Usual dose
2) Maximum dose
3) Dose rate

c. Amiodarone
i. Usual dose
ii. Maximum dose
iii. Dose rate

d. Digoxin
i. Usual dose
ii. Maximum dose
iii. Dose rate

6. Ventricular tachycardia of monomorphic etiology
a. Amiodarone
i. Usual dose
ii. Maximum dose
iii. Dose rate

b. Lidocaine
i. Usual dose
ii. Maximum dose

iii. Dose rate
iv. Use lidocaine only if amiodarone is not available or patient is allergic to amiodarone

7. Ventricular tachycardia of polymorphic etiology
   a. Magnesium
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate
   b. Amiodarone
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate
   c. Lidocaine
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate
      iv. Use lidocaine only if amiodarone is not available or patient is allergic to amiodarone

E. List contraindications and precautions of common cardiac medications
   1. Atropine
      a. Acute myocardial infarct
      b. Ventricular escape rhythm (heart rate <40 beats/min with wide complex)
   2. Calcium channel blockers
      a. Wolff-Parkinson-White syndrome
      b. Lown-Ganong-Levine syndrome
      c. Sick sinus syndrome
   3. Beta-blockers
      a. Wolff-Parkinson-White syndrome
      b. Sick sinus syndrome
      c. Atrial fibrillation with slow ventricular response
      d. Heart block, second and third degree
   4. Verapamil
      a. Wolff-Parkinson-White syndrome
      b. Lown-Ganong-Levine syndrome
      c. Sick sinus syndrome
      d. Atrial fibrillation with slow ventricular response
      e. Poor left ventricular function (ejection fraction <30%)
   5. Adenosine
      a. Known or suspected bronchoconstrictive or bronchospastic lung disease
      b. Poor left ventricular function
   6. Amiodarone
      a. Acute myocardial infarction

F. Follow a step-by-step approach to handling an ST elevation myocardial infarction
    1. Oxygen 2-4 L nasal cannula
    2. Aspirin 325 mg (non-EC aspirin) or two to four 81-mg chewable aspirin
    3. Nitroglycerin 0.4-mg tablets every 5 minutes for maximum of 3 tables or 3 nitroglycerin sprays
    4. Morphine
G. Follow a step-by-step approach to handling a stroke situation
    1. Provide proper oxygen therapy
    2. Obtain intravenous access
    3. Determine precise time of symptom onset
    4. Perform Cincinnati Prehospital Stroke Scale
        a. Facial droop (ask patient to show teeth and smile)
        b. Arm drift (ask patient to extend arms, palms down, with eyes closed
        c. Speech (ask patient to say “You can’t teach an old dog new tricks”)
H. Follow a step-by-step approach to handling other patient incidents
    1. Exercise-induced hypotension or hypertension
    2. Vasovagal syncope
    3. Asystole
    4. Ventricular tachycardia
I. Identify and delegate personnel to perform various tasks in preparation for cardiac emergencies
    1. Crash cart checks: see competency #5
    2. Required training or drills
J. Incorporate the appropriate federal, state, and institutional guidelines into departmental policies and procedures

III. Develop procedural policies and standards for cardiac arrest emergencies that occur within the department as directed by institutional policy and practice standards and provide indicated intervention for a cardiac emergency event
A. Establish intravenous access
B. Identify and administer the appropriate medications for commonly occurring cardiac arrhythmias under the direction of the supervising physician
    1. Asystole
        a. Epinephrine
            i. Usual dose
            ii. Maximum dose
            iii. Dose rate
        b. Atropine
            i. Usual dose
            ii. Maximum dose

iii. Dose rate

2. Pulseless electrical activity
   a. Epinephrine
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate
   b. Atropine
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate
3. Ventricular fibrillation
   a. Administer pharmacologic support, including reversal agents and/or medications necessary for support of vital functions, consistent with American Heart Association Advanced Life Support guidelines until the patient has been transferred to physician care
      i. Epinephrine
         1) Usual dose
         2) Maximum dose
         3) Dose rate
      ii. Vasopressin
         1) Usual dose
         2) Maximum dose
         3) Dose rate
      iii. Amiodarone
         1) Usual dose
         2) Maximum dose
         3) Dose rate
      iv. Lidocaine
         1) Usual dose
         2) Maximum dose
         3) Dose rate
         4) Use only if amiodarone not available
4. Pulseless ventricular tachycardia
   a. Epinephrine
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate
   b. Vasopressin
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate
   c. Amiodarone
      i. Usual dose
      ii. Maximum dose
      iii. Dose rate

d. Lidocaine
    i. Usual dose
    ii. Maximum dose
    iii. Dose rate
    iv. Use only if amiodarone not available

C. Perform cardiac compression or defibrillate patient if required
    1. Placement location of defibrillating pads on a patient needing to be cardioverted, defibrillated, or transcutaneously paced
    2. Manual and automated defibrillators
    3. Cardiac compression methodology

D. Facilitate the ordering of laboratory or other tests as needed for a cardiac arrest event under the direction of the supervising physician
    1. Required laboratory work
        a. Complete blood count
        b. Chemistry (CHEM-7, SMA7, basic metabolic panel, etc)
        c. Cardiac enzyme markers (troponin, creatine kinase MB)
        d. Protime and partial protime (prothrombin time, partial thromboplastin time, international normalized ratio)
        e. Arterial pO_2
    2. ECG

E. Facilitate admission of the patient to the hospital if necessary

IV. Provide indicated intervention for noncardiac emergency events

A. Diabetic patient
    1. Obtain blood sugar level
    2. Indications for administering oral medications/food versus intravenous dextrose

B. Respiratory distress
    1. Oxygen
    2. Medications as needed

C. Panic attack
    1. Relaxation techniques
    2. Medications as needed

V. Manage crash cart for compliance

A. Follow the appropriate guidelines in implementing regulation for managing the department's crash cart
    1. Institution
    2. Federal
    3. State
    4. Joint Commission
    5. American Heart Association

B. Inventory crash cart components according to institutional policy
    1. Personnel responsible for checking the crash cart
    2. Frequency of checks
    3. Items checked

a. Testing the defibrillator
b. Medications
c. Pads on the crash cart
d. Portable oxygen tank level
e. Security lock

C. Properly dispose of expired drugs
D. Replace expired drugs
E. Perform quality assurance testing on defibrillator and document results

VI. Take comprehensive patient history and evaluate for patient pathology
A. Interview the patient and document on department form a complete past and current cardiac history
1. Height and weight
2. Medication history
3. Family history of known cardiovascular disease
a. Acute syndromes
b. Chronic syndromes
c. Heart failure
4. Patient history of related disorders
a. Hypertension/hypotension
b. Thyroid disorders
c. Diabetes
d. Stroke
e. Previous thoracic surgery and/or cardiac intervention
f. Tobacco abuse
g. Metabolic syndrome
h. Glaucoma
i. Chest/back/jaw pain
j. Dyspnea
k. New onset of fatigue
l. Dyslipidemia

B. Establish “nothing by mouth” compliance
C. Evaluate ambulatory ability
D. Review noncardiac history for prevalence to study requested
E. Perform physical assessment
1. Heart sounds
2. Lung sounds
3. Blood pressure and heart rate

VII. Evaluate patient laboratory biochemical markers relevant to cardiac pathology
A. Review most recent laboratory test results relevant to cardiovascular diseases
1. Relevant laboratory tests
a. Urine tests

i. Glucose content
ii. Presence of albumin or blood cells
iii. pH
iv. Pregnancy

b. Blood tests
i. Cholesterol
1) High-density lipoprotein
2) Low-density lipoprotein
ii. Hemoglobin values
iii. Hematocrit values
iv. Leukocyte count
v. Serum chemistries
vi. Blood urea nitrogen
vii. Creatinine
viii. Serum electrolytes
1) Calcium
2) Potassium
3) Sodium
ix. Serum enzymes
x. Creatine phosphokinase
xi. Serum glutamic oxaloacetic transaminase
xii. Lactic dehydrogenase
xiii. Glucose
xiv. Thyroid
xv. Serum troponin levels

2. Normal and abnormal results
3. Relationship to cardiovascular disease

B. Order relevant blood tests if necessary (including pregnancy testing)

VIII. Evaluate patient medications for contraindications to stress testing

A. Understand contraindications to each type of stress test and evaluate for each
1. Contraindications to exercise testing
a. Absolute
i. Acute myocardial infarction (within 2 days)
ii. Unstable angina not previously stabilized by medical therapy
iii. Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise
iv. Symptomatic severe aortic stenosis
v. Uncontrolled symptomatic heart failure
vi. Acute pulmonary embolus or pulmonary infarction
vii. Acute myocarditis or pericarditis
viii. Acute aortic dissection

b. Relative

i. Left main coronary stenosis
ii. Moderate stenotic valvular heart disease (emphasis on aortic stenosis)
iii. Electrolyte abnormalities
iv. Severe arterial hypertension
v. Tachyarrhythmias or bradyarrhythmias
vi. Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
vii. Mental or physical impairment leading to inability to exercise adequately
viii. High-degree atrioventricular block

2. Contraindications to adenosine
   a. Second- or third-degree atrioventricular block (except in patients with a functioning artificial pacemaker)
   b. Sinus node disease, such as sick sinus syndrome or symptomatic bradycardia (except in patients with a functioning artificial pacemaker)
   c. Known or suspected bronchoconstrictive or bronchospastic lung disease (eg, asthma)
   d. Known hypersensitivity to adenosine
   e. Use of methylxanthines
3. Contraindications to dipyridamole
   a. Known sensitivity to dipyridamole
   b. Known sensitivity to aminophylline
   c. Use of medications containing methylxanthine
   d. Unstable angina
   e. Acute myocardial infarction
   f. Severe asthma or bronchospasm
   g. Hypotension
   h. Caffeine within 12-24 hours
4. Contraindications to dobutamine (Bedford Laboratories packet insert)
   a. Idiopathic hypertrophic subaortic stenosis
   b. Hypersensitivity to dobutamine
   c. Cardiac arrhythmias

B. Review patient medications for contraindications to exercise stress testing
   1. Evaluate medications and understand how they can affect the response to and assessment of exercise or pharmacologic stress testing
   2. Recognize the effect medications can have on heart rate, blood pressure, contractility, and left ventricular ejection fraction
   3. Know recommendations for length of time to discontinue medication if necessary
   4. Relevant medications
      a. Antiarrhythmics

b. Beta-blockers
c. Calcium channel blockers
d. Inotropics
e. Vasoactives
f. Diuretics
g. Analgesics
h. Caffeine-containing medications
i. Theophylline
j. Inhalers
k. Nitrates

C. Conduct preoperative evaluation for orthopedic or other surgery
1. Chronic obstructive pulmonary disease
2. Left bundle branch block
3. Pacemaker/automatic implantable cardioverter defibrillator

IX. Obtain patient informed consent as required for nuclear cardiology procedures according to state law and hospital policy

A. Understand the ethical and legal underpinnings of informed consent
1. Autonomy, veracity, and confidentiality
2. Who may give consent
a. Competency issues
b. Minors and mentally impaired adults
3. Types of consent
a. Express
b. Implied by law
c. Informed consent
4. Components of valid informed consent
a. Procedure that will be done
i. Diagnosis
ii. Nature or purpose of the treatment or procedure
b. The name and qualifications of the person doing the procedure
c. The consequences or expected outcome
d. The risks involved, except for the very remote
i. Exceptions: risk of death or sterility if applicable
e. The alternatives to this procedure must be discussed
i. Includes alternative of doing nothing
ii. Must then disclose the patient's prognosis
5. Responsibilities of physician and health care providers
6. When consent becomes invalid
a. The procedure exceeds the consent given
b. Inadequate information is given to the patient
c. The nurse or technologist answers medically related questions
d. The patient is given the consent form and told that it is just “routine papers”

e. There is a force of circumstances
f. There is a change of circumstances

B. Determine the capability of the patient to give informed consent
C. Explain the procedure to the patient, including all components of a valid informed consent
1. List precautions used to reduce risks
2. Review the confidentiality policy
3. Answer any questions or direct questions to the appropriate health care professional
D. Obtain the patient's or guardian's signature

X. Conduct treadmill testing per all protocol options under the direction of the supervising physician
A. Prepare the patient for exercise protocol
1. ECG preparation
a. Skin preparation
b. Electrode placement
2. Intravenous establishment
3. Baseline readings
a. Blood pressure
i. Normal
ii. Abnormal
b. ECG tracings
i. Normal
ii. Abnormal
B. Determine type of exercise stress test
1. Exercise equipment options
a. Treadmills and monitors
b. Bicycle ergometer
2. Protocol options
a. Bruce
b. Modified Bruce
c. Naughton
d. Patterson
e. Ramp
f. Isometric
g. Pharmacologic
C. Monitor ECG tracings and blood pressure for specific pathology and cardiac events during stress testing
1. Normal responses to exercise
a. ST-segment changes
b. T-wave changes
2. Arrhythmias
3. Hypotensive/hypertensive response
4. Nondiagnostic ECG

D. Use the appropriate termination protocols
    1. Absolute indication for termination
    2. Relative indication for termination
E. Calculate the Duke Treadmill Score
    1. Methodology
    2. Risk stratification
        a. Low
        b. Moderate
        c. High

XI. Prescribe and administer interventional drugs for pharmacologic stress under the direction of the supervising physician
A. Explain the indications and contraindications for each pharmacologic stress agent
    1. Adenosine
    2. Dipyridamole
    3. Dobutamine
B. Identify the physiologic action of each pharmacologic agent as it relates to stress testing
    1. Expected or normal responses
    2. Abnormal responses
C. Calculate total dose, volume, and dose rate for each of the most common pharmacologic stress agents
D. Set up drug administration pump
E. Prepare pharmacologic agents for administration utilizing sterile technique
F. Administer pharmacologic agents
G. Monitor the patient's response to pharmacologic agents and treat the patient appropriately in the event of an adverse effect
    1. Possible side effects
    2. Treatment of side effects

XII. Analyze the results of the stress test and imaging portion of the examination and prepare a preliminary description of findings for the supervising physician
A. Create a preliminary description of findings detailing the results of the stress portion of the test
    1. Indications and patient demographics
    2. Methodology
        a. Exercise time
        b. Maximum heart rate
        c. Blood pressure
        d. Symptoms
        e. Tolerance (exercise reserve)
    3. Findings
        a. PQRST changes

    b. Ectopy
    c. T-wave abnormalities
    d. Affected leads
    e. Dysrhythmia
        i. Tachycardia
        ii. Bradycardia
        iii. Blocks
    f. Physiologic responses
4. Risk assessment: Duke Treadmill Score
5. Validity of examination
6. Conclusion with clinically relevant comments

B. Examine rotating raw data from both stress and resting image acquisitions and evaluate image quality
    1. Upward creep
    2. Contamination
    3. Body habitus
    4. Motion
    5. Patient exceeds field of view

C. Review data for incidental finding outside of the heart
    1. Tumor uptake
    2. Enlarged viscera
    3. Halo patterns around heart
    4. Breast uptake
    5. Liver uptake

D. Compare and contrast stress versus resting processed images for perfusion defects
    1. Enlarged right ventricle
    2. Enlarged left ventricle
    3. Evaluate chamber volume data

E. Determine if the heart-to-lung ratio and transient ischemia dilation are abnormal
    1. Normal values
    2. Abnormal values

F. Evaluate the wall motion of stress and resting images for ejection fraction and kinetic abnormalities
    1. Dyskinesis
    2. Akinesis
    3. Hypokinesis

G. Review and evaluate bull's eye polar maps and summed stress scores
    1. Normal values
    2. Abnormal values

H. Create a preliminary description of findings detailing the results of the imaging portion of the test
    1. Indications
    2. Patient demographics

3. Dosing information
4. Imaging parameters
5. Findings
6. Conclusion
    a. Normal
    b. Abnormal
    c. Ejection fraction
    d. Summed stress score

XIII. Facilitate or recommend patient-specific cardiac-related procedures based on nuclear cardiology examination results (outcomes management) according to the supervising physician

A. Order or facilitate scheduling of complementary diagnostic procedures as indicated
    1. Multi-gated acquisition scan
    2. Viability
    3. Blood test
    4. Computed tomographic angiography/calcium scoring
    5. Positron emission tomography
    6. Heart catheterization
    7. Equilibrium radionuclide angiocardiography
    8. Magnetic resonance imaging

B. Identify the clinical pathways as outlined by the American Medical Association/American College of Cardiology for cardiac disease
    1. Cardiac intervention
        a. Stents
        b. Bypass
        c. Angioplasty
            i. Drug eluting
            ii. Non–drug eluting
    2. Medication adjustments
    3. Risk factor modification and lifestyle changes
    4. Surgical intervention

Chapter 5

Interpersonal and Communication Skills

Overview for the Interpersonal and Communication Skills Curriculum

Interpersonal and communication skills go beyond medical interviewing and history taking; they are at the heart of quality patient care. These skills overlap considerably with those in the Professionalism competency domain and permeate the entire fabric of the educational program. In looking at the key components of interpersonal and communication skills, 3 broad areas of interest emerge:

1. Communication with patients and families
2. Communication with colleagues
3. Scholarly communication.

In practical terms, it is often difficult to separate interpersonal and communication skills because both are interrelated. Interpersonal skills are those skills that relate to the impact that one's communication has on another. Communication skills can be thought of as a concrete skill set (eg, the ability to deliver bad news, encourage patients to change behavior, present a lecture). In practical terms, it is often difficult to separate interpersonal and communication skills because both are interrelated.

Learning effective interpersonal and communication skills with patients and families, with colleagues, and in the scholarly setting is a lifelong process. It is anticipated that the competencies in this section will be demonstrated in the clinical setting as well as the traditional classroom setting. Nuclear Medicine Advanced Practitioner (NMAA) educators will most likely provide instruction through modeling behavior, role playing, observation, and mentoring through intervention.

Interpersonal and Communication Skills
Curriculum Content

I. Demonstrate team communication and leadership skills to work effectively with others as a member or leader of a health care team or other professional group
   A. Demonstrate leadership skills by leading a group project to successful completion
   B. Communicate with the referring physician to assure appropriate examination selection, including actions to be taken if the requested procedure appears to be inappropriate
      1. Requisition process
         a. Receipt of order
         b. Verification of order
         c. Appropriateness of indication
         d. Correlation with history
         e. Contraindications
      2. Verbal orders
   C. Collaborate with other health care team members to improve service delivery
      1. Communications regarding
         a. Patient preparation
         b. Schedule necessary procedures before the nuclear medicine procedure
         c. Secure results of necessary procedures before the nuclear medicine procedure
         d. Schedule or facilitate the scheduling of follow-up examinations upon completion of the nuclear medicine procedure
         e. Report nuclear medicine examination results under the direction of the supervising physician and as allowed by institutional policy
            i. To the patient if indicated
            ii. To the referring physician
      2. Handoff of patients in institution
         a. Standardized method to reduce medical errors
         b. Aligns with Joint Commission initiatives

II. Protect and preserve personal and confidential information of others to which access is provided
   A. Adhere to privacy and regulatory standards and requirements regarding the accountability and protection of patient information
      1. Joint Commission
         a. Accountability for protecting patient information
            i. Information collection
            ii. Information maintenance

iii. Use of personally identifiable health information
iv. Contractual agreements
1) Confidentiality clause
v. Monitoring compliance
vi. Demonstrating compliance
1) Audits
2) External reviews

b. Consents
i. Informed
ii. Specific
iii. Voluntary
iv. Release of information
1) Purposes
2) Types of information released
3) Recipients of information

c. Education regarding policies, rights, and responsibilities
i. Patient education
ii. Provider education

2. Patient information standards
a. Privacy issues
i. Health Insurance Portability and Accountability Act (HIPAA) goals
1) Uniformity of electronic data interchange
2) Confidentiality of electronic health data
ii. Parties' HIPAA regulations apply to
1) Health care providers
2) Health plans
3) Health care clearinghouses
iii. Parties not covered by HIPAA regulations
iv. Electronic transactions and code sets
1) Technical standards
a) Formats
b) Data content
2) Electronic transactions
a) Claims/referral inquiry and submission
b) Eligibility inquiry
c) Financial transactions

b. Privacy standards
c. Security standards
i. Physical and technical safeguards for the storage and transmission of protected health information
ii. Unique identifiers
1) Providers
2) Employers
3) Health plans
4) Individuals

iii. Electronic digital signature
d. Enforcement
i. Centers for Medicaid & Medicare Services
ii. Electronic code sets
iii. Office of Civil Rights
iv. Privacy standards
v. State laws and regulations affecting the use and disclosure of health information
e. Medical informatics
i. Definition of informatics
ii. Application in medicine
iii. Telemedicine
iv. Management
1) Data
2) Information
3) Knowledge
v. Information systems and standards
1) Hospital information system (HIS)
2) Radiology information system (RIS)
3) Picture archiving and communications system (PACS)
4) Digital Imaging and Communications in Medicine (DICOM)

B. Identify potential abuses of confidential patient information
1. Information as a commodity
2. Potential abuses

C. Describe the challenges associated with maintaining the confidentiality of patient information stored in computer systems and transmitted via networks
1. Patient issues
a. Trust in the physician
b. Who gets what information
c. Rights in the case of an error or unauthorized disclosure of information
2. Provider issues
a. Implementation of confidentiality procedures
b. Patient education on confidentiality rights
3. Managed care organizations
a. Information shared with external parties
4. Research
a. Access to information without breaching patient rights

III. Use effective listening skills and elicit and provide information using effective nonverbal, explanatory, questioning, and writing skills

A. Listen to the “patient’s story,” extract important details from the history taking, and provide information to their patients in an understandable way

B. Demonstrate effective interviewing skills for patient assessment
    1. Skills of good interviewing
        a. Nonverbal communication
        b. Facilitation
        c. Reflection
        d. Clarification
        e. Summarization
        f. Validation
        g. Empathic responses
        h. Transitions
    2. Challenges to the practitioner
        a. Patients at different ages and comprehension abilities
        b. Situations that call for specific responses
C. Demonstrate effective communication skills with and provide psychosocial support to specific groups of people such as the terminally ill, physically or emotionally impaired, culturally diverse patients, families, and colleagues
    1. Cultural diversity
        a. Development of a personal value system
        b. Interrelationship between personal, community, and societal values
        c. Influence of personal value system on behavior
        d. Development of professional values
        e. Influence of professional values on patient care
        f. Kohlberg's theory on the influence of individual morality on behavior
        g. Differences between culture and ethnicity
        h. Influence of cultural beliefs regarding illness and recovery
        i. Medical ethnocentrism
        j. Influence of societal factors on quality of health care
        k. Alternative/complementary medicine
        l. Culture of poverty and its effect on health care
        m. Family dynamics in a cultural, social, ethnic, and lifestyle context
    2. Terminal illness
    3. Psychological impairment
    4. Physical impairment
D. Demonstrate effective age- and gender-specific communications
E. Be receptive to the clinical significance of the patient's personal beliefs and values for adaptation of an examination protocol or departmental policies
    1. Religion
        a. Use of blood products in an examination
        b. Mandatory presence of a family member during studies
    2. Lifestyle (eg, vegetarians and gastric emptying studies)

IV. Demonstrate emotional resilience and stability, adaptability, flexibility, and tolerance of ambiguity and anxiety
   A. Maintain composure in all situations
   B. Refrain from negative conversations
   C. Demonstrate self-awareness of personality traits

V. Follow appropriate protocol in resolution of conflict, exhibiting proper restraint when presented with potentially volatile situations
   A. Potential areas of conflict in the workplace
      1. Harassment in the workplace
      2. Quid pro quo
      3. Hostile work environment
      4. Protected persons
      5. Unwelcome conduct
      6. Employer's liability
      7. Sexual harassment
      8. Harassment
      9. Assault and battery
      10. Infliction of emotional distress
      11. Invasion of privacy
      12. Wrongful discharge
      13. Unclear expectations
      14. Lack of clear jurisdiction
      15. Operational or staffing changes
   B. Conflict prevention
      1. Chain of command
      2. Standard Operating Procedures)
      3. Mediation
   C. Common resolution strategies
      1. Avoidance
      2. Fight
      3. Surrender
      4. Compromise
      5. Collaborate

VI. Maintain comprehensive, timely, and legible records for medical, legal, quality improvement, and financial purposes
   A. Medical records
   B. Legal records
   C. Health information systems
   D. Informatics
   E. Quality improvement
   F. Regulatory
   G. Health law/legal

VII. Maintain appropriate protocol, courtesy, tact, and confidentiality in business communications, both written and oral
   A. E-mail
   B. Correspondence: letters and memos
   C. Telephone conversations
   D. Netiquette

VIII. Demonstrate an appropriate level of communication skills when orally presenting professional or scholarly work
   A. Grand rounds
   B. Presenting lectures/seminars/conferences/posters

IX. Demonstrate technical writing ability in a variety of venues, including scholarly writing and business communications
   A. Write an abstract according to published standards
   B. Prepare a poster for presentation at a professional conference
   C. Write scholarly articles
   D. Develop patient procedure protocols
   E. Develop departmental policies
   F. Write business correspondence such as business letters, memos, or internal reports
   G. Prepare reports, such as a needs assessment or progress report
   H. Develop action plans for quality improvement projects
   I. Develop patient education materials

X. Apply concepts of teaching and learning theories in design, implementation, and evaluation in the education of the patient, family, colleagues, and the community (See Practice-Based Decision Making competency domain)

Chapter 6

Practice-Based Decision Making

Overview for the Practice-Based Decision Making Curriculum

Nuclear Medicine Advanced Practitioners (NMAAs) will be expected to demonstrate competency in a wide range of clinical practice, including the ability to track, analyze, and improve practice processes and outcomes. Inasmuch as the advanced associate represents a “new” cohort of technologists, it is also intended that these individuals develop and evolve a new culture that will include practice of the science of nuclear medicine. With new credentials will come new expectations and duties, and with these, their interactions with and among other technologists, physicians, and patients will begin to move to a different level.

The inclusion of the term “practice” in the title is intentional and implies that the NMAA is expected to reach beyond the technical aspects of their careers to embrace and master skills in the area of evidence-based practice and decision making, taking on a greater degree of responsibility for the overall quality of the nuclear medicine departments and the care that patients receive while there. Unlike following existing guidelines and manuals, NMAAs will be required to seek out, gather, analyze, and act on a combination of quantitative and qualitative data as they work toward proactively improving the totality of the experiences associated with the department.

As the number and experience base of NMAAs grow, it is anticipated that these individuals will begin to work collectively through their own networks to alter the “organizational citizenship behavior” of our departments to reflect those steps that are taken to enhance the processes and experiences of the job beyond the basic job descriptions. The key point for prospective students is that they must be willing to and capable of analyzing and improving their own practice behaviors through self-reflection, a practice that is essential to self-improvement. This does not imply that evidentiary considerations will take a backseat but recognizes the need for balancing the unique context that we each function within as we try to bring everything together to create the best environment and outcomes within that particular context or construct. The Accreditation Council for Graduate Medical Education has stated that “…practitioners should be leaders in making change rather than reacting to changes made by others. Positive changes in one’s own practice behavior can have positive effects on larger systems.”

Practice-Based Decision Making Curriculum Content

I. Track and analyze processes, procedures, and outcomes using appropriate statistical and/or qualitative techniques
   A. Use the evidence-based medicine process of asking, acquiring, appraising, applying, and assessing to improve clinical practice
      1. The evidence-based medicine process
         a. Asking
         b. Acquiring
         c. Appraising
         d. Applying
         e. Assessing
      2. The patient
         a. Start with the patient
         b. A clinical problem or question arises out of the care of the patient
      3. The question: construct a well-built clinical question derived from the case
         a. Type of question
            i. Diagnosis: how to select the interpret diagnostic tests
            ii. Therapy: how to select treatments to offer patients
            iii. Prognosis: how to estimate the patient's likely clinical course over time and anticipate likely complications of disease
            iv. Etiology: how to identify causes for disease
            v. Other possible questions (eg, cost, risk, achievability, meaning, etc)
         b. Prioritizing competing clinical questions
      4. The resource: select the appropriate resource(s) and conduct search
         a. Types of scientific evidence
            i. Animal research/laboratory studies
            ii. Case series/case reports
            iii. Case-control studies
            iv. Cohort studies
            v. Randomized controlled trials
            vi. Systematic reviews
            vii. Meta-analyses
         b. Expert opinion
      5. The evaluation: appraise the evidence for its validity and applicability
      6. The patient: return to the patient
         a. Integrate evidence with clinical expertise and patient preferences
         b. Apply it to practice
      7. Self-evaluation: evaluate performance with this patient

B. Analyze practice organization and management and perform practice-based improvement activities
    1. Clinical practice evaluation
        a. Practice demographics
            i. Patient demographics
            ii. Organization demographics
                1) Location
                2) Number of examinations performed per year
                3) Number of full-time employees working in department
                4) Regulatory and accreditation agencies
        b. Customer service (patient/referring physician)
            i. Timing (wait times too long?)
            ii. Flow/scheduling (service flow seamlessly or fragmented?)
            iii. Accommodation (flexible enough to meet special requests?)
            iv. Anticipation (customers' needs anticipated?)
            v. Communication (communication accurate and timely?)
            vi. Customer feedback (know what customers are saying and thinking?)
            vii. Organization and supervision (how effective/efficient are procedures and protocols?)
        c. Clinical performance
            i. The performance gap: desired − actual performance
                1) Mission, goals, and vision
                2) Expectations
                3) Strategic planning and forecasting
            ii. Methods of evaluation
                1) Indirect
                    a) Surveys/ratings
                    b) Review of records (audits)
                2) Direct
                    a) Observation of real encounters
                    b) Observation of simulated encounters
            iii. Criteria for performance measures
                1) Relevance
                2) Understandable
                3) Measurable
                4) Formulated in behavioral (observable) terms
                5) Acceptable
            iv. Problem-prone departmental performance indicators
                1) Sentinel events
                    a) Patient misidentification events
                    b) Failure to assess pregnancy status
                    c) Failures to recognize and/or respond to changes in patient condition

d) Medication variances/adverse drug reactions
e) Infection control
f) Patient falls and other accidental injury

2) Routine events
a) Obtaining accurate medical history
i) Effective chart review
ii) Effective patient interview
iii) Effective referring physician interview/follow-up
iv) Effective and complete physical examination (including mental)
b) Documentation: completeness/accuracy/errors
c) Patient compliance with preparation guidelines
d) Patient complaints
e) Patient follow-up

v. Diagnostic accuracy
1) Reading films (false-positive/false-negative rates)
2) Accuracy and completeness of reports

vi. Patient-centered outcomes
1) Functional health status
2) Quality of life
3) Satisfaction

vii. Radiation exposure
1) Patients
2) Staff

viii. Individual staff performance and development (360 degree evaluation, report cards)
1) Adherence to job description
2) Attitude
3) Knowledge and skills
4) Productivity; cost-effectiveness of practice; quality of care
5) Accountability
6) Communication skills
7) Cooperation/teamwork

ix. Staff utilization and development

2. Practice organization and management
a. Patient medical records (including images and graphics)
b. Reporting
i. Transcription time
ii. Signature time
iii. Turnaround time
c. Scheduling (patient procedures, staffing)
d. Charge capture and checkout
e. Medical claims management (coding/reimbursement)
f. Medical billing and collections
g. Financial accounting indicators

i. Expenses
ii. Days in accounts receivable
iii. Cost per relative value unit (RVU)
iv. Average RVU per examination
v. Hours worked per RVU
vi. Collections by examination
vii. Supply cost per RVU

h. Productivity indicators
i. Examination volume
ii. RVUs per full-time employee
iii. Gross charges by examination
iv. Collections by full-time employee
v. Volume by device

3. Technology assessment
a. Equipment utilization and patient access
b. Quality control programs
c. Maintenance and replacement schedules

C. Develop a personal program of self-study and professional growth

II. Use benchmarking analysis and adjust processes, procedures, and operations for comparison with published standards of care

A. Follow a systematic process for identifying and implementing best or better practices

B. Follow professional standards of practice and work within the NMAA scope of practice to improve patient care and safety and protect the public

1. Scope of practice
a. Definition
i. Procedures, actions, and processes permitted for licensed individual
ii. Description of what can and cannot be done by licensed individual
1) Establishes which activities and procedures represent illegal activity if performed without licensure
2) Includes technical skills that, if performed improperly, represent a significant hazard to the patient and therefore must be kept out of the hands of the untrained

b. Purpose
i. Health care goals
1) Improve patient care
2) Ensure patient safety
3) Protect the public
ii. Legislative goals
1) Establish legislation, rules, and regulations

2) Establish boundaries between professionals and laypersons
3) Establish boundaries among different licensed health care professionals
a) Create exclusive domains of practice
b) Create overlapping domains of practice

iii. Components
1) Education
2) Certification
3) Licensure
4) Credentialing

c. Source of authority
i. Authority vested by state
ii. Defined in law, regulations, or policy documents
iii. Establishes licensing or governing boards

d. National or federal considerations in establishing professional guidelines
i. Improves consistency among states' scopes of practice
ii. Facilitates reciprocity or portability
iii. Improves professional mobility
iv. Promotes consistency of personnel titles
v. Improves the name recognition and public understanding of the role of the NMAA
vi. Establishes standardized curriculum

e. Education component
i. Establishes appropriate education, clinical experience, and competencies
1) Specifies education program accreditation requirements
2) Outlines cognitive, psychomotor, and affective learning requirements
ii. Establishes entry-level, advanced-level, and mandatory continuing or additional training, practice, or education

f. Certification component
i. Certification examinations
ii. Other demonstrations of competency

g. Licensure component
i. Permission granted to an individual by the state to perform certain restricted activities
ii. Outlines requirements for maintenance of licensure

h. Credentialing component
i. Definition
1) Local process by which an individual is permitted by a specific entity (medical director) to practice in a specific setting
2) Varies in sophistication and formality

ii. Facility policy: establishes rights and responsibilities within the hospital or health care setting
iii. Physician delegation: establishes oversight responsibility (eg, medical direction)

i. Ethical and legal considerations of licensee
   i. Patient and client needs are uppermost
   ii. Keep up-to-date and continue to develop knowledge, skills, and competence
   iii. Recognize limits to personal knowledge and skill and remedy deficiencies
   iv. Acknowledge personal accountability
   v. Avoid inappropriate delegation
j. Other variables in scope of practice issues
   i. Employer
   ii. Professional associations
   iii. Collaborating physician
   iv. Nurse Practice Act
   v. Medicare provider
   vi. Insurance carrier
k. Special considerations
   i. Scope of practice variations for special populations
      1) Pediatric
      2) Geriatric
      3) Patients with disabilities
      4) Patients with limited access to health care for geographic, demographic, socioeconomic, or other reasons
   ii. Scope of practice variations for specialized practice settings
      1) Cardiology
      2) Oncology
      3) Pediatrics
   iii. Scope of practice variations in nontraditional roles
   iv. Scope of practice variations during disasters or public health emergencies
l. Comparisons between NMAA and Nuclear Medicine Technologist scopes of practice
   i. Skills
   ii. Practice environment
   iii. Knowledge
   iv. Qualifications
   v. Services provided
   vi. Risk
   vii. Level of supervisory responsibility
   viii. Amount of autonomy
   ix. Judgment/critical thinking/decision making

2. Standards of practice
    a. Description
        i. Define a standard of care and role of practitioner
        ii. Establish criteria used to judge performance: quality assurance
        iii. Establish standards for clinical practice, technical activities, and professional responsibilities
    b. Role of standards of practice within workplace
        i. Used to develop job descriptions
        ii. Used to develop departmental policies
        iii. Used to develop performance appraisals
        iv. Used in quality assurance programs as a means of evaluating and improving care
        v. Used in medical malpractice or negligence cases regarding accepted standards of care
    c. Standards of practice development
        i. Developed from research and the actual practices (prevailing practices) of professionals
        ii. Developed from analysis of standards of related professionals
        iii. Developed from established benchmarking programs

III. Critically evaluate current literature and extant research to assess the effectiveness of diagnostic and therapeutic procedures
A. Identify and assess the relevance of and utilize credible sources of information
    1. Scientific literature
        a. Critically evaluate studies and research to determine the appropriateness of the type of research conducted and its relative validity
        b. Reflect on the merits of descriptive versus explanatory approaches given a specific context and/or construct
        c. Select the most appropriate research methodology
            i. Meta-analysis
            ii. Longitudinal
            iii. Randomized double-blind
            iv. Retrospective
            v. Cross-sectional
    2. Sources of information that patients may commonly access in literature or online
B. Determine applicability and completeness of information, clarifying patients' questions and misunderstandings about procedures, conditions, and assumptions based on what they may have read or been told about their study

C. Use findings from literature and benchmarks to design and initiate appropriate research to investigate a given clinical situation in order to arrive at an optimal solution
    1. Determine whether the research will be best undertaken at a formal or informal level, taking into consideration several factors:
        a. Significance or severity of problem
        b. Cost of not responding
        c. Universality of problem
        d. Generalizability of the proposed solution or findings
        e. Scope of problem
        f. Available resources
            i. Human
            ii. Fiscal
            iii. Temporal
            iv. Experiential
    2. Identify and clarify the research question reflecting on the optimal approaches
        a. Rank order and prioritize the key issues
        b. Gather and sort data
        c. Seek feedback and agreement with key stakeholders
        d. Pilot test any instruments designed to gather data and analyze the feedback to critically assess effectiveness
    3. Identify the population to be studied
    4. Determine the best approach to sample that population
    5. Select the study sample after carefully considering the following factors
        a. Population and sample
            i. Random or intentional
            ii. Cohort or stratified
        b. How should the study sample be characterized?
        c. Reflect on the appropriate sample size after analyzing the demographics of the population and focus of the study
        d. Based on the purpose of the study, critically evaluate each of the possible methods for identifying and selecting sample members
            i. Random
            ii. Intentional
            iii. Convenience
    6. Determine whether to use a quantitative and/or qualitative research approach after considering the following factors:
        a. Resource availability
            i. Human
            ii. Fiscal
            iii. Temporal
            iv. Experiential

b. Extent to which the study is seeking to build on extant knowledge or investigate new concepts and territory
c. Degree to which the methodology is congruent with the research question, topic, or problem

7. Contemplate and consider what other types of research might be helpful
8. Create a clear, comprehensive, and workable hypothesis and, based on that, include the following actions, findings, and safeguards:
    a. Decide whether the study should utilize participants or subjects
    b. Ensure that issues of ethics and approval have been adequately addressed
    c. Complete a critical analysis of the literature and disseminate the findings as appropriate, citing representative sources
    d. Address issues of potential bias in the study sample to ensure that the findings and conclusions of the study have high validity
    e. Ensure maximum study trustworthiness by monitoring the study and its design, implementation, and analysis on an ongoing basis
    f. If using a qualitative approach, contemplate, propose, and utilize multiple alternative approaches to assess and assure study validity
    g. When selecting the study instruments to be used to collect data, reflect on the following considerations:
        i. If appropriate, should norm or criterion referenced tests be chosen
        ii. If performance is being assessed, should optimum or typical performance be chosen as the best design for the study
        iii. Contemplate the overall experimental or study design in order to justify design choices
    h. Consider the use of descriptive and/or inferential statistics and be able to provide a clear rationale for that choice, including a description of how nominal data will be measured
        i. Basic concepts of measurement
            1) Variables and measurement scales
            2) Populations and samples
                a) Methods of sampling
                b) Sample bias
                c) Sample size
        ii. Descriptive statistics
    i. Organizing and grouping data
        i. Measures of central tendency (eg, mean, median, mode)
        ii. Measures of variability (eg, standard deviation, variance)

iii. Measuring relationships
    1) Correlation
    2) Prediction and regression
iv. Inferential statistics
    1) *t* test
    2) Analysis of variance
    3) Chi-square
v. Interpretation and use
    1) Reliability
    2) Validity
    3) Measurement error

j. Be able to analyze, interpret, and explain the effects of variance and sample size on the statistical tools and data

IV. Use feedback and observations to verify that changes were implemented to optimize patient care delivery and outcomes were effective

A. Utilize established research techniques to gather data from patient interviews and assessments in order to monitor the success, effectiveness, and quality of patient examinations, therapies, interventions, and education
B. Utilize these data and their analysis to educate peers and disseminate findings
C. Critically evaluate patient test results and images—on an individual basis and using retrospective, longitudinal, and meta-analysis—to validate the quality of care, maintain ongoing improvements, and seek methods and approaches to meaningfully participate in ongoing quality control and improvement
D. Carefully monitor the ratio of true positives to false positives in light of the context of the variables that affect these to assure that patient care and study quality meets or exceeds expected standards
E. Through ongoing and active participation in education and personal reflection, seek alternative objective measures that can be used to enhance practice, improve quality, and assure patient comfort and safety

V. Use information technology to effectively access, collect, analyze, and disseminate data

A. Use current information technology and other sources to efficiently locate and retrieve relevant information from credible sources
B. Follow ethical principles in using information that may be sensitive
C. Be aware of appropriate regulations or legislation involving information sharing, storing, and protecting or deleting sensitive information

VI. Provide discipline-specific education to patients, students, colleagues, and the public
- A. Use opportunities to teach and learning as facets of professional practice
  - 1. Teaching and learning in human service practice
    - a. Formal
    - b. Informal
  - 2. Learners in human service practice
    - a. Individuals
      - i. Patients
      - ii. Students
      - iii. Colleagues
      - iv. Other professionals
      - v. Other clients
      - vi. Member of the public
    - b. Small groups
    - c. Communities
    - d. Professional groups
  - 3. Teachable moments: finding teaching opportunities
    - a. Developmental learning opportunities (eg, common life tasks, role transitions)
    - b. Critical learning opportunities (eg, unexpected crisis)
  - 4. Foundations of teaching in human service practice
    - a. Patient education
    - b. Health promotion
    - c. Community education and development
    - d. Professional education
- B. Develop learning relationships with clients, patients, students, and colleagues
  - 1. Viewing patients/clients as learners
    - a. Teaching philosophies
      - i. Positivism
      - ii. Constructivism
      - iii. Stages of learning
        - 1) Dualism
        - 2) Multiplicity
        - 3) Contextual relativism
    - b. Styles of learning
      - i. Concrete to abstract
      - ii. Active to reflective
    - c. Principles of effective teaching
      - i. Based on the learner's self-concept
        - 1) Self-image and self-esteem
        - 2) Need for respect and partnership
      - ii. Based on the learner's life experience
        - 1) Level and context for learning

2) Grafting: understanding the new in terms of the old
3) Enriched communication
4) Sharing learning

iii. Based on the learner's purpose for learning

d. The resource: select the appropriate resource(s) and conduct search
   i. Types of scientific evidence
      1) Animal research/laboratory studies
      2) Case series/case reports
      3) Case-control studies
      4) Cohort studies
      5) Randomized controlled trials
      6) Systematic reviews
      7) Meta-analyses
   ii. Expert opinion
e. The evaluation: appraise the evidence for its validity and applicability
f. The patient
   i. Return to the patient
   ii. Integrate evidence with clinical expertise and patient preferences
   iii. Apply to practice
g. Self-evaluation: evaluate performance with the patient

2. Developing learning relationships with clients, patients, students, and colleagues
   a. Empowerment
   b. Critical reflection
   c. Self-directed learning
   d. Situational teaching and the teaching-to-facilitating continuum
      i. Telling
      ii. Instructing
      iii. Participating
      iv. Delegating
   e. Attributes of effective teachers and facilitators
      i. Interpersonal skills
      ii. Expertise
      iii. Empathy
      iv. Enthusiasm
      v. Clarity and organizational skills
   f. Sources of influence
      i. Coercive influence
      ii. Reward influence
      iii. Legitimate influence (role-related influence)
      iv. Referent influence (based on admiration or personal identification)

v. Expert influence
g. Building credibility
i. Maintenance credibility
ii. Organizational credibility
iii. Change agent credibility

C. Assess what needs to be learned and demonstrate effective teaching techniques in settings that may be spontaneous or by design
1. Assessing what needs to be learned
a. Preformative assessment
b. Who identifies learners and learning needs?
c. Who perceives the need?
d. Assessment strategies
i. Interviews
ii. Questionnaires
iii. Focus groups
iv. Emergent assessment (from shared experience)
v. Embedded assessment
e. Learning objectives
i. Objective clarification
ii. Objective classification
1) Cognitive domain
2) Psychomotor domain
3) Affective domain
iii. Elements of well-stated learning objectives
1) Who?
2) Will do what?
3) Under what conditions?
4) To what level?
iv. Advantages and limitations of performance-based objectives
f. Asking questions
i. Levels and types of questions
1) Exploratory
2) Challenge
3) Relational
4) Diagnostic
5) Action
6) Cause and effect
7) Extension
8) Hypothetical
9) Priority
10) Summary
ii. Tactics for effective questioning
1) Ask one question at a time
2) Avoid yes/no questions

3) Ask focused questions
4) After you ask a question, wait silently for answer
5) Ask questions that require the learner to demonstrate understanding
6) Draw out reserved or reluctant learners
7) Use questions to change the tempo or direction of the discussion
8) Use probing strategies

iii. Tactics for handling responses
1) Actively listen
2) Use nonverbal gestures to indicate your attention
3) Vary your reaction to students' answers
4) Tactfully correct inaccuracies
5) Ask questions that require the learner to demonstrate understanding
6) Draw out reserved or reluctant learners
7) Use questions to change the tempo or direction of the discussion
8) Use probing strategies

2. Teaching effectively – spontaneously and by design
   a. Selecting a delivery method
      i. Face-to-face teaching
      ii. Person-mediated distance education (eg, conference calls)
      iii. Program-mediated interactive distance education (eg, CD-ROM, Internet)
      iv. Noninteractive distance education (eg, printed materials)
   b. Sequencing learning activities
      i. Simple to complex
      ii. Established sequence
      iii. Historical sequence
      iv. Most important to least important
      v. Most familiar to least familiar
      vi. General to specific
      vii. Concrete to abstract
   c. Planning a teaching episode (using EDICT)
      i. Explain
      ii. Demonstrate
      iii. Involve
      iv. Coach
      v. Test/terminate/transfer

D. Select appropriate resources and activities to support teaching
   1. Developing and using learning activities
      a. Icebreakers
      b. Role playing
      c. Case studies

d. Simulations
e. Mind mapping
f. Values clarification
g. Problem-solving activities
h. Visioning exercises
i. Brainstorming
j. Decision/value matrices

2. Learning resources and materials
   a. Printed learning resources
   b. Flipcharts
   c. Audiovisual materials
      i. Videotapes
      ii. Slides and audiotapes
      iii. Computer-assisted instruction
      iv. Multimedia
   d. Simulations
   e. Mind mapping
   f. Values clarification
   g. Problem-solving activities
   h. Visioning exercises
   i. Brainstorming
   j. Decision/value matrices

E. Use evaluation and feedback to measure and enhance teaching effectiveness
   1. Pre-formative evaluation
   2. Formative evaluation
   3. Summative evaluation

F. Facilitate the transfer of learning
   1. Types of transfer
      a. Positive
      b. Negative
   2. Factors affecting transfer
      a. Context and degree of original learning
      b. Similarity of the situation in which something is learned and the situation in which it is to be transferred
      c. Relative advantage (extent that new behavior is seen as better than old)
      d. Compatibility with existing practices, needs, and experiences
      e. Complexity of new behavior
      f. Trialability of new behavior (extent to which new behavior can be experimented with)
      g. Observability of new behavior (extent to which positive outcomes are visible to others)
   3. Increasing the probability of transfer
      a. Working with intact social system within which learners will use new knowledge/skills

b. Promote conceptual learning, or higher-level learning, rather than informational learning
c. Follow-up teaching
    i. Fine tuning
    ii. Troubleshooting

4. Memory, retention, and learning
    a. How memory forms
    b. Stages and types of memory
    c. Factors affecting retention of learning
    d. Learning motor skills
    e. Effect of daily biological rhythms on learning and memory
    f. Intelligence and retrieval

Chapter 7

Professionalism

Overview for the Professionalism Curriculum

The mercurial concept of medical professionalism is embedded in the principle that health care givers have an unwritten contract with society to behave and perform in an expected manner. These expectations are centered on relationships with patients, peers, community, the health care system, self, and the profession. Health care education literature defines professionalism in terms of the following constructs: humanism, reliability, and responsibility; honesty and integrity; maturity; respect for others' critique; altruism; duty; caring and compassion; excellence and scholarship; leadership; interpersonal and communication skills; absence of impairment; self-improvement; adaptability; accountability; autonomy and self-regulation; conflict management; and knowledge.

Instruction and assessment of professionalism come in many forms, including direct classroom instruction, behavior observation and modeling, simulation, and self-reflection and journaling. Delivery of instruction should be guided by defined behaviors that can be documented instead of by value concepts that are abstract in nature. Professionalism instruction is delivered primarily through clinical observation and adoption of behaviors demonstrated by mentors in a clinical environment.

Professionalism Curriculum Content

I. Demonstrate a calm, compassionate, and helpful demeanor toward those in need
   A. Forms of help
      1. Philanthropic
      2. Work related
      3. Solicited
   B. Sharing workload
      1. Unsolicited
      2. Fulfilling need

II. Treat others with dignity and respect, demonstrating sensitivity and responsiveness to culture, age, gender, and disability
   A. Discuss how diversity issues, health literacy, or disparity issues might impact patient care and adherence to treatment
   B. Describe how cultural values and assumptions influence relationships and interactions

III. Consistently strive for excellence in professional activities
   A. Be meticulous and careful in conducting professional tasks
   B. Work systematically and complete assignments in a timely manner
   C. Take responsibility for continuity of care
   D. Recognize how Nuclear Medicine Advanced Practitioner (NMAA) patient care and professional practices might affect other health care professionals and the health care organization
   E. Demonstrate the ability to reflect on methods of improving professional behavior

IV. Act with integrity and understand personal limitations
   A. Refrain from performing tasks beyond personal capabilities or outside of professional scope of practice
   B. Accept responsibility for mistakes and report mistakes as appropriate
   C. Accept criticism and make an effort to improve
   D. Reflect on difficult encounters and analyze how values, skills, and knowledge are affecting care of patients with challenging and/or terminal illnesses
   E. Recognize and appropriately respond to impairment of self or colleagues
      1. Personal health
      2. Stress management
      3. Healthy living

V. Demonstrate the professional attitudes that must be considered by the NMAA

A. Uphold the goals of the profession by supporting professional organizations, keeping professional confidences, maintaining competency, and exhibiting a professional image
    1. Definition of profession
        a. Professionalism
        b. Professional behavior
    2. Attitude
        a. Upholding goals of profession
        b. Support of professional organization
        c. Keeping professional confidences
        d. Maintaining competency
        e. Professional image
B. Exhibit exemplary professional appearance and personal hygiene
C. Adhere to the scope of practice and standards of practice, including the role of state and federal regulations
    1. Scope of practice
        a. As defined by profession
        b. State regulations and restrictions
        c. Job descriptions (institutional scope of practice)
    2. Updating skills
D. Demonstrate conscientiousness and organization in addressing all professional obligations
    1. Achieving and maintaining appropriate credentials
        a. Professional credentialing
        b. Institutional credentialing
    2. State licensure
    3. Continuing education
    4. Regulatory compliance

VI. Foster professional relationships with members of the health care team
A. Mentor students, technologists, and other members of the health care team
B. Enhance the professional relationship by keeping the patient as the main focus
C. Manage conflict among health professionals in a constructive manner

VII. Demonstrate accountability to the health care organization and society by adhering to ethical business principles
A. Outline the nature of the special fiduciary relationship between the practitioner and the patient
B. Differentiate between compensatory, retributive, procedural, and distributive justice
    1. Definition of justice
    2. Types of justice
        a. Retributive justice

i. Proportionate punishment is morally acceptable
ii. Independent of whether punishment results in tangible benefits

b. Compensatory justice
i. Compensation for injuries incurred through another
ii. Medical negligence

c. Procedural justice
i. Due process safeguards equality of opportunity
ii. Due process ensures that like cases are treated alike
iii. Treatment is nondiscriminatory

d. Distributive justice
i. Demand that benefits and burdens be shared in a fair manner across society
ii. Justifying unequal distribution by relevant distinctions (ie, more resources expended in the care of critically ill patients)

VIII. Demonstrate a commitment to medicolegal and ethical principles

A. Apply the ethical principles of autonomy, nonmalfeasance, beneficence, justice, paternalism, fidelity, veracity, altruism, integrity, respect, and compassion

1. Morals versus ethics
2. Basic principles of medical ethics

a. Autonomy
i. Definition
1) Right of a rational person to make decisions
2) Right to have decision respected by others
ii. Implications
1) Patient has decisional capacity, which is a clinical concept
2) Patient is competent, which is a legal concept
iii. Safeguards
1) Require patient's informed consent for intervention
2) Honor patient's informed refusal of any intervention
3) Communicate openly and honestly with patient

b. Nonmalfeasance
i. Definition: practitioners should not cause needless harm or injury to patients
ii. Safeguards
1) Withhold an intervention unless the patient is more likely overall to benefit than to be harmed
2) Avoid unnecessary suffering by provision of appropriate palliative care
3) Protect patients from risks
4) Respect confidentiality

c. Beneficence

i. Definition: practitioners should act to promote the welfare of the patient
ii. Implications: assessment of how the patient can be best benefited through the skills and resources of the health care team
iii. Safeguarded by assurance of access to needed medical care regardless of ability to pay or insurance status

d. Paternalism
e. Fidelity
f. Veracity
g. Altruism
h. Integrity

3. Medical ethical codes

B. Practice patient-centered care that encompasses confidentiality, respect, and autonomy via appropriate informed consent and shared decision making

Chapter 8

Systems-Based Practice

Overview for the Systems-Based Practice Curriculum

A systems-based practice view is critical to understanding patient outcomes, safety, values, and quality. The Nuclear Medicine Advanced Practitioner (NMAA) must demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value. An interdisciplinary approach to understanding the structure, governance, financing, and operation of health care systems will provide the NMAA with skills that will maximize patient care and increase health care efficacy. Systems-based practice competencies will be achieved by both didactic and clinical programmatic participation.

NMAAs must be able to investigate and evaluate their patient care practices, appraise and assimilate scientific evidence, and improve their patient care practices. They will act as a patient advocate and assist patients in dealing with system complexities. NMAAs will be responsible for ensuring compliance with all local, state, regional, and federal requirements as applicable. They will be instrumental in securing and maintaining accreditation status for nuclear medicine laboratories. Knowledge of coding practices and procedures will assure optimal and legal reimbursement. They will participate in strategic planning and budgetary decision making within the clinical setting. Competencies in clinical management will provide graduates of the NMAA program with skills to assist the department managers in daily operations that are relevant to clinical practice.

Systems-Based Practice Curriculum Content

I. Describe the structure, governance, financing, and operation of the health care system and its facilities and how this influences patient care, research, and educational activities at a local, state, regional, and national level
   A. Understand the structure and function of health care delivery systems and medical practices
      1. Evolution of health care system in the United States
         a. Health care development to the 21st century
         b. Developing role of government
      2. Health care delivery systems
         a. Classification
            i. Ownership and system affiliation
            ii. Location
            iii. Levels of care provided
               1) Primary
               2) Secondary
               3) Tertiary
            iv. Teaching status
         b. Accreditation
         c. External influences
         d. Internal influences
         e. Administrative structure and governance
         f. Mission and vision
      3. Other delivery systems
         a. Outpatient clinics
         b. Emergency medical clinics
         c. Home health care
         d. Public health
         e. Mobile clinics
         f. Nursing home and extended care facilities
         g. Telemedicine
   B. Describe the various third-party payer systems, covered health benefits, formularies, preauthorization, appeals, disease management, and quality improvement
      1. Factors affecting economics of health care
         a. Entitlement to access
            i. Consumer expectations and demands
            ii. Ethical aspects
         b. Technology
            i. Improved care
            ii. Improved access
            iii. Cost of development
            iv. Cost of use
         c. Quality

i. Importance
ii. Cost

d. Legislation
i. Consumer protection
ii. Cost containment

e. Payer systems
i. Shift from retrospective to prospective systems
ii. Shift from nonprofit to profit-based systems
iii. Shift from fee for service to diagnostic-related groups (DRGs) and capitation
iv. Effects of federal and state regulations

f. Population
i. Insured versus uninsured
ii. Age shift
iii. Expense of chronic diseases

g. Supply and demand
i. Regional differences in availability and use of services
ii. Competition

h. Fraud and abuse

2. Health care delivery and insurance systems
a. Retrospective fee-for-service system
b. Medicare and Medicaid
i. Centers for Medicare & Medicaid Services (CMS)
ii. Original configuration
iii. Development of DRGs
iv. Effects of DRGs on other payer plans
v. Common Procedural Terminology (CPT), Ambulatory Payment Codes (APC), and International Classification of Diseases, Ninth Revision (ICD-9) codes

3. Managed care systems
a. Health maintenance organization
i. Configuration
ii. How costs are controlled
iii. Impact on health care costs
iv. Capitation

b. Preferred provider organization
c. Physician-hospital organization

C. Define and describe a patient population
1. Patient demographics
2. Cultural and socioeconomic conditions
3. Circumstances of living
4. Health status
5. Epidemiologic studies

II. Practice cost-effective health care and resource allocation that do not compromise quality of care

A. Review and adjust coding practices and procedures to assure optimal and legal reimbursement
    1. Reimbursement methodologies
    2. Laws and regulations pertaining to reimbursement
    3. Codes for services or examinations rendered
    4. Reimbursement maximization for services provided
    5. Support documentation for reimbursement for services
B. Analyze departmental budget, cost/revenue for optimal efficiency
    1. Understanding of accounting and finance practices
    2. Preparation of a departmental budget
    3. Assessment of appropriateness of expenditures
    4. Understanding capital equipment expenditures and depreciation
    5. Determination of staffing needs
    6. Projecting revenue and expenses
    7. Recognition of fixed and variable expenses
    8. Calculation of net income losses and gains
    9. Preparation of budgetary reports
    10. Aligning resources with expenses
C. Provide documented analysis and data for resource acquisition
    1. Modality appropriateness assessment
    2. Business plan development
    3. Cost-benefit analysis
    4. Preparation of Requests for Proposals (RFPs) and Requests for Information (RFIs)
    5. RFP and RFI analysis
    6. Interpretation of regulatory information
    7. Interpretation of financial reports and data
    8. Justification of need
    9. Comparative analyses
D. Follow filing and documentation practices for practitioner reimbursement as directed by CMS policies and procedures as well as state and federal law
    1. Maintenance of patient records
    2. CMS policies and procedures
    3. Documentation for services provided
    4. Documentation for physician reports
    5. Timely and accurate patient reporting

III. Ensure compliance with all local, state, regional, and federal requirements for laboratory operations and personnel training and credentialing
A. Comply with current federal, regional, and local regulations governing the laboratory
    1. Health care professional credentialing
        a. Certification

    b. Licensure
    c. Registration
  2. Credentialing agencies
    a. National organizations
    b. State agencies
  3. Regulatory agencies
    a. Food and Drug Administration
    b. Nuclear Regulatory Commission
    c. Occupational Safety and Health Administration
    d. U.S. Department of Transportation
    e. State agencies
  4. Advisory agencies
    a. International Commission on Radiation Units and Measurement
    b. National Council on Radiation Protection and Measurement
    c. National Academy of Sciences Advisory Committee on the Biologic Effects of Ionizing Radiation
    d. United Nations Scientific Committee on the Effects of Atomic Radiation

B. Conduct procedures and provide documentation for laboratory accreditation
  1. Purpose of accreditation
    a. Quality of care
    b. Reimbursement
  2. Health care facility accreditation
    a. Governmental
    b. National
      i. Intersocietal Commission for the Accreditation of Nuclear Medicine Laboratories
      ii. American College of Radiology
    c. State
  3. Standards of accreditation

C. Implement Joint Commission standards
  1. The accreditation process
  2. Sentinel events
  3. National patient safety goals
  4. The Joint Commission quality report
  5. Accreditation participation requirements
  6. Standards, rationales, elements of performance, and scoring
    a. Section 1: Patient-focused functions
      i. Ethics, fights, and responsibilities (RI)
      ii. Provision of care, treatment, and services (PC)
      iii. Medication management (MM)
      iv. Surveillance, prevention, and control of infection (IC)
    b. Section 2: Organization functions
      i. Improving organization performance (PI)

ii. Leadership (LD)
iii. Management of the environment of care (EC)
iv. Management of human resources (HR)
v. Management of information (IM)

c. Section 3: Structures with functions
i. Medical staff (MS)
ii. Nursing (NR)

IV. Partner with health care managers and health care providers to assess, coordinate, and improve health care

A. Structure department staffing for quality care delivery and employee satisfaction
1. Recruitment and staffing programs
2. Effective interviewing techniques and procedures
3. Staffing ratios
4. Retention programs

B. Conduct process for departmental strategic planning per institutional mission
1. Demand forecasting through market research
2. Implementation of measurable goals and objectives
3. Outcomes measurements
4. Market position
5. Alliance development

C. Advocate for quality patient care and assist patients in dealing with system complexities
1. Customer satisfaction methodologies
2. Implementation of continuous quality improvement methods to enhance customer satisfaction
3. Development and implementation of medical protocols to adhere to accepted standards of care
4. Patient management coordination
a. Appointment times
b. Resource availability
c. Transportation

V. Understand the reciprocal impact of personal professional practice, health care teams, and the health care organization on the community and society

A. Identify ways in which an NMAA may interact with health care professionals, health administrators, and community groups to positively impact the health and well-being of one's community

B. Gather information (eg, demographics and sociocultural beliefs) about the community in which one works and practices that affect health and disease

C. Participate in interdisciplinary team discussions, demonstrating the ability to accept, consider, and respect the opinions of the other

team members while contributing an appropriate level of expertise to patient care
1. Grand rounds
2. Committees internal to the institution
3. Interdepartmental projects or reports
4. Interdisciplinary team discussions
5. Interdisciplinary quality improvement projects
6. Accreditation processes
7. Community service

VI. Describe the major legal mechanisms for oversight and regulation of medical practice, including those related to licensure and discipline, negligence, malpractice, risk management, physician-patient relationships, confidentiality, and patient's rights
- A. Compare civil and criminal law
  1. Legal issues
  2. Civil liability
  3. Intentional torts
     a. Elements
     b. Assault
     c. Battery
     d. False imprisonment
     e. Emotional distress
     f. Fraud
     g. Invasion of privacy
     h. Defamation
        i. Slander
        ii. Libel
           1) Vicarious liability
  4. Unintentional torts/negligence
     a. Elements
     b. Contributory
     c. Comparative
  5. Criminal law
     a. Criminal negligence
     b. Falsification of records
     c. Drugs
     d. Fraud
     e. Patient abuse
     f. Theft
- B. Explain civil procedures
  1. Civil procedures
     a. Pleadings
     b. Summons and complaint
     c. Discovery
     d. Motions

e. Trial procedure
f. Evidence
g. Verdict
h. Appeals

C. Follow the prescribed standard of care for the NMAA
   1. Definitions
   2. Burden of proof
   3. Res Ipsa Loquitur
   4. Respondeat Superior
D. Distinguish between the different types of consent
   1. Informed
   2. Uninformed
   3. Implied
E. Understand and comply with the patient's directives in regard to medical care
   1. Living wills
   2. Do-not-resuscitate orders
   3. Power of attorney
F. Comply with employer and employee legal obligations
   1. Labor laws
   2. Unions
   3. Discrimination laws
   4. Harassment in the workplace
      a. Quid pro quo
      b. Hostile work environment
      c. Protected persons
      d. Unwelcome conduct
      e. Employer's liability
      f. Sexual harassment
      g. Harassment
      h. Assault and battery
      i. Infliction of emotional distress
      j. Invasion of privacy
      k. Wrongful discharge
   5. Conditions of employment
      a. Position descriptions
      b. Drug screening
      c. Background checks
      d. Misrepresentation
   6. Liability coverage
      a. Employer
      b. Personal
   7. Equipment safety regulations
   8. Safety
      a. Hazard identification and control
      b. Policies and procedures

        i. Occupational Safety and Health Administration
        ii. Centers for Disease Control and Prevention
        iii. Facility
        iv. State
    c. Employee training
    d. Fire, electrical, and chemical safety
    e. Magnetic fields and radiofrequency safety
    f. Injury prevention
    g. Safety/quality improvement committees
    h. Risk management
9. Whistleblower protection

Appendix I

Patient Assessment

Overview for the Patient Assessment, Management and Education Curriculum

The content outlined below was developed by the American Society of Radiologic Technologists for the Radiologist Assistant Curriculum guide. The Advanced Practice Task Force felt that this content reflects similar practices for the NMAA and chose to adopt this curriculum content rather than develop new content. This appendix is reprinted with permission by ASRT. Where the phrase "RA" or "Radiologist Assistant" is used, the reader may substitute "NMAA" or Nuclear Medicine Advanced Associate.

Patient Assessment, Management and Education

Description

Content reinforces the use of the clinical thinking model to aid in patient assessment to include interviewing skills and assessment techniques. The focus is on the application of anatomy and physiology knowledge to assist in patient assessment and management.

Prerequisite or Corequisite

It is required that radiologist assistants possess or obtain certification in advanced cardiac life support (ACLS) in support of their role in the patient care setting.

Objectives

1. Apply the clinical thinking process in the patient care setting.
2. Conduct interviews to confirm and document a patient's medical history.
3. Perform a physical assessment of the patients undergoing radiologist assistant directed exams and document findings.
4. Obtain and analyze a patient's vital signs.
5. Document initial observations made during an examination and contribute to the planning and management of the patient.
6. Participate in patient education.
7. Participate in relationship-centered patient care.
8. Adapt communications techniques to address patient needs.
9. Review patient medical data for indications and contraindications with patient procedure.

Patient Assessment, Management and Education Curriculum Content

I. The Clinical Thinking Model
- A. Identify abnormal findings
- B. Anatomically localize findings
- C. Interpret findings in terms of probable causes
- D. Develop one or two hypotheses about the nature of the patient's problem
  1. Select the most specific and central finding
  2. Match findings against conditions
  3. Weigh competing possibilities
  4. Give attention to potentially life-threatening and treatable conditions
- E. Identify steps and procedures to test the hypothesis
- F. Establish a working definition of the problem

II. Interviewing and Patient History
- A. Structure and purposes of the medical history
- B. Setting the stage for the interview
- C. Learning about the patient's illness
  1. Skills of good interviewing
     - a. Nonverbal communication
     - b. Facilitation
     - c. Reflection
     - d. Clarification
     - e. Summarization
     - f. Validation
     - g. Empathic responses
     - h. Transitions
  2. Challenges to the clinician
     - a. Patients at different ages and comprehension abilities
     - b. Situations that call for specific responses
  3. Components of a comprehensive history
     - a. Preliminary data
       1) Date and time of history
       2) Identifying data
       3) Reliability
     - b. Chief complaint
     - c. Present illness
     - d. Past history
     - e. Current health status

f. Review of systems for indications/contraindications to procedure or change in patient management
1) General
2) Skin
3) Head, eyes, ears, nose and throat
4) Respiration
5) Cardiac
6) Gastrointestinal
7) Urinary
8) Male genital
9) Female genital
10) Peripheral vascular
11) Musculoskeletal
12) Neurologic
13) Hematologic
14) Endocrine
15) Psychiatric

4. ICD-9 code (International Classification of Diseases, 9th Edition)

D. Physical assessment of the patient
1. Level of consciousness
2. Signs of distress
3. Apparent state of health
4. Vital statistics
5. Skin condition
6. Posture, gait, motor activity
7. Personal grooming
8. Odors of breath and body
9. Facial expression
10. Vital signs
a. Pulse
b. Respiration
c. Blood pressure
d. Body temperature

E. Documentation of findings
1. Characteristics required to describe a symptom
a. Site
b. Severity
c. Quality
d. Time course
e. Setting
f. Aggravating and relieving factors
g. Associated features

III. Performing the Patient Physical Assessment
    A. Patient preparation
    B. Method and technique for obtaining a patient's vital signs
        1. General considerations
        2. Temperature
        3. Respiration
        4. Pulse
            a. Regular
            b. Irregular
        5. Blood pressure
            a. Normal
            b. Isolated systolic hypertension
            c. Mild hypertension
            d. Moderate hypertension
            e. Severe hypertension
            f. Crisis hypertension

IV. Assessment of the Abdomen
    A. General considerations
    B. Patient preparation
    C. Characteristics of common signs and symptoms associated with causes of abdominal pain such as:
        1. Peptic ulcer
        2. Biliary colic and acute cholecystitis
        3. Renal colic
        4. Acute pancreatitis

V. Assessment of the Thorax and Lungs
    A. General considerations
        1. Patient preparation
        2. Finger clubbing, cyanosis, air hunger
    B. Inspection
        1. Respiratory rate, rhythm, depth and breathing effort
        2. Wheezes or unusual sounds
        3. Chest symmetry
        4. Palpation
        5. Auscultation
    C. Percussion
        1. Technique
        2. Posterior chest
            a. Diaphragmatic excursion

3. Anterior chest
    a. Interpretation
        1) Flat or dull
        2) Normal
        3) Hyperresonant

D. Auscultation
    1. Posterior chest
    2. Anterior chest
    3. Interpretation
        a. Crackles
        b. Wheezes
        c. Rhonchi

E. Special tests

F. Characteristics of common signs and symptoms associated with causes of chest pain, such as:
    1. Angina pectoris
    2. Myocardial infarction
    3. Acute pericarditis
    4. Pleurisy
    5. Esophageal disease/disorder
    6. Pneumothorax
    7. Pulmonary embolus

G. Characteristics of common signs and symptoms associated with shortness of breath, such as:
    1. Left ventricular failure and pulmonary edema
    2. Bronchial asthma
    3. Chronic obstructive airway disease
    4. Pneumothorax
    5. Metabolic acidosis
    6. Neurologic disease/damage
    7. Tumor
    8. Infection
    9. Anxiety – emotions

VI. Assessment of the Cardiovascular System
    A. General considerations
    B. Arterial pulses
        1. Rate and rhythm
        2. Amplitude and contour
        3. Auscultation for bruits and thrills
        4. Blood pressure
            a. Interpretation

b. Problems/situations
1) Apprehensive patient
2) Obese arm
3) Leg pulse and pressures
4) Weak or inaudible sounds
5) Arrhythmias

C. Jugular venous pressure (JVP)
1. Pulsations

D. Precordial movement

E. Auscultation
1. Interpretation

VII. Assessment of the Musculoskeletal System

A. Inspection and palpation

B. Range of motion and maneuvers
1. Temporomandibular joint
2. Shoulder
3. Elbow
4. Wrist and hand
5. Spine
6. Hip
7. Knee
8. Ankle and foot

C. Characteristics of common signs and symptoms associated with causes of joint pain, such as:
1. Rheumatoid arthritis
2. Osteoarthritis
3. Gout
4. Ankylosing spondylitis
5. Psoriatic arthritis

VIII. Assessment of the Peripheral Vascular System

A. Inspection and palpation
1. Arms
2. Legs
3. Pulses

B. Evaluation for edema

IX. Assessment of the Nervous System

A. Mental status and speech

B. Knowledge for interpretation of neurology and assessment data

C. Characteristics of common signs and symptoms associated with sudden loss of consciousness, such as:
    1. Vasovagal response
    2. Epilepsy
    3. Cardiac etiology
    4. Postural hypotension
    5. Hypoglycemia
    6. Cerebrovascular accident (CVA)

X. Assessment of the Breasts and Axillae
  A. Breast inspection
    1. Appearance of the skin
    2. Size and symmetry
    3. Contour
    4. Nipple characteristics
  B. Breast palpation – clinical exam
    1. Consistency of tissues – lumps, cysts
    2. Tenderness
    3. Nodules – lymph, size, shape, adherence
    4. Nipple
    5. Lumps, thickness
  C. The axillae
    1. Inspection
    2. Palpation
  D. General considerations
    1. Aging and hormonal effects on breast characteristics
  E. Patient education
    1. Breast self examination
    2. Breast cancer risk factors
    3. Breast cancer screening

XI. The Foundation of Patient Care Delivery
  A. Relationships formed in the delivery of care
  B. Relationship-centered care
    1. Dimensions of relationship-centered health care
      a. The patient-radiologist assistant relationship
      b. The community-radiologist assistant relationship
      c. The radiologist assistant-radiologist assistant relationship
  C. Knowledge, skills and values of relationship-centered care
    1. Self awareness
    2. Patient experience of health and illness
    3. Developing and maintaining caring relationships
    4. Effective communication

Appendix II

Pathophysiology

Overview for the Pathophysiology Curriculum

The content outlined below was developed by the American Society of Radiologic Technologists for the Radiologist Assistant Curriculum guide. The Advanced Practice Task Force felt that this content reflects similar practices for the NMAA and chose to adopt this curriculum content rather than develop new content. This appendix is reprinted with permission by ASRT. Where the phrase "RA" or "Radiologist Assistant" is used, the reader may substitute "NMAA" or Nuclear Medicine Advanced Associate.

Pathophysiology Description

Content is designed to focus on the characteristics and manifestations of disease caused by alterations or injury to the structure or function of the body. Concepts basic to pathophysiology as well as common disease conditions are studied and serve as prototypes in understanding alterations that occur in the major body systems. Emphasis is placed on the characteristic manifestations and image correlation with these pathologies observed through diagnostic imaging.

Objectives

1. Define terminology used in the study of disease.
2. Describe the general principles and mechanisms of disease including neoplasms.
3. Describe the physiological response in inflammation and cell injury due to pathological insult.
4. Differentiate between the processes of various types of cellular and tissue injury and adaptive mechanisms.
5. Describe the disorders of fluid and electrolyte balance.
6. Assess the relationship between morphologic and functional changes to the origins of signs and symptoms and to their clinical significance.
7. Differentiate between the mechanisms of tissue repair and healing.
8. Identify common tests used to diagnose disease or injury.
9. Examine the role of genetics in disorders.
10. Examine the role of nutrition in disorders.
11. Describe the common etiology, signs and symptoms, diagnostic tests, typical course and management of common diseases and disorders of body systems.
12. Discuss the common effects of aging on each of the body systems.
13. Identify etiologic influence in the identification of prevention and screening programs for the common diseases.
14. Assess the epidemiological influence in the identification and treatment of disorders or injuries.

Pathophysiology Curriculum Content

I. Alterations in Cell Function and Growth
- A. Cell and tissue characteristics
  1. Functional components of the cell
  2. Cellular energy metabolism
  3. Tissue types
- B. Cellular adaptation and injury
  1. Cellular adaptation
  2. Cell injury
  3. Types of cell injury
  4. Genetic control of cell function and inheritance
  5. Genetic control of cell function
  6. Chromosomes
  7. Patterns of inheritance
  8. Gene mapping
- C. Genetic and congenital disorders
  1. Genetic chromosomal disorders
  2. Disorders due to environmental agents
  3. Disorders due to environmental influences
- D. Alterations in cell differentiation: neoplasia
  1. Concepts of cell growth and replication
  2. Terminology
     a. The cell cycle
     b. Cell proliferation
     c. Cell differentiation
  3. Characteristics of benign and malignant neoplasms
  4. Staging and grading of tumors
  5. Carcinogenesis
  6. Cancer treatment
- E. Tissue repair and wound healing
  1. Regeneration
  2. Connective tissue repair
  3. Factors that affect wound healing

II. Alterations in Body Defenses
- A. Stress and adaption
  1. Stress
  2. Adaptation
  3. Treatment of stress
- B. Alterations in temperature regulation
  1. Body temperature regulation
     a. Mechanism of heat production
     b. Mechanism of heat loss

2. Increased body temperature
    a. Fever
    b. Hyperthermia
3. Decreased body temperature
    a. Hypothermia

C. Infectious processes
1. Infectious disease
2. Host-parasite relationship
3. Manifestations of infectious disease

D. Inflammation and repair
1. The inflammatory response
2. Systematic signs of inflammation
3. Tissue healing and repair

E. The immune response
1. The immune system
2. Developmental aspects of the immune system
    a. Transfer of immunity from mother to infant
3. Immune mechanism

F. Alterations in the immune response
1. Immunodeficiency disease
2. Allergy and hypersensitivity
3. Transplant rejection
4. Autoimmune disease

G. Acquired immunodeficiency syndrome (AIDS)
1. Transmission of human immunodeficiency virus (HIV) infection
2. Pathophysiology of AIDS
    a. Diagnosis
    b. Phases of the disease
    c. Clinical course
    d. Early management
    e. Treatment

H. White blood cell and lymphoproliferative disorders
1. Lymphoreticular system
2. Disorders of white blood cells
3. Lymphoproliferative disorders

I. Alterations in hemostasis and blood coagulation
1. Mechanisms associated with hemostasis
2. Disorders of hemostasis and blood coagulation

III. Alterations in Oxygenation of Tissues
- A. Blood cells and the hematopoietic system
  - 1. Composition of blood and blood formation
    - a. Plasma
    - b. Plasma proteins
    - c. Blood cells
    - d. Hematopoiesis
    - e. Blood count
    - f. Erythrocyte sedimentation rate
    - g. Bone marrow aspiration and biopsy
- B. The red blood cell and alterations in oxygen transport
  - 1. The red blood cell
  - 2. Anemia
  - 3. Transfusion therapy
  - 4. Polycythemia
  - 5. Age-related changes in red blood cells
- C. The circulatory system and control of blood flow
  - 1. Functional organization of the circulatory system
  - 2. Blood vessel structure
  - 3. Principles of blood flow
  - 4. Control of blood flow
- D. Alterations in blood flow
  - 1. Mechanisms of vessel obstruction
  - 2. Alterations in arterial flow
  - 3. Alterations in venous flow
  - 4. Impairment of local blood flow: pressure sores
- E. Control of arterial blood pressure
  - 1. Arterial pressure pulses
  - 2. Blood pressure measurement
  - 3. Determinants of blood pressure
  - 4. Control of blood pressure
  - 5. Pulmonary blood pressure
- F. Alterations in blood pressure
  - 1. Hypertension
  - 2. Orthostatic hypotension
- G. Control of cardiac function
  - 1. Functional anatomy of the heart
  - 2. Conduction system and electrical activity of the heart
  - 3. The cardiac cycle
  - 4. Regulation of cardiac performance
  - 5. Coronary circulation
  - 6. Diagnostic methods
- H. Alterations in cardiac function
  - 1. Disorders of the pericardium
  - 2. Coronary artery disease

3. Dysrhythmias and conduction disorders
    a. Types of dysrhythmias
        1) Sinus node
        2) Premature atrial contraction
        3) Atrial flutter
        4) Atrial fibrillation
        5) Junctional
        6) Ventricular
    b. Diagnostic methods
4. Disorders of the endocardium
5. Valvular disease
6. Cardiomyopathies
7. Congenital heart disease
8. Diagnosis and treatment

I. Heart failure
1. Compensatory mechanisms
2. Congestive heart failure
3. Acute pulmonary edema
4. Diagnosis and treatment

J. Circulatory shock
1. Types of shock
2. Manifestations
3. Complications of shock
4. Treatment measures

K. Control of respiratory function
1. Structural organization of the respiratory system
2. Exchange of gases between the atmosphere and the alveoli
3. Exchange and transport of gases in the body
4. Control of respiration

IV. Alterations in Respiratory Function
A. Respiratory infections
B. Disorders of the pleura
C. Obstructive lung disorders
D. Interstitial lung disorders
E. Pulmonary vascular disorders
F. Cancer of the lung

V. Alterations in Control of Ventilation and Respiratory Failure
A. Alterations in the control of ventilation
B. Acute respiratory failure

VI. Alterations in Body Fluids
- A. Alterations in body fluids and electrolytes
  - 1. Regulation of body fluids
  - 2. Alterations in body water
  - 3. Electrolytic disorders
- B. Alterations in the distribution of body fluids
  - 1. Regulation of interstitial fluid volume
  - 2. Edema
- C. Alterations in acid-base balance
  - 1. Regulation of acid-base balance
- D. Control of renal function
  - 1. Kidney structure and function
  - 2. Tests of renal function
  - 3. Actions of diuretics
- E. Alterations in renal function
  - 1. Congenital disorders
  - 2. Urinary tract infections and pyelonephritis
  - 3. Obstructive disorders
  - 4. Disorders of the nephron and glomerulus
  - 5. Neoplasms
- F. Renal failure
  - 1. Acute renal failure
  - 2. Chronic renal failure

VII. Alterations in genitourinary function
- A. Alterations in urine elimination
  - 1. Control of urine elimination
  - 2. Alterations in bladder function
  - 3. Cancer of the bladder
- B. Structure and function of the male genitourinary system
  - 1. Genitourinary structures
  - 2. Reproductive function
- C. Alterations in the structure and function of the male genitourinary system
  - 1. Disorders of the penis
  - 2. Disorders of the scrotum and testes
  - 3. Disorders of the prostate
- D. Structure and function of the female reproductive system
  - 1. Reproductive structures
  - 2. The menstrual cycle
  - 3. The breast
  - 4. Alterations in the structure and function of the female reproductive system
  - 5. Menstrual disorders
  - 6. Alterations in uterine position and pelvic support
  - 7. Inflammation and infection

8. Benign growths and aberrant tissue
9. Cancer of the genital structures
10. Diseases of the ovary
11. Diseases of the breast

E. Sexually transmitted diseases
1. Major sexually transmitted diseases
2. Minor sexually transmitted diseases

VIII. Alterations in Endocrine Function, Metabolism and Nutrition
A. Mechanism of endocrine control
1. The endocrine system
2. General aspects of altered endocrine function

B. Control of metabolism
1. Metabolism
2. Hormonal control of metabolism

C. Alterations in endocrine control of growth and metabolism
1. Growth hormone disorders
2. Thyroid disorders
3. Disorders of adrenal cortical function

D. Diabetes mellitus
1. Types of diabetes
2. Manifestations
3. Diagnosis and management

E. Control of gastrointestinal function
1. Structure and organization of the gastrointestinal tract
2. Motility
3. Secretory function
4. Digestion and absorption

F. Alterations of gastrointestinal function
1. Manifestations of gastrointestinal tract disorders
a. Anorexia
b. Nausea
c. Vomiting
d. Gastrointestinal tract bleeding
2. Disorders of the esophagus
a. Dysphagia
b. Esophageal diverticulum
c. Gastroesophageal reflux disease
d. Cancer of the esophagus
3. Disorders of the stomach
a. Gastric mucosal barrier
b. Gastritis
c. Ulcer disease
d. Cancer of the stomach

4. Disorders of the small and large bowel
    a. Irritable bowel syndrome
    b. Inflammatory bowel disease
    c. Infectious colitis
    d. Diverticular disease
    e. Appendicitis
    f. Alterations in intestinal motility
    g. Alterations in intestinal absorption
    h. Neoplasm
    i. Obstruction
5. Disorders of the peritoneum
    a. Peritonitis
6. Alterations in the integrity of the gastrointestinal tract wall
7. Malabsorption

G. Alterations in function of the hepatobiliary system and pancreas
1. Hepatobiliary function
2. Alterations in liver function
3. Alterations in gallbladder function
4. Alterations in pancreatic function

IX. Alterations in Neuromuscular Function
A. Properties of the nervous tissue
1. Nervous tissue cells
2. Excitable properties of nervous tissue

B. Control of neuromuscular and autonomic nervous system function
C. Development and segmental organization of the nervous system
1. The spinal cord
2. The brain
3. Supporting and protective structures
4. The autonomic nervous system
5. Higher-order functions

D. Disorders of cerebral function
1. Increased cranial pressure
2. Infections
3. Seizures
4. Consciousness and unconsciousness
5. Organic brain syndrome

E. Alterations in motor function
1. Control of motor function
2. Alterations in cerebral circulation
3. Disorders of the myelin
4. Spinal cord injury
5. Alterations in neuromuscular function

F. Pain
    1. Pain mechanisms and response
    2. Pain disorders
    3. Treatment for pain

X. Alterations in Skeletal Support and Movement
    A. Structure and function of the skeletal system
        1. Characteristics of skeletal tissue
        2. Joints and articulations
    B. Alterations in skeletal function: trauma and infection
        1. Injury and trauma of musculoskeletal structures
        2. Bone infections
            a. Osteomyelitis and osteitis
            b. Tuberculosis of the bone or joint
    C. Alterations in skeletal function: congenital disorders, metabolic bone disease and neoplasms
        1. Alterations in skeletal growth and development
            a. Bone growth and remodeling
        2. Metabolic bone disease
    D. Neoplasms
        1. Benign
        2. Malignant
        3. Metastatic
    E. Alterations in skeletal function
        1. Rheumatoid arthritis
        2. Osteoarthritis
        3. Spondyloarthropathies
        4. Crystal-induced arthropathies
        5. Gout

XI. Alterations in Skin Defenses
    A. Alterations in skin function and integrity
        1. Structure of the skin
        2. Manifestations of skin disorders
        3. Lesions and rashes
        4. Pruritus
        5. Dry skin
    B. Burns
        1. Classification
        2. Systematic complications
        3. Treatment
        4. Rehabilitation

XII. Concepts of Altered Health in Children: Common Health Problems
- A. Infants
- B. Early childhood
- C. Adolescence

XIII. Theories of Aging
- A. Physiologic changes of aging
  1. Skin
  2. Structure and musculoskeletal function
  3. Cardiovascular function
  4. Respiratory function
  5. Neurologic function
  6. Special senses
  7. Immune function
  8. Gastrointestinal function
  9. Renal function
  10. Genitourinary function
- B. Functional problems of aging
  1. Functional assessment
  2. Urinary incontinence
  3. Instability and falls
  4. Sensory impairment
  5. Depression
  6. Dementia
  7. Delirium

Appendix III

Pharmacology

Overview for the Pharmacology Curriculum

The content outlined below was developed by the American Society of Radiologic Technologists for the Radiologist Assistant Curriculum guide. The Advanced Practice Task Force felt that this content reflects similar practices for the NMAA and chose to adopt this curriculum content rather than develop new content. This appendix is reprinted with permission by ASRT. Where the phrase "RA" or "Radiologist Assistant" is used, the reader may substitute "NMAA" or Nuclear Medicine Advanced Associate.

Pharmacology and Clinical Decision-Making in Radiology

Description

This content is designed to enhance the radiologist assistant's knowledge of pharmaceuticals commonly used by and given to radiology patients. The content addresses the intent of the drug and its effect on diseases, conditions and physiology. After learning this content and possessing the appropriate clinical skills, the radiologist assistant will analyze the patient's current condition with regards to medications and other therapies and determine the significance to the radiology procedure. He or she will suggest the appropriate action plan for the procedure for the specific patient. The radiologist assistant will be responsible for the delivery and documentation of procedure-related pharmaceuticals and for patient assessment and monitoring before, during and after the procedure and drug administration. It is essential the radiologist assistant have a clear understanding of the laws and policies related to pharmaceuticals in his or her practice setting.

Objectives

1. Identify key drug laws impacting consumer safety.
2. Identify the five schedules of controlled substances and cite a drug example of each.
3. Identify the role of the Food and Drug Administration (FDA) and Drug Enforcement Administration (DEA) in the regulation and control of consumer drugs.
4. Explain strategies for health care workers involved in dispensing medications to comply with the restrictions of drug laws.
5. Identify common abbreviations and symbols used for medication orders.
6. Differentiate among drug names (generic, chemical, trade, official).
7. Explain the restrictions of drug sales implied by the designation of: over the counter, legend drug and controlled substance.
8. Research drug reference information from standard pharmacological resources.

9. Describe the biological processing of drugs in the body.
10. List common variables affecting drug action within the body.
11. Describe common unexpected responses to drugs.
12. Describe the purposes for and principles of clinical drug trials.
13. Accurately perform calculations for drug dose delivery.
14. Describe various forms of drug preparations and supplies.
15. Incorporate the principles of responsible drug administration in the patient care setting to prevent medication error.
16. Use proper medical techniques of drug administration for common routes of delivery.
17. Describe dose modifiers for pediatric and geriatric patients.
18. Identify factors that may lead to cumulative effects in the elderly.
19. List the categories of drugs that frequently cause adverse side effects in older adults.
20. Identify guidelines and competencies for sedation and analgesia according to Joint Commission requirements.
21. Describe the side effects and cautions with preoperative medications.
22. Describe the methods for administering local anesthetics.
23. Describe the goals and desired effects of conscious sedation.
24. Describe the undesirable effects of conscious sedation.
25. Perform assessments of the patient and patient's records prior to and during examinations requiring the use of conscious sedation.
26. Participate in patient management during examinations that require the use of conscious sedation.
27. Identify drugs for sedation and analgesia.
28. Recognize the side effects, contraindications and interactions common to each category of anti-infectives.
29. List the side effects common to antineoplastic agents.
30. Explain precautions in caring for patients receiving radioactive isotopes.
31. Demonstrate an awareness of the clinical side effects of major analgesics, sedatives and hypnotics.
32. Recognize common seizure disorder medications.
33. Recognize the side effects, contraindications and interactions for psychotropic medications in common use.
34. Identify the uses, side effects, cautions and interactions associated with the use of diuretics.
35. Describe the side effects, contraindications and interactions of antacids, antiulcer agents,antidiarrheal, antiflatulents, cathartics and laxatives and antiemetics.
36. Describe conditions that may be treated with corticosteroids.
37. List potential side effects of long-term steroid therapy.
38. Identify diabetes medications.

39. Identify the symptoms of hyperglycemia and hypoglycemia, and appropriate interventions.
40. Identify the use, side effects and precautions associated with estrogens and progestins.
41. Identify types of antiarrhythmics and the side effects.
42. Identify types of antihypertensives and the side effects.
43. Identify types of coronary vasodilators and the side effects.
44. Compare and contrast heparin and coumarin derivatives in terms of administration, action and antidotes.
45. Describe the uses of and precautions necessary with oxygen therapy.
46. Identify the uses, side effects and contraindications for bronchodilators and antitussives.
47. Describe the action and uses of antihistamines and decongestants.
48. Identify commonly used skeletal muscle relaxants and the side effects.
49. Describe medications used for osteoporosis therapy.

Pharmacology Curriculum Content

I. Consumer Safety and Drug Regulations
- A. Drug laws
  - 1. 1906 Pure Food and Drug Act
    - a. Drug standards
  - 2. 1938 Federal Food, Drug, and Cosmetic Act
- B. 1970 Controlled Substances Act
  - 1. Five schedules of controlled substances
- C. Role of the FDA
- D. Role of the DEA
- E. Health care workers and the law

II. Abbreviations and Systems of Measurement
- A. Common abbreviations for medication orders
- B. Medication order components
  - 1. Date
  - 2. Patient's name
  - 3. Medication name
  - 4. Dosage or amount of medication
  - 5. Route/manner of delivery
  - 6. Time to be administered or frequency

III. Pharmaceutical Terminology References
- A. Classifications
- B. Identifying names
  - 1. Generic name
  - 2. Chemical name
  - 3. Trade name
  - 4. Official name (as it appears in the United States Pharmacopoeia - USP/National Formulary - NF)
- C. Legal terms referring to drugs
  - 1. Over-the-counter
  - 2. Legend (or prescription) drug
  - 3. Controlled substance
- D. Terms indicating drug actions
  - 1. Indications
  - 2. Actions
  - 3. Contraindications
  - 4. Cautions
  - 5. Side effects and adverse reactions
  - 6. Interactions

IV. Sources of Drug Information
- A. Drug references
  1. Physicians' Desk Reference Companion Guide
  2. United States Pharmacopoeia/dispensing information
  3. American Hospital Formulary Service
  4. Compendium of Drug Therapy (Physician's ed.)
  5. Electronic drug databases and analysis

V. Pharmacotherapeutic Decision-Making
- A. Effects of drugs
  1. Systemic effects
  2. Local effects
- B. Pharmacokinetics
  1. Absorption
  2. Distribution
  3. Metabolism
  4. Excretion
  5. Other variables
     - a. Age
     - b. Weight
     - c. Sex
     - d. Psychological state
     - e. Drug interactions
       1) Synergism
       2) Potentiation
       3) Antagonism
     - f. Dosage
       1) Minimum and maximum dose
       2) Loading dose
       3) Maintenance dose
       4) Toxic dose
       5) Lethal dose
       6) Therapeutic dose
     - g. Route
       1) GI tract/enteral
       2) Parenteral
       3) Inhalation respiratory
- C. Undesirable responses to drugs
  1. Teratogenic effect
  2. Tolerance
  3. Dependence
  4. Hypersensitivity
  5. Anaphylactic reaction

VI. Clinical Drug Trials
- A. Principles of the controlled trial
- B. Pragmatic and explanatory trials
- C. Protection of subjects
- D. Efficacy assessment
- E. Randomization
- F. Single-blind and double-blind trials
- G. Sample size
- H. Choice of comparator
- I. Preparing a protocol
- J. Auditing the clinical trial

VII. Safe Dosage Preparation
- A. Calculation guidelines
- B. Basic calculation
- C. Ratio and proportion
- D. Pediatric dosage
- E. Geriatric dosage

VIII. Responsibilities and Principles of Drug Administration
- A. Responsible drug administration
- B. Medication error avoidance

IX. Administration Routes, Techniques and Preparations
- A. Gastrointestinal
  1. Oral
  2. Nasogastric tube
  3. Gastric tube
  4. Rectal
- B. Parenteral
  1. Buccal
  2. Transcutaneous
  3. Inhalation therapy
  4. Injections
  5. Topical
  6. Application to mucous membranes
- C. Appropriate documentation of administration and patient outcomes
  1. Dose
  2. Time
  3. Route
  4. Location of injections
  5. Sign or initial record
  6. Documentation involving narcotics and any medications

X. Pediatric Considerations
- A. Anatomic and physiologic variables
- B. Pharmacokinetic and pharmacodynamic considerations
- C. Concerns with neonates
  1. Blood-brain barrier permeability
  2. Renal function
- D. Factors affecting dose
  1. Body surface area
  2. Weight
  3. Age

XI. Geriatric Considerations
- A. Anatomic and physiologic variables
- B. Pharmacokinetic and pharmacodynamic considerations
- C. Drugs and geriatrics
  1. Cumulative effect of drugs
  2. Gray list drugs (inappropriate for use in nursing homes)
  3. Drugs that may cause mental impairment
  4. Nonsteroidal anti-inflammatory drugs
  5. Polypharmacy

XII. Preoperative Medication and Local Anesthetics
- A. Sedation and analgesia
  1. Policies and procedures
  2. Guidelines
  3. Competencies
- B. Typical exams requiring conscious sedation
  1. Endoscopic exams
  2. Vascular and cardiac catheterizations
  3. Bronchoscopy
  4. Bone marrow aspiration
  5. Computed tomography
  6. Magnetic resonance imaging
- C. Applied definitions
  1. Conscious sedation and analgesia
  2. Premedication
  3. General anesthesia
  4. Local anesthesia
  5. Postprocedural and postoperative pain management
- D. Conscious sedation goals
  1. Altered level of consciousness and mood
  2. Maintenance of consciousness
  3. Cooperation

4. Elevation of pain threshold
5. Minimal variation of vital signs
6. Rapid degree of amnesia
7. Safe, prompt recovery and ambulation

E. Desired effects of conscious sedation
1. Relaxation
2. Cooperation
3. Purposeful responses to verbal communication and instruction
4. Purposeful responses to tactile stimulation
5. Easy and prompt arousal from sleep

F. Undesirable effects of conscious sedation
1. Deep unarousable sleep
2. Hypotension
3. Bradycardia
4. Agitation and combativeness
5. Hypoventilation
6. Respiratory depression
7. Airway obstruction
8. Apnea

G. Assessment and documentation prior to starting a study
1. Informed consent
2. Preprocedural assessment
3. Laboratory evaluation

H. Assessments during a procedure
1. Vital signs
2. The dose, route, medication, time of administration and effects of conscious sedation agents and other medications
3. Oxygen therapy
4. Level of consciousness throughout the procedure
5. Any reactions and required interventions
6. Type and amount of IV fluids, blood and blood products used

I. Airway management
1. Positioning of the airway
2. Use of oropharyngeal and nasopharyngeal airways
3. Application of positive pressure ventilation
a. Ambu Bag use

J. The recovery period
1. Preprocedural/presedation state
a. Airway
b. Breathing
c. Level of consciousness

K. Drugs used for sedation and analgesia

XIII. Vitamins, Anti-infective and Antineoplastic Drugs
- A. Vitamins, minerals and herbs and alternative medicines
  1. Impact on procedures
  2. Interactions
- B. Anti-infective drugs
  1. Impact on procedures
  2. Interactions
- C. Antineoplastic drugs
  1. Impact on procedures
  2. Interactions

XIV. Drugs by Body System
- A. Autonomic nervous system drugs
  1. Andrenergics (Sympathomimetics)
  2. Adrenergic blockers (Alpha and beta blockers)
  3. Cholinergics (Parasympathomimetics)
  4. Cholinergic blockers (Anticholinergics)
- B. Central nervous system drugs
  1. Analgesics, sedatives, and hypnotics
     a. Analgesics
     b. Sedatives and hypnotics
  2. Anticonvulsants, antiparkinsonian drugs, and agents for Alzheimer disease
     a. Anticonvulsants
     b. Drugs for absence epilepsy
     c. Drugs for grand mal and psychomotor epilepsy
     d. Antiparkinsonian drugs
     e. Agents for Alzheimer disease
  3. Psychotropic medications, alcohol and drug abuse
     a. CNS stimulants
     b. Antidepressants
     c. Antimanic agents
     d. Anxiolytics
     e. Antipsychotic medications
     f. Alcohol
     g. Drug abuse
- C. Urinary system drugs
  1. Diuretics
  2. Medications for gout
  3. Antispasmodics
  4. Cholinergics
  5. Analgesics
  6. Treatment of benign prostatic hypertrophy
  7. Alpha blockers

D. Gastrointestinal drugs
    1. Antacids
    2. Agents for treatment of ulcers and gastroesophageal reflux disease
    3. Antispasmodics/anticholinergics
    4. Agents for treatment of inflammatory bowel disease
    5. Antidiarrhea agents
    6. Antiflatulents
    7. Laxatives and cathartics
    8. Antiemetics
E. Endocrine system drugs
    1. Pituitary hormones
    2. Adrenal corticosteroids
    3. Thyroid agents
    4. Diabetic agents
F. Reproductive system drugs
    1. Androgens
    2. Impotence agents
    3. Estrogens
    4. Progestins
G. Cardiovascular drugs
    1. Cardiac glycosides
    2. Antiarrhythmic agents
    3. Antihypertensives
    4. Coronary vasodilators
    5. Antilipemic agents
    6. Vasoconstrictors
    7. Anticoagulants
    8. Platelet inhibitor therapy
H. Respiratory system drugs and antihistamines
    1. Oxygen
    2. Respiratory stimulants
    3. Bronchodilators
    4. Corticosteroids
    5. Asthma prophylaxis
    6. Mucolytics and expectorants
    7. Antihistamines
    8. Decongestants
    9. Smoking cessation aids
I. Musculoskeletal and anti-inflammatory drugs
    1. Skeletal muscle relaxants
    2. Anti-inflammatory drugs
    3. Osteoporosis therapy

Appendix IV

Contrast Media

Overview for the Contrast Media Curriculum

The content outlined below was developed by the American Society of Radiologic Technologists for the Radiologist Assistant Curriculum guide. The Advanced Practice Task Force felt that this content reflects similar practices for the NMAA and chose to adopt this curriculum content rather than develop new content. This appendix is reprinted with permission by ASRT. Where the phrase "RA" or "Radiologist Assistant" is used, the reader may substitute "NMAA" or Nuclear Medicine Advanced Associate.

Contrast Media

Description

Content imparts an understanding of contrast media used during common diagnostic procedures. Topics include an overview of the chemical makeup and physical properties of select contrast agents, selection of contrast agents for given exams, patient risk factors, premedication strategies, indicators/symptoms of a patient contrast media reaction and recommendations for care and treatment of patients experiencing an adverse reaction to a given contrast agent.

Objectives

1. Discuss the rationale for the use of contrast media.
2. Differentiate between negative and positive contrast agents.
3. Identify the physical properties of select contrast agents.
4. Describe the structural differences and characteristics of low and high osmolar injectable contrast media.
5. Identify the desired contrast agent employed for select exams.
6. Discuss the resources used to identify patients at risk of an adverse reaction to contrast media used to perform a given diagnostic procedure.
7. Identify patient indicators for altering the selection of contrast media used to perform a given procedure.
8. Recite the patient preparation necessary for various contrast and special studies.
9. Identify the strategies employed when faced with patients with a known history of a previous allergic reaction.
10. Recognize the indicators/symptoms associated with a patient experiencing a mild, moderate or severe reaction to contrast media.
11. Implement strategies for treating a patient experiencing an adverse reaction to contrast media.
12. Discuss patient counseling and recommended follow-up care for patients undergoing a procedure requiring the use of contrast media.

Contrast Media Curriculum Content

I. Rationale for the Use of Contrast Media

II. Agents
- A. Negative agents
  - 1. Air
  - 2. Carbon dioxide
  - 3. Nitrous oxide
- B. Positive agents
  - 1. Barium sulfate
  - 2. Iodinated
    - a. Water soluble
    - b. Oily
- C. Paramagnetic agents
  - 1. Gadolinium-DTPA
- D. Echogenic agents
  - 1. Gas microbubble

III. Contrast preparations
- A. Barium sulfate (Ba2SO4)
  - 1. Dry powder or premixed
  - 2. Suspension
  - 3. Paste
  - 4. Tablets
- B. Iodinated water soluble
  - 1. Types
    - a. Diatrizoic acid (Hypaque and Renografin)
    - b. Iothalamate (Conray)
    - c. Metrizamide (Amipaque)
    - d. Iohexol (Omnipaque)
    - e. Ioxaglate (Hexabrix)
    - f. Iopamidol (Isovue and Niopam)
    - g. Ioversol (Optiray)
- C. Gas microbubble
  - 1. Particulate suspension or emulsion

IV. Characteristics of Iodinated Contrast Materials
- A. Water solubility and hydrophilicity
- B. Osmality
  - 1. High osmolar contrast media (HOCM)
    - a. Molecular structure

2. Low osmolar contrast media (LOCM)
    a. Molecular structure
    b. Advantages of LOCM
    c. Disadvantages of LOCM
C. Viscosity
D. Calcium binding
E. Chemical stability

V. Media in Use
A. Barium sulfate
1. Procedures requiring the use of barium
2. Low occurrence of allergic reaction
3. Cause(s) of allergic reaction
4. Patient risks following the administration of barium
5. Characteristics of patients at risk
6. Glucagon administration
    a. Rationale for use
    b. Administration
B. Iodinated contrast materials
1. Procedures requiring the use of iodinated contrast
2. Oily iodinated contrast
    a. Procedures requiring the use of oily iodinated media
3. Contrast used for intrathecal injections
    a. Oily contrast
    b. Aqueous contrast
    c. Patient management to reduce the rate and severity of adverse reactions
4. Instructions given to diabetes patients receiving antihyperglycemic agents (Metformin, Glucophage)

VI. Strategies for Dealing With Patients With a Known History of Allergic Reaction
A. Steroid premedication for intravascular contrast media
B. Indications for steroid premedication
C. Contraindications for steroid premedication
D. Dosage
1. Nonemergency cases
    a. Two-dose regimen
2. Emergency cases
E. Suggesting alternative procedures

VII. Adverse Reactions to Contrast Administration, Symptoms, Indicators and Recommended Patient Care
- A. Minor reaction
  - 1. Symptoms
  - 2. Recommended response
- B. Moderate reaction
  - 1. Symptoms
  - 2. Recommended response
- C. Severe reaction
  - 1. Symptoms
    - a. Early symptoms
    - b. Late symptoms
  - 2. Recommended response
- D. Infiltration
  - 1. Symptoms
  - 2. Recommended response

VIII. Patient Counseling and Recommended Follow-up Care for Patients Undergoing a Procedure Requiring the use of Contrast Media
- A. Following barium procedures
- B. Following iodinated contrast media procedures
- C. Following adverse reactions to administered contrast agents